JIM HANLEY
HEWLETT-PACKARD ASIA
47/F CHINA RESOURCES BLDG
26 HARBOUR RD
WAN CHAI
HONG KONG

852-5-833-0873

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Mr. James Hanley
Hewlett-Packard Asia Ltd.
G.P.O. Box 863
Hong Kong

Dear Jim:

Can you provide the citation to the publication in which "Fishing for the magic fish" appeared? It looks like it may be a tourist brochure. The feature fish of the article is a huchen or taimen (Hucho hucho taimen) of the Amur River basin. I could not precisely locate the ~~Duobuukur~~ "Dupbukur" River, but with help from our visiting professor from China, I can place the general locality as a tributary to the Nen River, probably near the city of Qiqihar (it was mentioned that the Japanese anglers stayed at a hotel and I assume only the larger cities have hotels and a transportation network to accomodate foreigners). It was mentioned that ~~The~~ the Japanese anglers ~~sought~~ came to China, specifically to catch a huchen, which is very rare now in Japan (the Japanese huchen is a different species, Hucho bleekeri, native to Hokkaido). I wonder ~~How~~ ~~was~~ the trip was arranged? I note that guides and jeeps were used to transport the anglers, thus there ~~are~~ at least the rudiments for a tourist fishery in China. I doubt, however, that there is much information yet on "where to go". That is, information ~~what~~ on specific localities which offer the best opportunities to catch ~~spec~~ different species such as huchen, lenok, grayling, pike, etc.

Last week I received color slides of fish caught last summer in the Zhang (Zhan?) River, a tributary to the Amur River (the main Amur River [Heilongjiang in Chinese] forms the northeastern border between China and the Soviet Union). One species was the lenok (Brachymystax lenok), the other was the Amur pike (Esox reicherti).

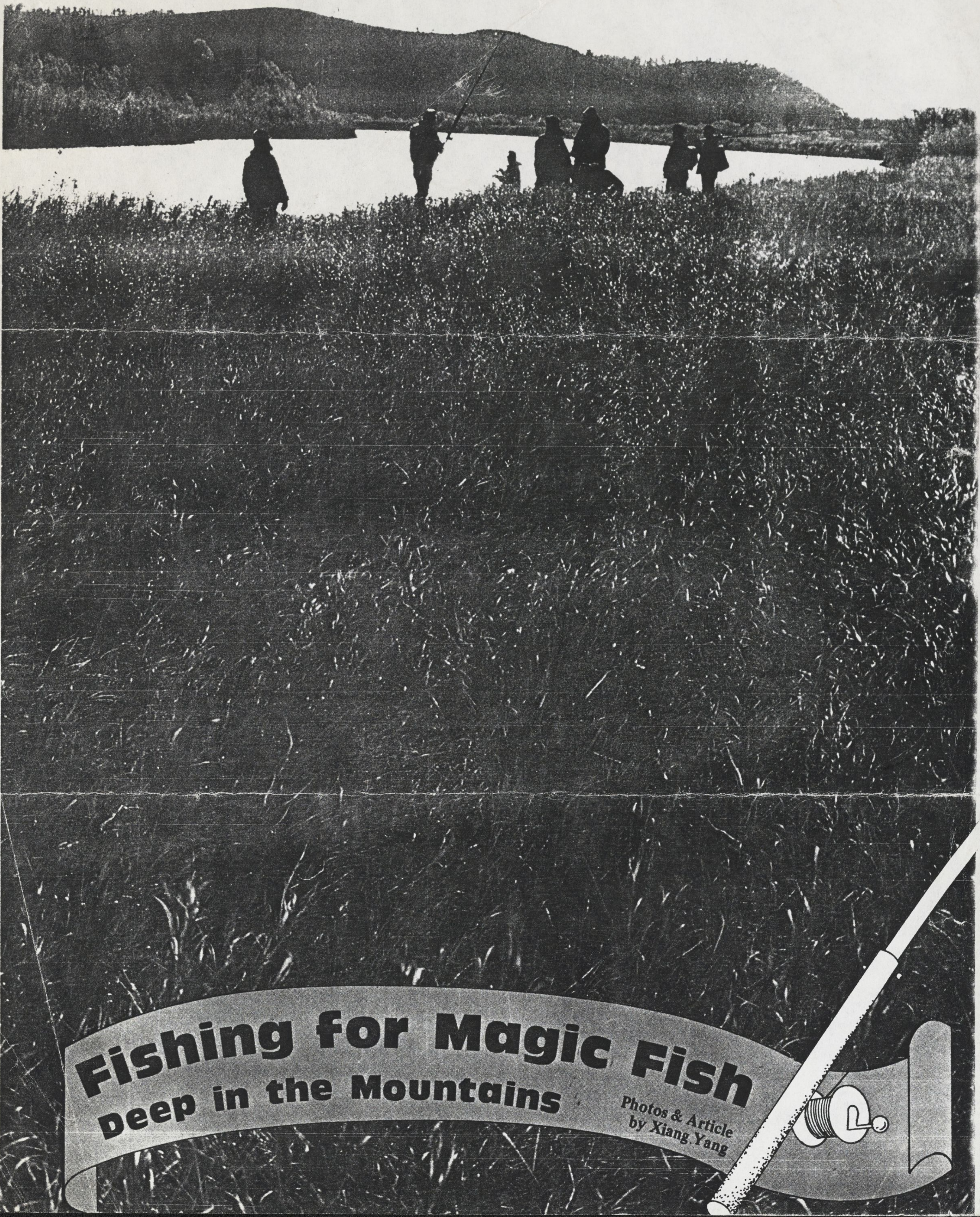
Frontiers International Travel and Trout Unlimited are exploring possibilities for a tourist fishery in China and a group of anglers plans an angling trip this summer.

Keep me informed.

Sincerely,

Robert Behnke

cc:
W.M. Fitzgerald
Fronteirs Travel



Fishing for Magic Fish Deep in the Mountains

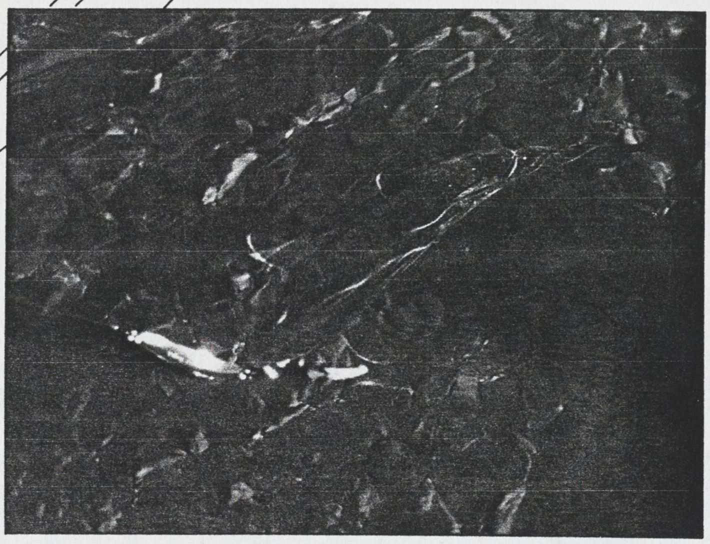
Photos & Article by Xiang Yang

The Songhuajiang-Nenjiang Plain in the northeast of China is skirted by a green screen which forms a protective arc. To the east of this screen is the Greater Hinggan Range,

2

known as the 'Green Treasure Trove'.

A semi-frigid, semi-temperate zone with a monsoon climate, it is hot in summer with long periods of sunshine and abundant rainfall. The rainy season can be as long as from ninety to one hundred and ten days a year, the best time for trees to grow. One late spring and early summer, I, slinging my camera on my shoulder, paid a visit to the area.



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The Greater Hinggan Range still keeps its natural, primitive look, unspoilt by modern civilization. One feels as if it were a place untouched by any human beings. No wonder tourists seeking tranquility and joy come to this spot.

It is a unique experience and great fun to fish in the waters of the deep mountains of the Greater Hinggan Range. The waters of the Duobukur River meandering through the area are so limpid that one can easily see the bottom. Its banks are lined with luxuriant trees. In the distance are misty undulating mountains.

A fellow traveller told me that we might be lucky to find Magic Fish in this river. Seeing I was puzzled, he explained, 'The so-called Magic Fish is called by the locals *zheluo*. It is a valuable tiny-scaled fish, similar to chum salmon and indeed it belongs to the salmon family. It lives in waters below fifteen degrees centigrade in deep mountains in the northern temperate or subfrigid zone.'

Only then did I realize that amidst the thick, tall grass, a number of people, in twos and threes, were sitting like stone statues with fishing-rods in their hands. As I was approaching, one angler turned round and put his forefinger over his lips to indicate silence so that I might not disturb the fish. I walked to him on tiptoe and sat beside him, watching the clear flowing water with schools of fish frolicking in it.

The fish of one variety were exceedingly lively, but I had no idea what they was called. The man beside me produced a pen, a piece of paper and wrote on it *zheluo*. He also told me by gesticulating that all the people there were fishing for this particular fish.

However it was not easy to catch *zheluo*. The Japanese friend beside me had sat there for half a day and all he had caught was a big coloured pike. This rather disappointed him.

I became interested in my Japanese friend, and found out through conversation that he had come here with a Japanese Anglers' Delegation specially to find a kind of fish known in Japan as *gui*, which is almost extinct in his country now. Nowadays one could only get to know what it looked like from books. Many Japanese anglers went to Hokkaido to look for *gui* but returned disappointed. Hearing that *gui* existed in China's Greater Hinggan Range, these Japanese anglers flew across the Pacific to trace the fish.

I was puzzled by his words, '*gui*', 'flying across the Pacific' and so on. He then explained, '*Gui* is a Japanese name for the fish known in China as *zheluo*. They are the same thing.' He then added, 'The Japanese also call this rare fish 'Magic Fish'. Only those with good luck will be able to catch one.' My curiosity grew and I made up my mind to stay close to them to see if they could find any.

At three o'clock the following morning, the Japanese anglers set off in three jeeps. I joined them hoping to see some fun. The jeeps threaded along the mountainside which was very green after the recent rain, and set off across the marshland covered with grassy mounds. To avoid being bogged down, the drivers had to choose shrubbery no one seemed ever to have trodden on. Sometimes, they veered abruptly or throttled to dash forward, the wheels churning up mud and

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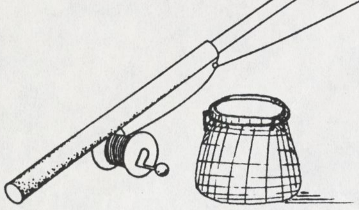
1 *Want to fish for a Magic Fish? Go to the Duobukur River!*

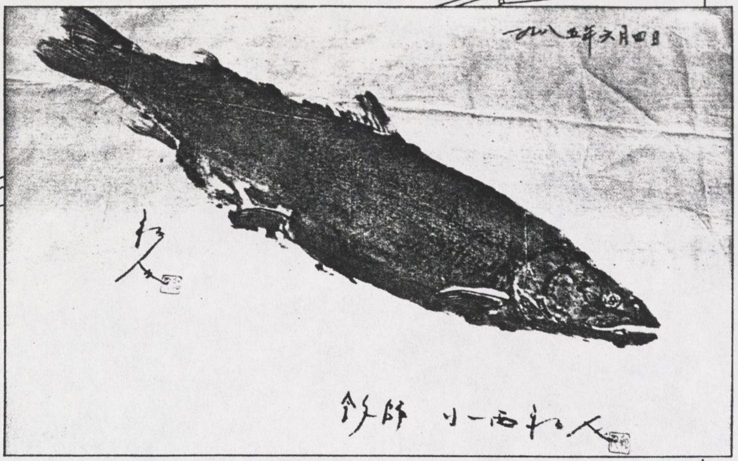
2 *'Oh, Magic Fish! I'll track you down even if I have to wait for ever.'*

3 *'See if you can escape this time!'*

4 *'Come and take a picture of me!'*

sending bits of grass flying behind them, startling roe deer and pheasants. As soon as we reached our destination, we got off the jeeps and walked to Zheluo Bay in the Duobukur River Valley. It was still cold in the Greater Hinggan Range at that time of the year. I had a sweater on but still felt chilly. Before daybreak, a drizzle fell and the fish began their breakfast. The head





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of the Japanese Anglers' Delegation suddenly indicated to us that he felt a pull on his fishing rod. Obviously a fish was hooked and struggling under the water's surface. He lifted the rod and everybody watched, their eyes wide open. On the end of his line was a large *zheluo*, as much as nine catties in weight! All the Japanese anglers left their posts and rushed over shouting 'Bravo!' With both hands holding the Magic Fish, he smiled from ear to ear, and let us take pictures of him. It was natural that he was so excited, for only a few days before, he had failed to catch a big *zheluo* which had been swimming around his bait for more than an hour until, finally, as if seeing through his plot, left. After that he had thought that never in his life would he catch a *zheluo*!

When we returned to our hotel, the head of the delegation began to make a 'fish rubbing' of the *zheluo* he had caught, because, he thought, it was a great event in his life as a fisherman.

He washed the fish clean as people gathered to look and carefully painted the fish with ink brushes following the fish's original shades of colour. Then he covered it with a piece of white cloth and pressed it gently from head to tail. The result was a fish the same size and shape printed on the cloth. Then matter-of-factly he signed and printed his seal on it. He also asked a few witnesses to sign their names. Thus, he had proof of his catch and no one could doubt it. How interesting that a man could be so fascinated by a Magic Fish! Would more anglers, I wondered on my way back home, who were keen on Magic Fish, flock to fish there?

Translated by Wang Mingjie

1 *A fish rubbing: a proud trophy for a Japanese angler*
2 *A break from fishing: a chance to take a meal and warm up*

ACTA HYDROBIOLOGICA SINICA 1959 (2):215-220

Title: *Brachymystax lenok* (Pallas), *Hucho taimen* Pallas), and their natural hybrids in the He-lung-chiang ("Black Dragon" River) system, (Manchuria) China

Authors: Hsüeh, Cheng-yü, Huang Shang-wu, and Yen Jung-yüan

Affiliation: Institute of Hydrobiology, Academia Sinica, China

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*Brachymys*tax *lenok* and *Hucho taimen* are two species in the family Salmonidae, suborder Salmonidei, and order Clupeiformes. In China, both species are found only in the He-lung-chiang basins.

Brachymystax is monotypic with only *B. lenok*. In *Hucho*, however, there are four more holarctic species in addition to *H. taimen*, e.g., *H. hucho* in the Russian portion of the Danube River drainage basins; *H. ishikawai* in the upper Yalu River; *H. perryi* in the Japan Sea and the coastal area of the mouth of the Yalu River; and *H. bleekeri* in Szechuan Province in central China.

B. lenok and *H. taimen* have been studies by He-lung-chiang Fisheries Survey in 1957-58. The preliminary report follows:

1. <u>The Shih-ling ("minute-scaled"), *Brachymystax lenok*</u>

Body compressed and elongated; mouth moderately large; maxillaries not fused, extending backward but not to the middle of eye; upper jaw longer than lower jaw; mouth almost ventral; eyes very large; body covered with minute scales, adipose fin opposite to anal fin; back dark brown, becoming paler downward, and belly white; moderately wide black curves packed on body sides; red pigmentation on sides of live fish; black spots on dorsal and adipose fins.

Swimbladder one-chambered, extending from heart to anus; stomach large and expanded, curving as a "U", stomach wall thick with marked folds; pyloric caeca tubular and about 100; gut slightly shorter than standard length (see Table 1).

Table 1. Gut length and the number of pyloric caeca of the Shih-ling

Body Weight (g)	Standard Length (mm)	Gut Length (mm)	Gut Length/ Standard Length	Number of pyloric caeca
13.2	98.5	92	0.93	108
17.5	109	99	0.90	111
65.4	178	165	0.9	108
-------	230	---	----	91
-------	435	440	1.01	92
1,875	515	510	0.99	101

The Shih-ling usually weights 500 - 1,500 g, though some may reach 8 kg. Among 46 specimens examined here, the standard length ranges between 814 - 51.5 cm and body weight between 73 - 1,875 g. Eighteen among 26 specimens collected in the upper "El-ku-na" River and "He-shan-tow-gun" River area on June 4, 1958 show:

Standard length (cm)	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46
(Number of fish)	3	2	2	5	3	2	0	0	1

Body weight (g)	300-400	400-500	500-600	600-700	700-800	800-900	900-1000	1000-1100	1100-1200	1200-1300	1300-1400
(Number of fish)	5	1	5	4	2	0	0	0	0	0	1

Reproduction and growth: The spawning time of the Shih-ling in the He-lung-chiang system is between late April and May. A specimen caught in "Luan" River on May 2, 1958 had already reached stage V of gonad development -- spawning phase. In early June of the same year, specimens at postspawning stage and juvenile of the year were collected.

Gonads of the Shih-ling had developed between stage III and IV one year prior to spawning (Table 2). They remain at III or (IV) during much of the winter. A fish with gonad developed at stages III - IV was collected in "Hu-ma" River in October, 1958.

Table 2. Gonadal development of the Shih-ling

Locality	Date	Body Length	Sex	Stage	
"Luan" R.	V-2-58	420 (mm?)	F	V	Ovary l./body l. = 1/2; egg diameter 4 mm; spawning
"El-du-na" R.	VII-4-58	408.5	F	II	Ovary wt. 2 g; postspawning
"Luan" R.	IX-19-57	500	F	III	Ovary l./body l. = 1/4; ovary l. 165 (mm?)
"Hu-ma" R.	X-6-58	580	F	III-IV	Egg diam. 3 mm; ovary 250 (mm) long & 25 (mm) wide
"Hu-ma" R.	X-6-58	475	F	III-IV	Egg diam. 3-4 mm; ovary weight 35.5 g

A specimen, 47.5 cm long, has 4,260 eggs in its ovary. Sodatov reported an egg number ranging between 4,700 - 7,500.

"El-ku-na" River, near the upper He-lung-chiang, "Hu-ma" River and "Kuan" River (at the lower reach of "Hu-ma" River) may well be the Shih-ling's spawning grounds. For instance, more than 10 juveniles less than 10 mm in length were collected in the "El-ku-na" and "Kuan" Rivers on July 14, 1958. So the tributaries in the upper reach of He-lung-chiang provide favorable spawning conditions.

The body lenth of juveniles of the year collected in the "El-ku-na" ("Wuchilov" R), Russian name, on July 14 of the same year was:

21	22	23	24	25	26	27	28	29	30	31	32	33	34	mm
1	0	1	0	0	0	2	5	3	6	2	0	1		

It may be seen that the Shih-ling may grow up to 27 - 32 mm in a period of two months. From the "El-ku-na" at "Mo-chih-ghan", an even more rapid-grown juvenile (53 mm) was collected on July 16.

The Shih-ling may reach 100 - 120 mm long and 18 - 25 g in weight after the first year of growth. According to Berg (1949), the fish may be 235 mm in two years and 300 in three years. The Shih-ling's first spawning occurs at four-year old.

Food habits: The Shih-ling is mainly carnivorous. Stomach contents found are: plant seeds, leaves, aquatic weeds, small stones, sand, molluscs, worms, four orders of insects, fishes (*Phoxinus* and other small fishes), amphibians (frogs), etc. (Table 3).

The digestive tract of smaller fish (100 - 120 mm) generally contains smaller food items. Fishes and amphibians were found only in fish of 500 - 600 mm (and up) long, and apparently were preyed upon heavily.

Table 3. Food of the Shih-ling

Locality	Date	Std. Length (mm)	Body wt.(g)	Food
"Hay" R.	V-26	106	13.7	Water beetles; insect nymphs ; plant stems
"San-bu-dun" at "He-lung-chiang"	VI-10	178	65.4	Aquatic insects, plant stems
"Luan" R.	V-10	280	------	Small fishes; plant stems
"He-san-tow-gun" R.	VII-4	367	622.5	Insect nymphs ; leaves of aquatic weeds
"Luan" R.	V-2	370	880	Aquatic insects; fishes (*Phoxinus*)
"He-san-tow-gun" R.	VII-4	371	612.5	Insect nymphs ; aquatic plants
"Hu-ma" R.	X-6	405	969	Insect nymphs ; leaves; small stones; sands & mud
"Luan" R.	IX-19	435	------	Molluscs, aquatic insects, sands
"Hu-ma" R.	X-6	515	1875	Frogs; molluscs; aquatic insects; leaves; slits

Migration: The Shih-ling is very likely migratory, moving up to the tributaries during Spring and down to the "He-lung-chiang" proper in fall. Local fishermen have a saying: "Chih-lo, Shih-ling, seven up and eight down", meaning, during July when the water temperature raised in "He-lung-chiang", the Shih-ling move upstream to colder tributaries, and move downstream after August to the "He-lung-chiang" where they winter.

We saw, in the winter of 1958, many local fishmen used small fishes as bait while ice-fishing for the Shih-ling and Chih-lo prior to the "He-lung-chiang" thaw. After the "He-lung-chiang" thawed, the gonads of specimens from "Men-lu" River at the upper "Luan" River area found at stage V. They were also found actively feeding with the digestive tract fullness index above 0.8 (stomach containing aquatic insects, *Phoxinus*, and other small fishes). It is apparent that the Shih-ling have adequate food supply even in the tributaries as the fullness index was high (0.7 - 0.8 and up) in fish collected from the "Hu-ma" during September - October. Juveniles of the year, collected in the upper "El-ku-na" River in early July and in the "Kuan" in June, show that the Shih-ling began their upstream migration very early, well before the thaw of the "He-lung-chiang". Apparently, the feeding does not cease furing the spawning phase.

The Shih-ling are widespread in the Northeast (i.e. Manchuria). They are found in many other river systems there. In order to fully ue this fish as an aquatic resources, artificial propagation should be started in hatcheries which could be conveniently built in the vicinity of reservoirs.

2. The Chih-lo, *Hucho taimen* (Pallas)

Body compressed but elongated; mouth large; maxillaries marked, not fused, extending backward to the rear of the eye; teeth sharp, numerous and backward grown; teeth on tongue, jaw bones; black dots on body sides, arranged randomly in only a few rows; scales very small with equally spaced circuli but without radii.

Internal structure similar to that of Shih-ling; swimbladder one-chambered, large and long; stomach markedly large, with the middle potion "U" shaped, and of two parts - anterior and posterior; pyloric caeca about 200; gut usually as long as body. (Table 4)

Table 4. Comparison of gut with body lengths in the Chih-lo

Body wt. (g)	Body length (mm)	Gut length (mm)	Gut length/body length
175	255	230	0.9
220	285	285	1.0
375	345	260	0.8
750	425	450	1.1
1,500	490	450	0.9
1,750	565	550	0.95
2,350	590	650	1.1

It is very common to catch a Chih-lo over 5 kg. The weight of 13 specimens collected from the "He-lung-chiang", "El-ku-na" and "Luan" indicates that this fish can grow to rather large sizes:

(These are Chinese Scales) 3-6-9-12-15-18-21-24-27-30-33
(kg) 1.5-3-4.5-6-7.5-9-10.5-12-13.5-15-16.5
(Number of fish) 3 1 0 1 2 3 2 0 00 1

Reproduction: The spawning time of the Chih-lo in "He-lung-chiang" is May. A specimen (590 mm long and weighing 2350 g), collected on May 2, 1958, had its gonad developed at stages IV-V and its eggs easily stripped out. This specimen was caught from "Men-lu" River, a cool, clear river with a pebbled bottom.

During spawning, the parent fish swim happily above spawning grounds. Using the caudal fin skillfully, the fish made redds by removing pebbles on the bottom. Then the eggs were deposited and subsequently covered with sand. The courting behavior can readily be seen. Often 200 - 300 m^2.

They stay in the spawning grounds after spawning for a period of time.

Food habits: The Chih-lo is a vigorous carnivore. It has been found that the digestive tract will be filled with "Shih-ling" at a fullness index as high as 0.95. It can also prey on frogs, small mammals and water ducks. Nevertheless, the small fishes are common food items.

Such fishes as *Phoxinus*, *Gobio*, *Saurogobio*, *Hemibarbus*, and *Percottus* were found in the digestive tracts of specimens examined in 1958.

Digestive tracts of eight large specimens of Chih-lo (4 females and 4 males, 15.5 - 30.5 kg), collected from the "El-ku-na" in early July, were empty. These fishes were spent. Apparently the Chih-lo do not feed for a time after the spawning and begin to feed again in fall. (Table 5)

Table 5. Food of the Ch-lo

Locality	Date	Std. l. (mm)	Body wt. (g)	Food
"Luan" R.	IV-30	630	1750	*Phoxinus*, *Percottus* frog (*Rana*)
"Luan" R.	V-2	590	2350	*Phoxinus*
"Hay" R.	IV-4	315	220	*Gobio*
"Hay" R.	IV 6	335	310	*Saurogobio*
"El-ku-na" R.	VII-4	530	1500	5 stones (diam. 10 mm)
"El-ku-na" R.	VII-4	900	7750	(empty)
"El-ku-na" R.	VII-4	1050	9600	(empty)
"Hu-ma" R.	X-3	475	750	*Hemibarbus*, other fishes (high fullness index)
"Hu-ma" R.	X-3	390	375	Fish skeletons (high fullness index)

Migration: The migration of Chih-lo is similar to that of Shih-ling.

That is why the fishermen's saying "Chih-lo and Shih-ling, seven up and eight down". Using "connection nets" under the ice, local fishermen catch a large quantity of Chih-lo during the winter. The Chih-lo is actively feeding in winter under the ice.

3. *Brachymystax lenok* X *Hucho taimen*

These two fishes (Shih-ling and Chih-lo) are of two genera, but similar to each other in many aspects of morphology and biology. Nevertheless, they can be readily distinguished. Externally, the Chih-lo's body surface has scattered dots while the Shih-lings's black curving marks are larger and packed. The mouth of Chih-lo is terminal and larger while that of Shih-ling is smaller and subventral. Differences are also seen in the number of gill rakers and pyloric caeca. (Table 6)

Table 6. Comparison: *B. lenok, H. taimen,* and hybrids

Fish	*taimen*	hybrids	*lenok*
Gill rakers	10-12	21-22	24-28
Pyloric caeca	205-219	123	91-111
Marks on sides	scattered black dots	about in between	marks large and packed
Mouth position	terminal; upper jaw can not be seen when viewed from below	upper and lower jaws nearly equal in length; a small portion of upper jaw can be seen from below	upper jaw longer than lower jaw; upper jaw readily seen when viewed from below

One of the three specimens, collected from the "Huma" in late September - early October, has the following body dimensions which are similar to, or intermediate between that of *B. lenok* and *H. taimen*:

Body length	485 mm	Caudal peduncle length/depth	57/38
Std. l.	420 mm	Body depth	83 mm
Head l.	98 mm	Dorsal fin	II, 10
Snout l.	22 mm	Anal fin	III, 9
Eye diam.	19		

All three specimens show such characters as mouth position, body marks, pyloric caeca, and gill rakers intermediate between that of *lenok* and *taimen*. They may well be natural hybrids between these two species.

Translated by Ting T. Kan, work not polished, but readable (hopefully).

表 1　鸭绿江细鳞鱼的主要性状

Tab. 1　Morphological characters of *Brachymystax lenok* from the Yalu River

测定项目 Items	体高/体长	头长/体长	吻长/头长	眼径/头长	眼间距/头长	尾柄长/头长	尾柄高/头长	纵列鳞数	幽门垂数	鳃耙数	脊椎骨数
变幅 Range	4.0—5.1	4.1—4.7	3.1—4.0	3.4—4.9	2.9—3.5	1.2—1.5	2.5—3.3	111—158	61—84	20—24	58—60

表 2　各地细鳞鱼的主要可数性状的比较

Tab. 2　Comparison of morphological characters of *Brachymystax lenok* from various rivers

地　点 Place	鳃耙数 No. of gill-rakers	幽门垂数 No. of pyloric caeca	纵列鳞数 No. of lateral line scales
鸭绿江	20—24	61—84	111—158
图们江	20—24	60—77	132—166
松花江	24	98—104	132—168
秦　岭	17—23	63—95	115—156
额尔齐斯河	21—27	80—102	113—129
黑龙江	19—22	91—111	135—175
河北小滦河上游	19—21	63—91	119—164

我们认为不同水系的细鳞鱼无法区分不同的种或亚种，鸭绿江的细鳞鱼应为 *Brachymystax lenok* (Pallas)

繁　殖

1. 产卵期与成熟系数

初春 4 月清明前后，鸭绿江解冻时，栖居大江深处的细鳞鱼就顶着冰流上溯开始生殖洄游。成熟细鳞鱼通常喜在水质清晰，砂砾底质的支流山溪中产卵。历年 4 月中旬，细鳞鱼首先在十三道沟河产卵，产卵期自 4 月中旬(沟河旬平均水温 6.7℃，沟口江水旬平均水温 7.8℃) 至 5 月末。随着江冰的逐渐消溶，成熟细鳞鱼亦逐渐游向鸭绿江上游的各支流

表 3　十三道沟细鳞鱼性腺发育百分比 (1984 年)

Tab. 3　Percentage of *B. lenok* from Shisandaogou at different stages of gonad development in 1984

性别 Sex		♀				♂			
性腺发育期 Stage of gonad development		I II III	IV	V	VI	I II III	IV	V	VI
4 月中、下旬	尾数 (%)	10 28.5	20 57.1	2 5.7	3 8.6		31 67.4	11 23.9	4 8.6
5 月	尾数 (%)	2 12.5	8 50	3 18.7	3 18.7		17 80.9	4 19.1	

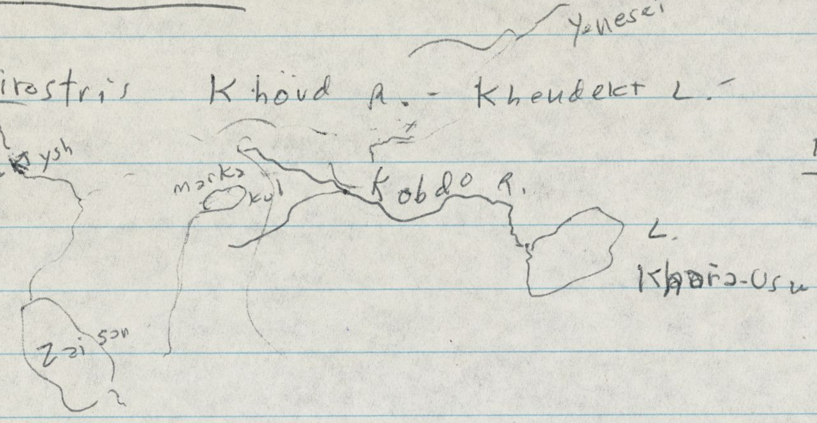
Holcik - 1969 - Czech -

Mongolia 4 regions (1) Arctic basin - Yenisei (Baical) Selenga → Baical

(2) Amur R., (3) West Mongolian (desiccating lakes Khar-nur, Ufs-nor - etc incl. Telmen lakes) - (4) - Tamir (northern China)

- lenok - rakers 24 - Tul R. → Selenga. - Yenis
- pidschian - Dod Nur L. → Selenga
- T. arcticus - Dod Nur L. -
- T. a. baicalensis - Kosogol L. (nigrescens)

T. brevirostris Khovd R. - Kheudekt L. -



mountain streams also H. taimen, lenok, grayling, C. lavaretus lake

H. taimen in L. Zaisan, Teletskoe.

type locality H. bleekeri · Kuan-hsien, Szechwan Prov. Yangtze

Stenodus - L. Zaisan - peculiar form (non migratory). also in Chernyi Irtysh -

T. brevirostris - Kobdo R. & L. Kirgiz-Nor basins

- Barsukov
- Altai stay
- China - name -

Brachymyztax lenok (Pallaz)

The samples were collected near QuShui Bridge of Yarlung Zangbo River in Tibet in June, 1982.

No. №	Sex	Body length (cm)	Ration of dry weight to fresh weight
No. 1	♀	23.6	31.0
No. 2	♂	26.1	32.4

Identifier: Chen Qingtai
Wang Cunxin
(Institute of Oceanology, Academia Sinica Qingdao)

Mr. Chen Xinyu
Department of Marine Sciences
University of Puerto Rico
~~Box 5000~~
Mayaguez, Puerto Rico 00709-5000

Dear Mr. Xinyu:

~~I would be interested to have~~.

Your background and experience in ichthyology ~~are~~ ~~exce~~ provide an excellent basis to pursue a Ph.D. degree. The problem concerns finding funding to support your work. Mr. Wang, from your country is currently spending a year in our department to further his education in fisheries. I will ~~as~~ ask him to write a letter to be enclosed, explaining his source of ~~funding~~ financial support.

I have ~~an~~ English translations of a paper by Li Si-zhong on the salmonid fishes of China, and by → This topic would make an excellent Ph.D. thesis. For example, ~~thorou~~ documenting complete distribution patterns of salmonid fishes in the Yellow and Yangtze basins and in Sinkiang Province.

There is considerable interest among American and other foreign anglers for sport fishing for salmonid species in China. It would be beneficial to the Chinese tourist agency to have detailed knowledge of ~~spec~~ the distribution of species of fish attractive to foreign tourists.

~~Do you~~, Such a research project would entail considerable field work in China. You might look into the possibility of funding such a study through the tourism industry. I will make inquiries among Americans interested in Chinese salmonid fishes regarding possible sources of funding.

Sincerely,

*(gone Wed-Fri

→ Liu Chenhan et al. on the Yantzekiang *Hucho bleekeri*.

the only ones. Roy Chapman Andrews, discoverer of dinosaurs in the Gobi Desert and collector of most of the American Museum of Natural History's Asian mammals, tells in his classic 1920's book, *Across Mongolian Plains* of "...three foot trout which were herded into the shallows which also...tasted very good."

what river?

Anglers on the 1990 June exploratory trip can attest to this last statement. Taimen have white meat and when broiled taste like exceptionally sweet yellow perch...only without all the bones.

More Tall Tales

And the legend continues! Some recent hunters returning from Asia recount a number of intriguing fish tales. One recalled he was watching a duck swimming down a stream. As it drifted past him, a mammoth hole appeared in the river and the duck disappeared...fly fishermen take note!

Another party stopped on a bridge to take pictures of a particularly scenic view. One looked off the bridge and into the water. There in a pool below lay huge logs from 4 to 6-feet long, just finning in the current "...and I left my rods at home," he lamented. (Note: the June 1990 exploratory fishing trip might have found this location, for they did see large taimen in a pool below a bridge and managed to tempt one of them into hitting a mouse imitation lure).

A third hunter had the savvy to borrow a rod and reel locally before heading into the wilds. One evening he tossed a crude spoon into the water at a streamside camp. The rod was vintage something, line about 50-pounds test of rope and the ancient reel belonged in someone's collection.

The lure hit the water and instantly "...a fish of about 50-pounds nailed it, jumped a couple times and headed downstream. I held on, but the reel froze and exploded into bits and pieces! End of fishing!"

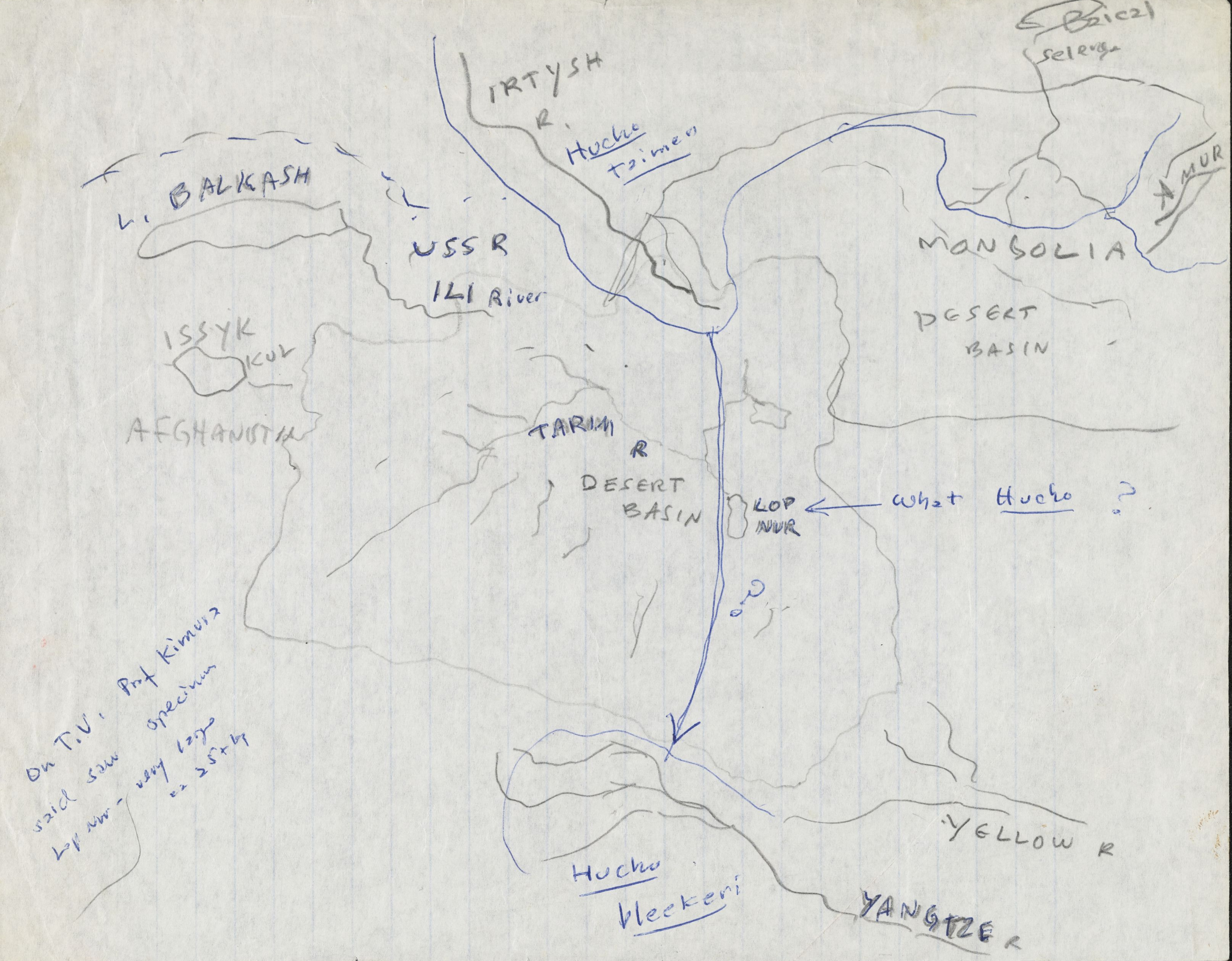
The largest recorded huchen (*Hucho hucho hucho*), also known as the Danube salmon, was one of 132 pounds (73.2 inches) caught in the Danube River, January 9, 1873. The largest known taimen was a 231-pounder (84 inches) netted commercially 1943 in the Kotui River.

check record

Data on record taimen sports catches are very sparse, particularly in the USSR and Inner Asia. In 1990, one spincasting fisherman from the first Asian exploratory trip did hook a taimen estimated to be well in excess of 100 pounds, but it broke off. Soviet Union fly fishermen, however, have landed ones in the 40-pound range.

The fact that taimen attain larger size than huchen is due to two factors: primarily taimen inhabit larger rivers, often to their estuary, and Bergmann's rule, which in simple terms states that members of a genus or species attain larger size the further north in latitude (or south in the Southern Hemisphere) they exist.

mammals? vol/temp


Baical
Selenga
IRTYSH R.
Hucho taimen
L. BALKASH
USSR
ILI River
MONGOLIA
AMUR
DESERT BASIN
ISSYK KUL
AFGHANISTAN
TARIM R
DESERT BASIN
LOP NUR
What Hucho ?
?
On T.V. Prof Kimura said saw specimen Lop Nur - very large ca 25 kg
YELLOW R
Hucho bleekeri
YANGTZE R

letter fm. Sergei. (Apr. 92)

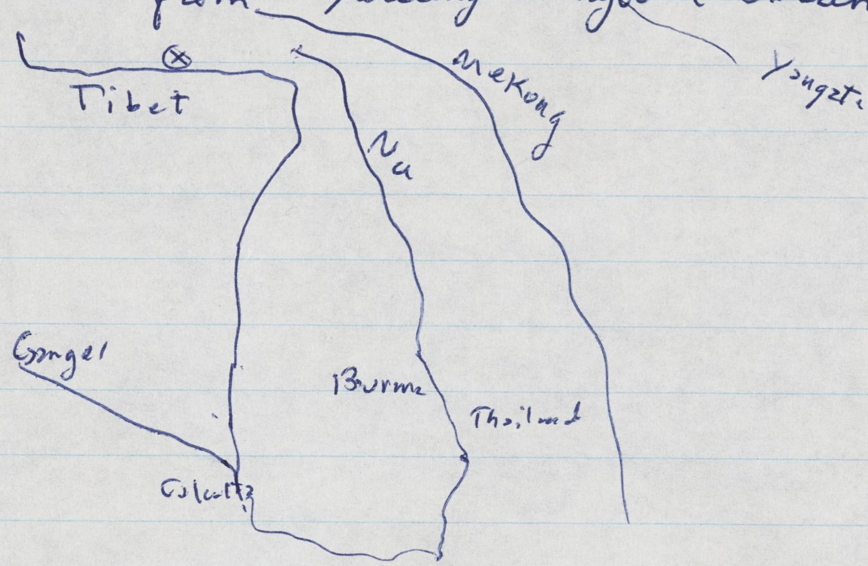
1986.

Oceanology and Limnology Sinica 17(1): 66-71

internal bassi

lenok from Yarlung Zangbo (B.rahmaptura R)

⊗ S. trutta



Acta Hydrobiogia Sinica 1989. vol. 13(2): 160-69

Biol. studies of B. lenok in the Yula R.

Japanese charrs - Phylogeny

S. leucomaenis
pluvius
imbrius
japonicus

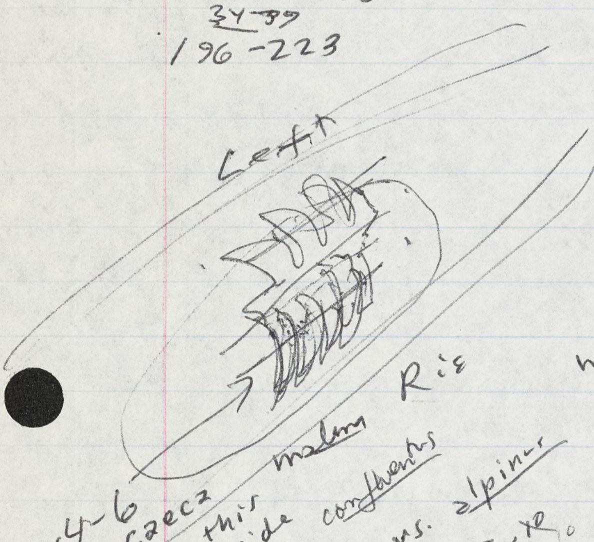
black mouth
S. malma type
miyabei
domin coloration - yellow-orange leucomaenis
red - malma

Hokkaido	malma	miyabei	AK N. malma	So. N. Am
rakers	19-22	25-29	22-23	16-19
caeca	21-22	18-21	23-28	?
lat. ser.	37-41 199-220	39-42 202-225	43-46 234-242	?
vert.	60-62	60-61	66-68	63-64
raker structure	~~thin long~~ thin, fine	very long, fine thin	long, fine thin	?

leucomaenis and Hokkaido confluentus
- thin rakers
~~l. ser.~~ 34-39
196-223

rakers 15-16
caeca 17-23
34-39
196-223

imbrius	pluvius	japonicus
	14-18	12-15
	14-28	14-20
	36-40 185-218	193-230 36-40

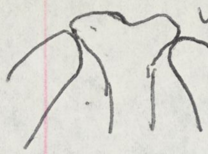


4-6 caeca on this side malma confluentus vs. alpinus

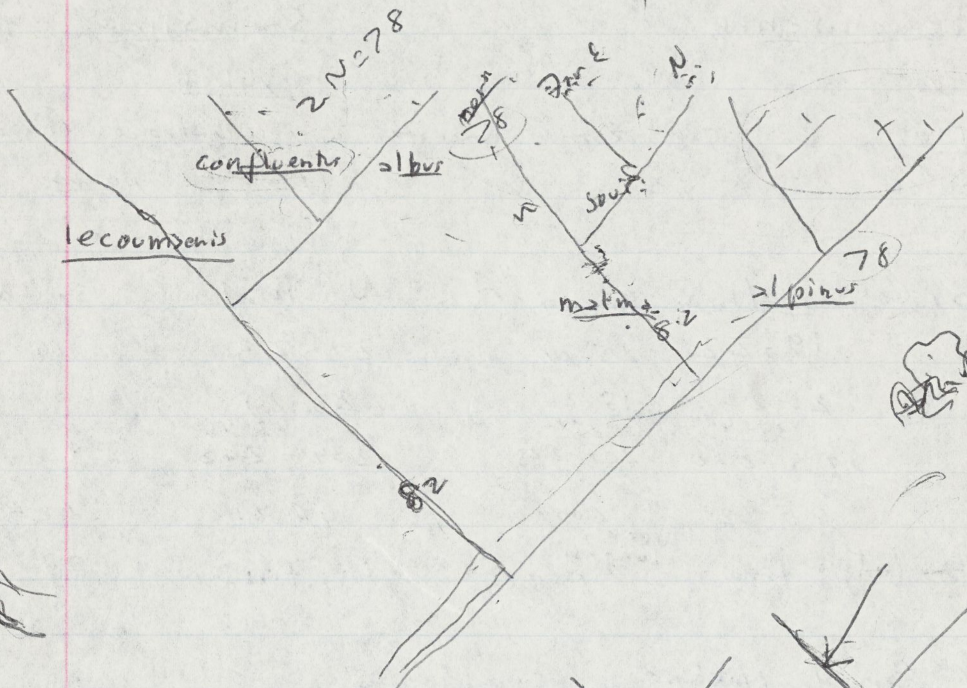
8-10
6 7-9

leucomaenis 4-5

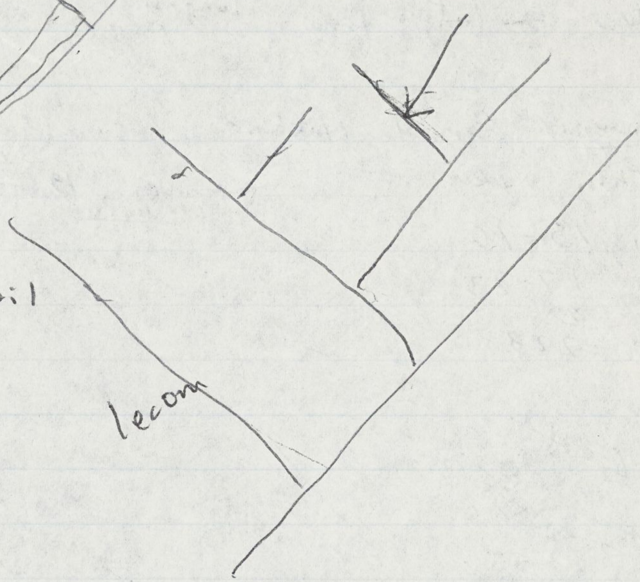
malma - leucomaenis thin, long caeca
vs. alpinus short, thick



vomer head and
palatines about
meet in malma - separate in leucomaenis
(+ confluentus) alpinus



alpinus Ʒ most forked tail



Kype - only malma.

- malma
  parr marks appear before yolk sac absorbed
- leucomaenis
  parr marks only after yolk sac absorption

only alpinus w rounded ◯ body cross-section - others lat. compressed

Systematic Ichthyologists of P. R. China

CHEN, YIN-RUI Dept. of Vertebrate, Kunming Institute of Zoology, Academia Sinica, Kunming, Yunnan, P.R. CHINA

Current work: (1) Taxonomy and evolution of cavefishes of China; (2) the phylogeny and zoogeography of the cyprinid genus Spinibarbus (with Dr.Yan); (3) the biology and fishery problems of the fishes from Fuxian Lake of Yunnan.

CUI, GUI-HUA Department of Vertebrate Taxonomy, Kunming Institute of Zoology, Academia Sinica, Kunming, Yunnan, P.R.CHINA

Current work: (1) Taxonomic research of the genus Sinocyclocheilus; (2) collecting the basic information for creating the database of Yunnan fishes; (3) continuing study on phylogeny of the genus Discogobio; (4) in collaboration with Dr. W. Zhou, revision of the genus Tor of Lancangjiang River Basin (upper Mekong), China; (5) in collaboration with Dr. W. Zhou, research on the sucking disc differentiation of the genus Discogobio.

FANG, FANG Researcher, Institute of Zoology,Academia Sinica, 19 Zhongguancun Road, Haidian, Beijing 100080, P.R.CHINA

During the last three months of 1992, Fang Fang was a guest researcher at the Swedish Museum of Natural History in Stockholm studying freshwater fishes of China and Sri Lanka.

Current work: (1) Taxonomic revision in subspecies of the cyprinid fisher (Leuciscinae and Culterinae) from China, based on morphological and molecular methods; (2) ultrastructure of spermatogenesis and testis in the prickly sculpin, Trachidermus fasciatus Heckel; (3) a project on the fish biodiversity in Yunnan is planned.

LI, MIN-DE Department of Biology, Nankai University, 94 Weijin Road, Tianjin, P.R.CHINA

Current work is not known.

LI, SI-ZHONG Research Professor, Fish Museum, Dept. of Vertebrates, Inst. of Zoology, Academia Sinica, Zhongguancun St.Haidian, Beijing, P.R.CHINA 100080

Current work: (1) Chinese codfisher (Gadiformes); (2) soldierfishes (Beryciformes); (3) Ophidiiformes; (4) the ichthyofauna of the Huanghe River (Yellow R.); (5) the geographical distribution of the Chinese freshwater fishes.

MENG, QINGWEN Professor of Ichthyology, Dept. of Aquaculture, Shanghai Fisheries University, 334 Jun Gong Road, Shanghai 200090, P.R.CHINA

Current work: (1) Study on the development and function of filter organ of silver carp; (2) systematical anatomy of shark and skate; (3) study continues on the systematics of the Chondrichthyes of China.

QIAO, X.G. Division of Ichthyology, Department of vertebrate, Institute of Zoology Academia, Haidian Beijing 100080, P.R.CHINA

Current work: Study on the fishes Salangidae of China.

TIAN, MING-CHENG Associate Professor, Dept. of Vertebrate Zoology, Institute of Oceanology, Academia Sinica, 7 Nan-Hai Road,Qingdao 266071, P.R.CHINA

Current work: (1) China-Germany biological expedition to Hainan Is. (Marine fishes, with Dr. F. Krupp); (2) systematic study on Pempheridae, Ephippidae, Drepanidae, Scatophagidae and Oplegnathidae of China.

Systematic Ichthyologists of P. R. China

WU, HAN-LING Professor of Ichthyology, Laboratory of Fishes, Shanghai Fisheries University, 334 Jun Gong Rd., 200090, Shanghai, P.R.CHINA

Current work: (1) Eutaeniichthys sinensis, a new species of gobiid fish from southern China (with Seishi Kimura); (2) study on deep-water macrouids of the South China Sea (with Osamu Okamura); (3) study on the taxonomy and the distribution of Chaenogobius collected from China (with Zhong); (4) continuation and expansion of work on the ichthyofauna of Gobioider from China.

YANG, JUN-XING Dept. of Vertebrate, Kunming Institute of Zoology, Academia Sinica,Kunming, Yunnan, P.R.CHINA

Current work: Study on the cave fishes from Guangxi province; (2) the phylogeny and zoogeography of the cyprinid genus Spinibarbus (with Dr. Chen); (3) the phylogeny and zoogeography of the loaches Yunnanilus and Triplophysa; (4) the taxonomy of Cobitidae and Balitoridae of southern China.

ZHENG, WEN-LIAN Research Full Professor, The Laboratory of Marine Experimental Biology, South China Sea Institute of Oceanology, Academia Sinica, Guangzhou, P.R.CHINA

Current work: (1) A taxonomic study of the Chinese carangoid fishes; (2) taxonomic and biological studies of fishes of Daya Bay, Guangdong Province.

ZHOU, WEI Department of Vertebrate Taxonomy, Kunming Institute of Zoology, Academia Sinica, Kunming, Yunnan, P.R.CHINA

Current work: (1) Revision of the genus Tor of Lancangjiang River Basin (upper Mekong), (2) research on the sucking disc differentiation of the genus Discogobio; (3) continuing study on phylogeny of the genus Cyprinus.

日本応用動物昆虫学会第26回大会講演要旨　昭和57年4月（名古屋大学）

On the Morphological Peculiarity of the Saramao Trouts in Taiwan.

サケ科魚類最南限，台湾サラマオマスの特異性について

安江安宣（東京都在住）Y. YASUE (Tokyo).

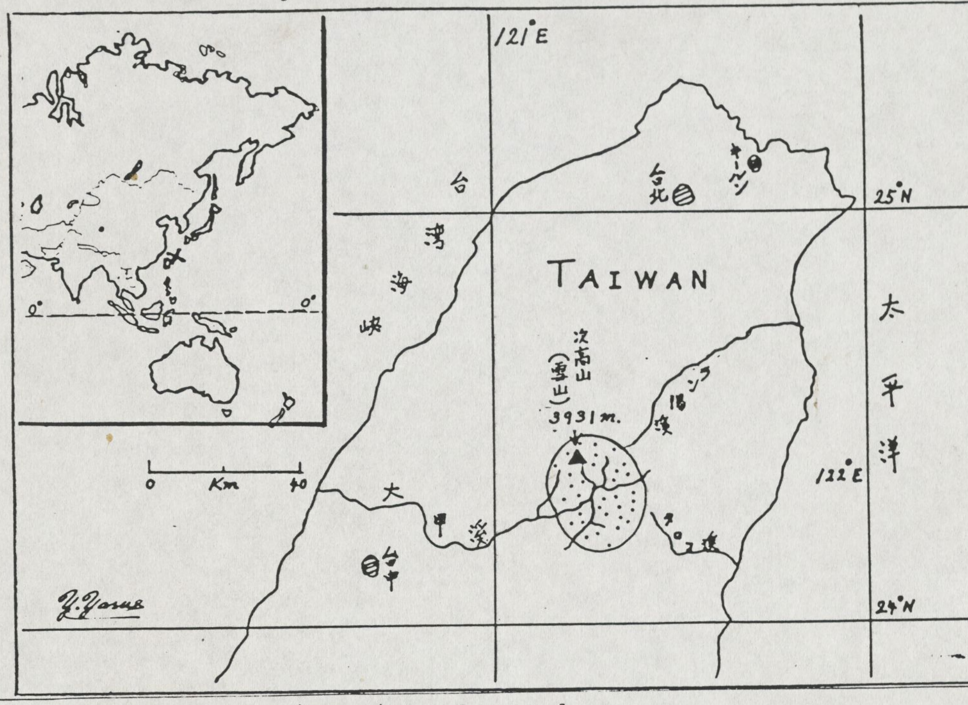
亜熱帯の島，台湾中央山脈の大甲溪源流から和名サラマオマスが発見されたのは1917年のことであった。この学名については紆余曲折をへて，今では北日本に広く分布するサクラマス *Oncorhynchus masou* の陸封型ヤマメに外ならないことが大島正満（1936）によって明らかとなった。ところでサラマオマスはメキシコ中部のデルプラシドゥ川源流（約25°43′N）に棲息するニジマス *Salmo gairdnerii* とならんで現在世界におけるサケ科魚類の自然分布の最南限（約24°10′N）とされており，旧台湾総督府は天然記念物に指定（1938）した。　安江は我国内の大学，国立科学博物館等にあるサラマオマスの標本20数体について日本産ヤマメと比較検討した結果，魚体の体側に散在する3パーマーク以外の小黒点数が日本産にくらべて著るしく少ないことに気がついたので報告する。因みに Behnkeら（1962）は別の観点から現存する大甲溪のサラマオマスに対し，ヤマメの別亜種とみなした。また小黒点については中村広司（1938）が指摘したことがある。

日本産ヤマメとの小黒点数の比較

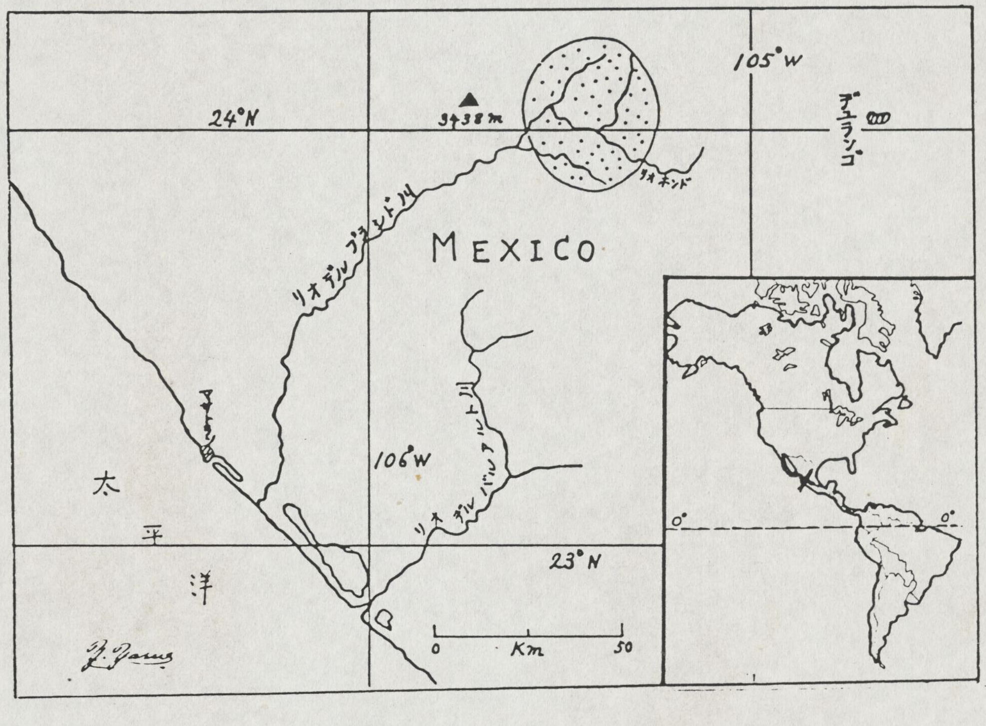
産地別	検体数	平均値	標準偏差
日本産ヤマメ	23	78.13	30.16
サラマオマス	19	24.00	5.68

＊魚体の左側，側線以上の部分

サケ科魚類の東半球に関する世界最南限にあたる
サラマオマス *Oncorhynchus masou f. formosanus* (Jordan et Oshima)
の台湾における産地



サケ科魚類の西半球に関する世界最南限にあたる
ニジマス Salmo(Salmo) Gardneri Richardson
の メキシコにおける南限産地



Abstracts of the Annual Meeting of the Japanese Society of Applied Entomology and Zoology, April 5, 1982.

于女士：您能助我弄到下一書中的：
"Moser H.G. et al.(eds),1984 Ontogeny and systematics of fishes. Special publication No.1, Amer.Soc.Ichthy.Herp., pp.259-264, Allen Press. Inc. Lawrence USA." 6页複印資料吗？如可能時，請劳神，先謝謝。又上

于曉莉女士：

您好。来信已收到十多天了，因瑣事很忙，今天才復，請原諒。

关于拙著"中国鲑科鱼类地理分布的探讨"是发表在《动物学雜誌》1984年第一期。此文附有2个地图，图1为中国鲑科鱼类分布图；图2为黄海与東海在更新世末海退時期的河系輪廓图（依Lindberg, 1972，作者稍有修改。1985年日本友人佐藤一彦先生曾译为日文並增附9个鱼图，刊在日本《淡水魚、别册，第11号：89—93页，figs. 1—9，1985年9月3日。

我1946年畢业于西北联大的西北師範学院博物系（即北京师範大学生物系在抗日战争時期迁移后方時的名子），教过一年中学，在长白师範学院博物系以助教名义教过一年脊椎动物学。1948年又考入北京师大研究院，随张春霖教授（法国巴黎大学1935年获博士学位）專学鱼类分類学。1950年畢业即到中国科学院动物标本整理委员会（为今动物研究所前身）任助理研究员，开始调查黄渤海鱼类（1955年与张春霖教授等合著有《黄渤海

鱼类调查报告》(科学出版社)，接着又调查南海鱼类。我承担的是鳕形目(Gadiformes)、鳚亚目(Blennioidei)、杜父鱼亚目(Cottoidei)(=鲉形目Scorpaeniformes)、䲟形目(Echeneiformes)、鲀形目(Tetraodontiformes)和鲈形目(Perciformes)的石首鱼科(Sciaenidae)等。不幸的是国家政治生活日益不正常，1957年我因不同意追查鸣放人姓名，主张"人言可信"而被诬为右派。多年受辱被撤职、劳动，仅在其间稍有宽松时发表过一些东西。如《南海鱼类志》(科学出版社1962)我在其中的860种鱼内承担183种而书上未有我的名子。仅在1965—1966，1974，1979，和以后发表些研究文章(1978年初升副研，1978年底平反，情况才渐好转)和专著，如1979年我主编有《新疆鱼类志》(这是我1964—1965的工作)，与别人合作有《南海诸岛海域鱼类志》，1981年发表有个人专著《中国淡水鱼的分布区划》(科学出版社)，与别人合著有《中国鱼类系统检索》(科学出版社，1987)，今年或明年初我的专著《中国动物志鱼类第16卷鲽形目鱼类志》可望印出发行(1993年与科学出版社已签有出版合同)。翻译过两本专著《鱼类的洄游》(科学出版社，1958；苏联ШМИДТ原著)及《世界鱼类》(台湾水产出版社1994年1月；加拿大Nelson，1984原著)，

在国内外发表论文60多篇。为中国鱼类学会理事(1979—1993)和副理事长(1990—1993)，中国动物分类学报及中国动物志编辑委员会编委，和北京市渔业技术顾问(1983—现今)。

我发表与鲑科Salmonidae有关的文章有①《黄河鱼类区系的探讨》(动物学杂志1965(5): 217—222)；②《陕西太白山细鳞鲑的一新亚种》(1966，动物分类学报3(1): 92—94)；③《新疆北部鱼类的调查研究》(动物学报，18(1): 41—56)；④《中国淡水鱼类的分布区划》；⑤《中国鲑科鱼类地理分布的探讨》。

我1987年元月已离休。但一直仍被回聘在此作研究工作。除专著外每年有2—3篇论文发表。目前我在编写研究《中国动物志鱼类第4卷上册，鳕形目、蛇鳚目(Ophidiiformes)等，明年计划交稿。个人兴趣是中国淡水鱼类地理分布的研究。虽然我1921年2月19日生，已73周岁，但身体很好，每日早晨跑步锻炼，每天步行5公里以上。如有机会我有意与国外合作和到美国看看。我的小儿子李振勤夫妇及一孙子在加州San Diego工作。我也很希望知道Robert Behnke教授有何想法？望顺便告诉我。祝

工作顺利，愉快

李思忠敬上
1994年4月27日

Letter from Li, Sizhong (summary)

My papers related to salmonid fishes are :

1) The geographical distribution of fishes in Huang River

2). A new species of *Brachymystax lenok* in Shanxi Taibai –

Journ. Ichthyol.
– main unknown

3). An investigation of fishes in the Northern Xinjiang

Tibetan
interest
– H. bleekeri

4). The geographical distribution of fresh water fishes in China

Sep. version
– Hannas L. - Hucho -
– Xinjiang
Brachymystax -
– Trutta

5). Discussion on the geographical distribution of the salmonid fishes in China

I was born in Feb. 19, 1921. Although I was retired in 1987, I have been still working in the Zoological Research Institute of Academia Sinica. My research interest is the study of geographical distribution of fresh water fishes in China. I would like do some research with foreign partners. It would be very nice If I had the chance to go to the US. I hope I would know more about Dr. Behnky and his research interest as well as his suggestions on our cooperative work.

Letter from Li, Sizhong (summary)

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482-0879

General Translator's notes concerning "Discussion on the Geographical Distribution of the Salmonid Fishes in China" (Li Sizhong) and "A Study on the Yangtzekiang Salmon, *Hucho bleekeri* Kimura" (Liu Chenhan and Kazuhiko Sato):

1. In both of the abovementioned articles, almost all place names and personal names are in Chinese; these have been transliterated into Roman letters in the translation.

2. The first of the abovementioned articles was originally written in Chinese, and subsequently translated into Japanese. Some technical terms were not found in Japanese references, and may have been left in Chinese in the Japanese translation. In the case of doubtful terms, translator's notes were entered in the text of the translation.

3. The second of the abovementioned articles is incomplete; the text ends in mid-sentence.

Annual Bulletin of the Freshwater Fish Protection Association

Freshwater Fish

No. 11, 1985

Discussion on the Geographical Distribution of the Salmonid Fishes in China*1

Li Sizhong (Translated by Kazuhiko Sato)

In Classical Chinese literature, a reference to gui (fish name--Translator) is seen in the following passage in the Lun wei, written by Wang ch'ung (27 to 107 A.D.) of the Later Han Dynasty: "The liver of gui is fatal to humans".[3] However, this gui refers to a puffer (a tetraodontiform fish--Translator). Salmonidae began to be referred to as the gui family (Chinese name for the family--Translator) in the Tung wu hsüeh ta tzu tien ("Comprehensive Dictionary of Zoology") (1923) of Tu yach'üan (illegible character--Translator). The principal characteristics of fishes in the family Salmonidae are as follows: Such fishes have teeth in their main upper maxilla, dentine, vormer, palate bone and tongue; the fishes have no spiny rays or spines in their fins; the fishes have two dorsal fins, with the posterior fin being an adipose fin; the pelvic fin has seven or more soft rays and is located in an abdominal position, with a projection at the base; except for the head, the body is covered with cycloid scales; the fishes have lateral lines; the gill membranes are separated and are not connected to the channel isthmus area (?) (doubtful term--Translator); the number of branchiostegal rays ranges from 7 to 20, and the fishes have premaxillae (?) (doubtful term, literally "middle crow bill bones"--Translator) and auxiliary supra maxillae (lit. trans.--Tr.); the parietal bones are located between the frontal (?) and upper supra occipital (?) bones (doubtful terms--Tr.) (e. g., in the genus Coregonus) or on both sides (e. g., in the genus Oncorhynchus); some species have membrane-form wedge ear bones (lit. trans.--Tr.) and upper frontal gill cover bones (lit. trans.--Tr.), and some species do not; the number of pyloric flaps caeca (lit. trans.--Tr.) ranges from 11 to 210; and the swim bladder has a duct which connects with the gut.

The first fossils of such fishes are Mesozoic and Cenozoic fossils discovered in Europe (Berg, 1940). Originally, such fishes were freshwater or river-ascending migratory fishes living in cold-water regions of the northern hemisphere; however, they were transplanted to the southern hemisphere several decades ago. There are currently approximately 68 living species belonging to nine genera in three sub-families. These fishes have an extremely important economical significance for the fishing industry (Nelson, 1976). Professor Wang Ik'ang (1958) previously noted a total of 13 species and subspecies in China; according to available data, however, 8 genera and 14 species, or 17 species and subspecies, are currently known. Next, we will set forth a brief analysis with an emphasis on the geographical distribution of fishes belonging to the family Salmonidae, and will then discuss this distribution in detail.

Figure 1. Distribution map of Salmonidae in China.

Key: 1. Amur river system, 2. Touman/Suifen river system, 3. Irtysh river system, 4. Yalu river system, 5. Source stream of the Wei river (Yellow river system), 6. Upper reaches of the Lo river/upper reaches of the Ch'aopai river, 7. Hun river system, 8. Upper reaches of the Yangtze river, 9. Upper reaches of the Tsinling Nanluan Han river (Translator's note: "Han river of the southern foothills of the Tsinling mountains") (Yangtze river system), 10. Tachia river, 11. Yatung (Ganges river system).

Table 1. Distribution table of Salmonidae in China. (Translator's note: in this table and elsewhere, double parentheses enclose translator's notes (mainly Japanese fish names, etc.) made by Sāto, the translator who translated the present article from Chinese into Japanese.)

Key: a. Species name, b. River systems in which species is distributed, c. Amur river system, d. Suifen river/Touman river, e. Irtysh river system, f. Middle and upper reaches of the Yalu river, g. Upper reaches of the Wei river (foothills), h. Upper reaches of the Ch'aopai river and Lo river, i. Upper reaches of the Hun river, j. Upper reaches of the Yangtze river in (continued)

Szechwan and Ch'inghai, k. Upper reaches of the Tsinling Nanluan Han river, l. Upper reaches of the Tachia river in Taiwan, m. Tibetan Yatung (Ganges river system), n. ((Brown trout)), o. ((Amur huchen Itou)), p. ((Korai huchen Itou)) *Translator's note (by Kimura--Tr.): correctly, "Mori", q. ((Choko huchen Itou)), r. ((char Iwana)), s. ((Oshorokoma)), t. (Land-locked type), u. ((Karafutomasu)), v. ((Sake)), w. ((Sakuramasu)), x. (Land-locked type) ((Yamame)), y. ((Taiwan Yamame)), z. ((Kokuchimasu)), a'. ((Tsinling Kokuchimasu)), b'. Total: 17 species and subspecies, c'. + = distributed, ⊕ = artificially transplanted, ⓐ = distributed in downstream river mouths (distributed in rivers mixed downstream), * = migratory species which return to river mouths in order to ascend rivers and lay eggs. At the present time, most taxonomists do not believe that subspecies are formed in identical environments. According to this view, Salvelinus malma curilus Pallas and Oncorhynchus masou ishikawai Jordan et McGregor are not subspecies, but rather land-locked variants within species.

Analysis of Current Distribution of Salmonidae in China

1. It is seen from Table 1 that Salmonidae are distributed in 11 areas in China (Figure 1). The genera, species and subspecies distributed in each area are as shown in the distribution table. According to past survey results, the brown trout in the Yatung region of southern Tibet were transplanted to the Ganges river system from England a century ago, and subsequently diffused into the Yatung region.[6] The distribution of ((Tsinling Kokuchimasu)) (Translator's note: i. e., Brachymystax lenok tsinlingensis Li) in the T'aipai river and Hsü river (Han river system) of the southern foothills of the Tsinling mountain range is a result of transplantation from the Heh river

(northern foothills of the Tsinling mountain range, Han river system) to the southern foothills around 1940 by a certain Chu Minsung of the town of Shih-chentzu in the district of Chouchih.[4, 6] Accordingly, the natural distribution of the family consists of a total of 10 areas.

2. Looking at the distribution table, it is seen that the naturally distributed genera and species are concentrated in the north. For example, 10 species are found in the Amur river system. 8 of these species are found in China,[2] and 8 are also found in the Touman and Suifen rivers.[2, 8] Five of the species are anadromous ~~river-mouth migratory~~ fish which ascend rivers in order to lay eggs, and two species are land-locked species which never descend to the sea. The large number of species in the north is due to the nearness to river mouths, and to the great influence of cold currents flowing along the northeast Asian coastline. Next, Stenodus leucichthys nelma, which is widely distributed in rivers flowing into the Arctic ocean (from the Dvina river in northern Europe to the Anadyr river) and the northern part of the Bering sea, lives in the Irtysh river system.[4, 5, 6] Three species are distributed in the Yalu river.[11] Each of the remaining areas has one species each.[6,7,11]

3. It is seen from the distribution map that Salmonidae have a strong affinity for cold water. Salmonid fishes are widely distributed in the arctic zone and northern parts of the temperate zone in the northern hemisphere; this is especially conspicuous in the case of Coregoninae. The few genera and species distributed in warmer zones are all restricted to mountains of high altitude. The reason for this is that air and water temperatures are relatively low in mountainous areas.

4. Salmonid fishes originated in the arctic zone of the Eurasian continent, and reached China by progressing southward during the glacial epoch of the Quaternary period.[2, 5, 6] Accordingly, the species distributed in China are relic fishes from the glacial epoch.[6] Furthermore, Salmonid fishes reached the Irtysh river and the Sunghua and Nun rivers, etc., after the separation of the Irtysh river and Ulungur river in Sinkiang[5, 6] from the Liao, Sunghua and Nun rivers to the northeast. If this were not the case, it would be difficult to understand the cause of the differences in current distribution between the abovementioned river systems.[6] The Choko Itou (H. bleekeri Kimura--Translator) of the Min and Tatu rivers on the upper reaches of the Yangtze, and of the Hsü river on the upper reaches of the Han, the Tsinling Kokuchimasu[*2] (B. l. tsinlingensis Li--Translator) of the upstream mountainous regions of the Wei, Ch'aopai, Lo and Hun rivers and the Taiwan Yamame (O. m. formosanus Jordan et Oshima--Translator) reached the Yellow Sea and the southern part of the East China Sea via the Sea of Japan during the second-to-last cold glacial period (Lushan glacial period) or the last Tali glacial period. Subsequently, as a result of a warming trend in the climate, most of these fishes either retreated to the north or became extinct. However, small numbers escaped and remained in current mountainous regions, forming several isolated distribution areas. Furthermore, the migratory Sakuramasu ((Oncorhynchus masou masou)) and the land-locked Sakuramasu ((O. masou masou)) currently live in the river systems on the eastern side of the Korean peninsula[12] and in the Touman river[8], etc. The reason for this is that cold currents along the coast are strong in these areas even today. On the other hand, Taiwan is surrounded by warm currents from the north Pacific; as a result, the Taiwan Yamame has become a land-locked subspecies which is ~~closed in~~ restricted to the Tachia river.[6] Furthermore, the land-locked Sakuramasu of the Touman river has

a small body, and the sex glands of the male mature only in the reproductive stage. Moreover, the ovaries of the female only reach stage II (sic--Tr.). However, the reason for these phenomena is unclear.

Figure 2. Conceptual map of the water systems of the Yellow Sea and the East China Sea during the period of recession of the seas at the end of the Pleistocene epoch. According to Lindb~~ack~~erg (transliteration--Tr.) (1955). Cited from Nishimura (1967). Slightly modified by the author.

5. The Tsinling Kokuchimasu distributed in the upstream regions of the Wei river, Ch'aopai river, Lo river, Hun river and Han river (of the Korean peninsula), etc., shows clear differences from the subspecies distributed in northern rivers such as the Irtysh river and Amur river, etc.; i. e., the number of pyloric ~~flaps~~ caeca (lit. trans.--Tr.) (51 to 75) and the number of gill rakers (lit. trans.--Tr.) of the ~~primary gills~~ 1st arch (18 to 23) are ~~small~~ fewer, the spots on the body are large, the body length is short, maturation is rapid, and 4 to 5 black spots are present at the base of the dorsal fin, etc. ((The ancestral

species of the Tsinling Kokuchimasu)) probably reached the southern part of the Yellow Sea during the final glacial period and the preceding glacial period, and subsequently reached the upstream portions of the Han river of the Korean peninsula via the Great Eastern River of the Yellow Sea (Translator's note: the preceding term is apparently a reference to a river which existed during the Pleistocene epoch, and which is now submerged in the Yellow Sea.), and also reached the upstream portions of the Wei river, Ch'aopai river, Lo river and Hun river via the old course of the Yellow river from the Great Eastern River of the Yellow Sea and the Yangtze river. At that time, it appears that the Gulf of Chihli had already sunk to form lowlands, but had not yet become sea. It appears that sea water entered the Gulf of Chihli from the Yellow Sea via the straits of the Gulf of Chihli (area of the Miaotao island chain) after the glacial period at the end of the Pleistocene epoch and beginning of the Holocene epoch (Translator's note: the term translated as "Holocene" is not listed in Japanese references, and may actually be a Chinese term; however, the context indicates that "Holocene" is almost certainly the intended meaning.).(9) Originally, the Liao river and Hun river, etc., flowed together and then flowed to the southwest via the lower reaches of the old course of the Liao river. This river then joined with the Lo river and Ch'aopai river, etc., and reached the area of Tungp'ing lake and Tushan lake on the west side of T'aishan (Mount T'ai--Translator) from the southern portion of the Gulf of Chihli. The river then joined with the Yellow river, flowed southward,(10) and emptied into the sea via the Great Western River of the Yellow Sea (Figure 2). As a result, the varieties of Tsinling Kokuchimasu which currently inhabit these regions resemble each other.

6. Some scientists believe that the formation of new species in nature

is extremely slow, and that although new subspecies may have been formed in the short span of 20,000 years which has passed since the last glacial period, new species cannot have been formed.[13] If this view is correct, then the Kocho Itou (Hucho bleekeri) and Korai Itou (H. ishikawai) are the same species as the Amur Itou (H. taimen), and the differences between these fishes are differences between geographical subspecies. No final conclusion regarding this question can be reached until geneticists have attempted cross-breeding and ascertained whether or not the offspring produced are fertile.

7. Many salmonid fishes are used as food, and such fishes are therefore important from an economical standpoint. The artificial transplantation of such fishes has been widely practiced in foreign countries in the past, and favorable results have been obtained. Domestically as well, favorable results have been obtained in transplantation to the Yatung region of Tibet and to the southern foothills of the Tsinling mountain range. Accordingly, I would suggest that fishery experts consider the great possibility of sucess in transplanting fishes of the genera Thymallus, Brachymystax, Hucho and Oncorhynchus to mountain streams on the upper reaches of the Yellow river, Chinsha river, Lants'ang river, Yar... (illegible characters--Tr.)* river and Tarim river, etc. If success were once achieved, the benefits would last forever. It is worth assessing the situation and making an attempt.

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*Translator's note: context would indicate a possible reference to the Yarkand river, a tributary of the Tarim river; however, poor legibility makes identification of this river uncertain.

Figure 3. Coregonus ussuriensis Berg (Miyaji, 1940).

Figure 4. Stenodus leucichthys nelma (Pallas) (Jordan and Thompson).

Figure 5. Thymallus arcticus arcticus (Pallas) (Jordan and Thompson).

Figure 6. Thymallus arcticus grubei Dybowski (Miyaji, 1940).

Figure 7. Hucho taimen (Pallas) (Miyaji, 1940).

Figure 8. Brachymystax lenok lenok (Pallas) (Jordan and Thompson).

Figure 9. Brachymystax lenok tsinlingensis Li (Li, (illegible date--Tr.)).

*1: The author is grateful to Mr. Wang Huimin for his cooperation in the preparation of the drawings in the present paper.

*2: The author is grateful to Mr. Wang Hsiangt'ing of the Department of Biology of (illegible characters--Tr.), Mr. (illegible characters) of the Shensi Animal Research Institute, Mr. Wang ...yuan (unidentifiable character--Tr.) of the (illegible characters--Tr.) Museum and Mr. (illegible characters--Tr.) of the Liaoning Freshwater Fishery Research Institute for providing data concerning the distribution of the Tsinling Kokuchimasu in the Wei river, Ch'aopai river, (illegible characters--Tr.) and Hun river of Kansu and Shensi Provinces.

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A Study on the Yangtzekiang Salmon, *Hucho bleekeri* Kimura

Liu Chenhan and Kazuhiko Sato

There are reportedly five living species of the genus *Hucho* in the world. Among these, *Hucho bleekeri* Kimura was announced as a new species in 1934 on the basis of a specimen collected by Mr. Shigeru Kimura during the Yangtze river fish-collecting expedition of Dr. Kenkichi Kishigami (1927 to 1929). Of the five known species, this species is distributed farthest south. So far, this species is known to be distributed in restricted areas of the upstream tributaries of the Yangtze river, the Han river (Hsü river), the Min river and the Tatu river between 29 and 34 degrees north latitude. Furthermore, this species is a "land-locked" fish, which is rare in China, and is therefore important for gaining an understanding of the origin and historical changes of the family *Salmonidae*.

However, since the discovery of this species, there have been few reports on the species even in China, and no detailed reports have appeared in Japan. This paper was written for the purpose of summarizing and introducing past reports on the species which have appeared in China.

Collection Records

Shigeru Kimura (Kimura, 1934) collected one specimen with a total length of 280 mm in the district of Kuan on the upper reaches of the Min river in Szechwan Province. In 1944, Chang Hsiaowei collected two specimens with respective total lengths of 329 mm and 518 mm, and respective body lengths of 282 mm and 458 mm, in the district of Kuan on the Min river and at Ngopien on the Tatu river. In 1957, Chang Ch'unlin and Liu Chenhan collected two specimens with total lengths of 468 mm and 538 mm in the district of Kuan. In 1964, Liu Chenhan collected two specimens with body lengths of 374 mm and 504 mm at Apa and Luting on the Tatu river. In 1978, Kao Hsichang collected 10 specimens in the district of T'aipai (on the upper reaches of the Tatu river) in Shensi Province. In 1979, Wu Yünfei et al. collected specimens with respective total lengths of 430 mm and 720 mm, and respective body lengths of 375 mm and 640 mm, in the district of Pan (Mak'o river on the upper reaches of the Tatu river) in Ch'inghai Province.

Thus, there are collection records for approximately 20 specimens of this species, and these specimens are preserved at the Marine Biology Research Institute of the Chinese Academy of Sciences, the Ch'inghai Plateau Research Institute, the Shensi Province Animal Research Institute and the Biology Department of Szechwan University. Furthermore, it appears that there are no specimens of this species outside of China.

Morphological Characteristics

The body is long and slender, and has the form of an offset spindle. The ratio of body length to body height is 5.5 to 6, the ratio of body length to head length is 3.9 to 4.2, the ratio of head length to snout proboscis length is 3.5, the ratio of head length to eye diameter is 5.2, the ratio of head length to distance between the eyes is 4, and the ratio of snout proboscis length to eye diameter is 1.5 to 2. The dorsal fin has 7 to 12 soft rays, the pectoral fins have 13 to 16 soft rays, the abdominal fin has 8 to 10 soft rays, and the anal fin has 8 soft rays. The number of scales in/above? along the lateral lines is 120 to 146, the number of scales forward of the dorsal fin is 72, the number of scales ~~sideways~~ above the lateral line is 36, and the number of gill rakers (sic--Tr.) on of the 1st arch primary gills is 5 + 9 (14). The head is somewhat broad, and the vertex is more or less flat. The tip of the snout proboscis is slightly pointed. The upper jaw protrudes slightly forward of the lower jaw; the mouth is large and obliquely split. The gill openings are large, and the gill membranes do not connect with the isthmus channels (sic--Tr.). The eye diameter is relatively large. The distance from the origin starting point of the dorsal fin to the base of the caudal tail fin is slightly shorter than the distance to the tip of the snout proboscis. The origin ~~starting point~~ of the dorsal fin is positioned farther forward than the origin starting point of the pelvic abdominal fin. There is one adipose fin located to the rear of the dorsal fin; the distance from this adipose fin to the tail fin is slightly shorter than the distance to the dorsal fin. The tips of the pectoral fins are slightly pointed. The anus is located in a position close to the anal fin. The tail fin is forked, and the tips are indented into a crescent shape. The mouth contains maxillae and vormer bones, and fine teeth are densely distributed on the palate bone. 10 or more fairly large teeth are present on the tongue? hyoid bone. (Translator's note: in regard to the abovementioned bones, note that there is no singular/plural distinction in the original Japanese, and the translator is unfamiliar with the specific anatomy involved.)

Distinguishing Characteristics

In his original description, Kimura points out that "this species is very similar to *Salmo pomatops* Bleeker; however, it can be distinguished from other species of the genera *Salmo* and *Hucho* by its slenderer body and slightly larger number of scales, and especially by the shape of the vo~~r~~mer and the arrangement of teeth".

Correction of Original Description

As a result of a detailed comparison of the 10 specimens collected in the T'aipai district of Shensi Province and the specimens stored at the Marine Biology Research Institute of the Chinese Academy of Sciences, Kao Hsi-chang (1975) has noted the following: "In his original description, Kimura notes that 'the vo~~r~~mer is fairly flat, and the columnar portion is not indented. There are four small teeth at the front end. There are no teeth on the columnar portion; however, four teeth are arranged on the edge of the vo~~r~~mer'. However, this is an observational error. Furthermore, Kimura noted that the number of teeth on the tongue (sic) was 6 + 6, and then later erroneously viewed these as vomer teeth, and separately described them once again". Thus, Kimura erroneously described the presence of four small teeth on the edge of the vomer. Actually, there are two coarse (?) (doubtful term--Tr.) teeth at the front end of the vomer, and conspicuous projections on the inside near the base. There are no teeth on the shaft columnar portion or edge of the columnar portion.

Distribution

The present species is currently known to be spottily distributed only in the upstream portions of three tributaries (Han river, Min river and Ta-tu river) in the upper reaches of the Yangtze river in a region (29 to 34 degrees north latitude) including portions of three provinces, i. e., Szechwan, Shensi and Ch'inghai.

Living Habits

The color of the body is silvery white, and the back is dark brown. There are small, irregular spots on the sides of the body and the gill covers. The spots of the male are black, while those of the female show a slightly reddish color. Clear grooves and irregularly spaced annual rings can be seen on the scales; accordingly, the age of the fish can be distinguished, and its growth estimated, by means of the scales. According to this measuring criterion, the body length of a year-old fish is 150 mm, that of a two-year-old fish is 280 mm, and that of a three-year-old fish is 463 mm. The maximum body length is in excess of 1 meter, and the body weight reaches 20 kg. The fish likes clear, oxygen-rich mountain streams with gravel bottoms.

The fish is a strong, active swimmer, and is usually solitary. The fish eats fishes of the genera Schizothorax (Translator's note: original actually reads "Schzothorax", but this is apparently an error.) and Nemachilus, and insects of the orders Ephemeroptera and Coleoptera, etc. The egg-laying period is March to April, and egg-laying is performed on a sunny gravel bottom. Furthermore, on the upper reaches of the Min river, there is a water rat that eats the eggs after they have been laid. In its habitat, the fish is easily caught in the winter; since the fish returns to upstream tributaries in the spring in order to lay its eggs, it is easily caught in upstream areas in the summer. In the area of its habitat, the fish is referred to as "maoryü" ("cat fish") or "huyü" ("tiger fish"). The reason for this is that the fish has a large head, a broad snout proboscis and a large number of teeth, and thus has some resemblance to a cat in terms of its head. The body of the fish is large and the flesh is tender; accordingly, the fish is an important food fish in areas where it is found.

In China, the genus name Hucho has been translated as "hujia fish". Since the present species was first discovered in Szechwan Province, it was given the name "Szechwan hujia" (Chang Ch'unlin, 1957). After later being discovered in Shensi Province, the fish was also referred to as "Chwanshen chelo gui"(Li Sizhong, 1981). Furthermore, the fish is also known as "Szechwan chelo gui" (Kao Hsichang, 1983) and "Changkiang chelo gui" (Li Sizhong, 1984).

Investigation of Origin

The views of Liu (1957) and Kao (1983) concerning the origin of H. bleekeri are as follows:

Of the five aforementioned species of fish belonging to the genus _Hucho_, _H. hucho_ is distributed in the Danube river system, _H. taimen_ is distributed from the upper reaches of the Volga and Pechora rivers in the west to the Amur river in the east (including the basins of the Amur river, Sunghua river, Ussuri river and Irtysh river in China), _H. ishikawai_ is distributed in the Yalu river system, and _H. perryi_ is distributed in Hokkaido, Karafuto (Sakhalin Island--Translator) and mainland coastal areas (poss. reference to Pacific maritime regions of Soviet Union?--Translator). _H. hucho_ and _H. taimen_ are riverine fishes, while _H. ishikawai_ and _H. bleekeri_ are land-locked fishes. _H. perryi_ lives along the middle and lower courses of rivers, and descends to the sea. In regard to the origin of _H. perryi_, which is the only species of the genus _Hucho_ that descends to the sea, Nishimura (1977) has made the following remarks: "This species is distributed in the region around the northern part of the Sea of Japan; however, it may be surmised that the ancestral type of this fish was a lake-dwelling fish. The lake in question was the "Sea of Japan Lake", which apparently existed as a large freshwater lake at the time. Then, when the "Sea of Japan Lake" was transformed into ocean, the fish transferred its life cycle (including reproduction) to the middle and lower courses of rivers flowing into the Sea of Japan. At the same time, the adult fish acquired a resistance to salinity, and acquired the characteristic of descending to the sea during non-reproductive periods". This argument suggests that the characteristic of descending to the sea shown by _H. perryi_ is something that was acquired _a posteriori_ by a species of freshwater origin in the course of its evolutionary development. Furthermore, this would seem to support the theory that fishes of the genus _Hucho_ originated in fresh water.

H. bleekeri is distributed only in a small region on the upper reaches of the Yangtze river south of the Tsinling mountain range. The fish does not inhabit the basins of the Liao, Lo and Yellow rivers, etc., north of the Tsinling mountain range. The current center of distribution of the genus *Hucho* is in an area of Siberia located in the Arctic Ocean flow region (Translator's note: i. e., region of rivers flowing into the Arctic Ocean), and it is surmised that the genus *Hucho* originated in this area. *H. bleekeri* apparently reached its current distribution area south of the Tsinling mountain range from the abovementioned area of origin. Furthermore, the fact that the species does not occur north of the Tsinling mountain range indicates that there is little likelihood that the species expanded its distribution area from north to south via inland water systems.

There were four glacial advances and retreats in China during the Quaternary epoch of the Cenozoic era. During this period, there were major changes in climate on a global scale. In the western part of China at this time, mountainous regions from the northeast to the area of Huape (?) (Chinese place name?--Translator) were covered by glaciers ...

(Translator's note: original text ends in mid-sentence at this point.)

The China Reconstructs article then moves on to relating the events of 1985, and essentially confirms the previous report (above). In July, a group of biology and geography students arrived at Lake Hanas to draw up plans for a possible nature reserve in the area. On July 24, the students, led by Professor Xiang Lihao (not Xiang Ligai), climbed to an observation tower built 2 years earlier on the lake's western side. A student pointed to a part of the lake, exclaiming, "Look, what's that?" Everybody saw several large reddish shapes on the lake's surface about 1,000 feet distant. The objects reportedly formed a triangle and then a straight line. One of the students had taken along a pair of binoculars, and used them to observe the red objects. "They look like fish!" he exclaimed.

Professor Xiang took the binoculars and observed the objects, concurring with the student's assessment. However, the article does not mention the professor's previously reported opinion that the fish were salmon. All it states is that "fish of this description" are found in the Arctic Ocean "and the river systems connected with it."

The next morning Professor Xiang was back at the observation tower with binoculars and camera. At 9 a.m. he spotted the giant, slow-moving fish again, and observed them pushing their heads above the surface. Their heads were reportedly the size of automobile tires. As the sun rose, more fish became visible, until about 60 were observable. "He took as many photos as he could," Wen wrote, "and from one of his color shots it was possible to estimate the length of one [fish] stretched out over the distance between two trees on the bank--more than 10 meters" (about 33 feet). The professor continued observing all day, and as the sun began to set the fish gradually disappeared from sight.

On July 27, an attempt was made to actually catch one of the fish. The students had two extra large fishhooks made by a blacksmith at a village 40 miles away, bought 300 feet of nylon rope, and made a raft from a tree trunk. They then attached sheep legs to the hooks, which were fastened to the rope, and sank them in the lake where the giant fish had been seen. They tied the other end of the rope to a large tree on the bank. Nothing took the bait for 2 days, and on the third day they replaced the sheep legs with wild ducks. This attempt also failed to produce a specimen.

To end the article, Wen asks if the denizens of the lake are "merely large fish." In fact, 30-foot salmon would be truly phenomenal, and monsters in their own right. The largest strictly freshwater fish in the world are only 10 to 15 feet in length (see Wood's Animal Facts column, this issue). Hopefully, additional information will eventually reach the Society. □

BLUFF CREEK REMEMBERED

Most persons interested in Sasquatch will have heard of--or even seen--the famed 1967 Patterson-Gimlin film footage, labeled a hoax by debunkers and the best evidence on record by many proponents, including a number of scientists. Roger Patterson died in 1972, but Bob Gimlin, the less well-known of the two, is alive and well in Yakima, Washington. He was interviewed in December 1985 by Ed Pehhale of the Seattle Post-Intelligencer, who described him as "a slow-talking cowboy who raises quarter horses."

"I'd have been better off if I said a long time ago that I believe it was a man in a fur suit because I took so much ridicule about it," said Gimlin, who has never profited financially from the film. "But Roger's been dead a long time now, so I kind of feel I owe it to people to tell about what we saw. We made the bend [in Bluff Creek, northern California]... here this thing stood by the creek, just stood. We were on one side of the creek, and the creature on the other, and our horses went crazy. Roger's little horse just went bananas." Patterson then reportedly grabbed the movie camera from his saddle bags.

"As all this was going on," Gimlin continued, "this creature turned and started to walk away from us, just slow like a man would if he were just walking down the street, but as it did this, Roger ran across the creek behind it, but then he stumbled on a sandbar. It was all happening boom, boom, boom. He was shooting the camera while he was running. He hollered...'Cover me!,' and, naturally, I knew what he meant. So I rode across the creek on my horse and took my 30.06 rifle out of the saddle scabbard and just stood there--pointing but not aiming the rifle at the beast.

"When I did this," said Gimlin, "this creature was quite a little ways away from me--about 90 feet--and it turned as it was walking. It never stopped walking. And then...I heard Roger say, 'Oh, my God, I ran out of film.' What he'd been doing was taking scenery-type pictures all the way up..."

Does Gimlin believe in Sasquatch today? "There's no question in my mind, none whatsoever," he stated. Members will find the famous "still" shot from the movie on the cover of the Summer, 1984, Newsletter.

INDO-PACIFIC FISH BIOLOGY

Studies on Making Fish Chromosomes Elongated with High Resolution G-banding

by

LIU Lingyun

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To Prof. R Behnke

With best wishes!

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Studies on Making Fish Chromosomes Elongated with High Resolution G-banding

LIU Lingyun

Department of Biology, Beijing Normal University, Beijing, China

Abstract Methods for elongating and providing high resolution G-banding in fish chromosomes were developed. Four methods were shown to be effective as applied to the mitotic figures in *Misgurnus anguillicaudatus* and *Monopterus albus*. Using these techiques, chromosome elongation and high resolution G-banding were observed in late prophase, early-full- and even late-metaphase figures.

Since 1970, many chromosome banding techniques in humans have been developed, ushering in a new stage in cytogenetic studies. In 1976, a high resolution G-banding technique was developed by Yunis (1976). Using this technique individual chromosomes of each genome could be identified accurately, offering application in clinical genetics, cancer genetics, genetic toxicology, and to exploring cancer mechanisms and gene mapping (Yunis *et al.*, 1978, 1981; Wingerson, 1981). But the studies of chromosome banding in fish are still in an early stage. Reports to date on studies in fish chromosome banding, including Q-, G-, C-, N-, B[redacted] G-banding (SCD), are not more than 40 papers, in which studies of G-banding were rarely found. The reason why studies of G-banding are going slowly is that fish chromosomes, in a general way, are rather small and thus there lie some difficulties in banding research. By elongating fish chromosomes one can make the intrinsic bands clearer. Thus we tried to develop some techniques for elongating and providing high resolution G-banding in fish chromosomes.

Materials and Methods

Experimental fishes were bought from the fishery in the suburbs of Beijing. Twenty-eight fish, 10 individuals of *Misgurnus anguillicaudatus* and 18 individuals of *Monopterus albus,* were used in this study. Methods used were as follows:

(1) MTX-TdR method. According to the conventional method the fish lymphocytes were cultured for 70–72 hours at 29°C in 5 m*l* of RPMI 1640 medium to which 15% fetal calf serum and 0.2 m*l* PHA were added. Methotrexate (MTX) was then added to the cultures to a final concentration of 0.5–2.5 μg/m*l*. After 17–19 hours, the culture medium was changed by RPMI 1640. 5 m*l* of cultures were then supplemented with 12 μg thymidine, cultured for 7–7.5 hours and treated with colcemid 0.1–0.2 μg/m*l* for 1–1.5 hours before cells were harvested.

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Air-dried chromosome preparations were stained in Giemsa.

(2) BUdR-MMC-AMD method. The lymphocytes were cultured for 24 hours by the above-mentioned method. 5-Bromodeoxyuridine (BUdR) was then added at a final concentration of 10 μg/m*l* to the cultures. After an additional 48 hours of culturing, the Mitomycin C (MMC) was added at a final concentration of 0.01–0.02 μg/m*l*. After culturing for 24 hours, 1.5–2.5 hours before the cells were harvested, the Actinomycin D (AMD) at the final concentration of 0.5 μg/m*l*, and colcemid (0.1–0.2 μg/m*l*) were added to the cultures. Air-dried preparations were treated as follows:

The slides were stained in Hoechst 33258 (1 μg/m*l*) for 20–30 minutes and were treated with $2\times$SSC under an ultraviolet lamp (30W) for 30 minutes, and then stained in Giemsa.

(3) BUdR-AMD method. The method of fish lymphocyte culturing was the same as above. The BUdR (10 μg/m*l* final concentration) was added to the cultures after the cells were cultured for 24 hours, then cultured for 48–72 hours. 1.5–2.5 hours before the cells harvest, the AMD at the final concentration of 0.5–1 μg/m*l* and colcemid (0.1–0.2 μg/m*l*) were added to the cultures. Preparations were as above. The method of chromosome banding was the same as (2).

(4) BUdR method. The fish lymphocyte culturing method was mentioned above. After culturing 66–67 hours, the BUdR at the final concentration of 30–100 μg/m*l* was added to the cultures, then cultured for 16–20 hours. After culture medium was changed by normal medium, the culture continued for 6–9 hours before harvesting. Preparations and chromosome banding method were as mentioned above.

Results

The results showed that all of the four methods used could make the fish chromosomes elongated and that the high resolution G-banding chromosomes were observed (Tables 1–2 and Figs. 1–3). A lot of elongated chromosomes with high resolution G-bands, including prophase, late-prophase, elongated early-metaphase and full-metaphase, were found in *M. anguillicaudatus* and *M. albus*. All of the elongated chromosome mitotic figures in the total mitotic figures were about 20–80 percent (Table 1). Method (2) gave the highest rate of elongated chromosome mitotic figures in *M. albus*, averaging $60.50\pm15.30\%$. A few of individuals with maximum rate amounted to 80.94%. Using methods (1) and (3), the rates of elongated chromosome mitotic figures in *M. anguillicaudatus* were quite similar to that of *M. albus*. On the average they were $41.71\pm18.41\%$, $42.85\pm21.97\%$, respectively. Method (4) was the lowest rate of elongation among the four methods.

The 2n total mean length of the elongated chromosomes is about 53–74% longer than that of the control (Table 2). Some mitotic figures are almost twice as long as the control. It was noted that the lengths of the elongated chromosomes in full-metaphase and early-metaphase were almost the same, and that they were all longer than their controls (Fig. 1A–D, Fig. 2B–E, Fig. 3A). Some full-metaphase chromosomes were somewhat longer than those of early-metaphase chromosomes. Also, the treated early-metaphase chromosomes proved longer than those untreated (Fig. 3A). Even late-metaphase chromosomes treated with MTX showed no trace of contraction (Fig. 1E–F, Fig. 3A). In the experimental group (1), the length of late-metaphase chromosomes is compared favorably with that of the elongated full-metaphase and early-metaphase chromosomes.

More plentiful bands were revealed in the chromosomes of the late-prophase, elongated early-metaphase and full-metaphase than in those of the controls. As the chromosomes

Table 1. Comparison of the mitotic figure data of the four methods to elongate fish lymphocyte chromosomes. Number in parentheses exclude prophase mitotic figures.

Method	Species	No. of fish	No. of mitotic figs.	No. of elongated mitotic figs.	Rate of elongated mitotic figs. % ($\bar{x}$)	Range %
(1) MTX-TdR	*Misgurnus anguillicaudatus*	10	787 (787)	315 (315)	41.71 ± 18.41	21.00–77.00
(2) BUdR-MMC-AMD	*Monopterus albus*	6	12141 (9224)	9009 (6102)	60.50 ± 15.30 55.03 ± 13.18)	39.91–80.94 (39.91–73.53)
(3) BUdR-AMD	*M. albus*	4	2725 (2621)	770 (656)	42.85 ± 21.91 (39.25 ± 20.27)	20.32–64.21 (17.40–57.45)
(4) BUdR	*M. albus*	8	3368 (3229)	943 (804)	24.97 ± 11.70 (22.85 ± 11.76)	10.00–44.18 (10.00–44.18)

Table 2. Comparison of the 2n total length between elongated (full-metaphase and early-metaphase) chromosomes and control.

Treatment	Species	No. of mitotic figs.	Relative length* of 2n chr./cell	Ratio of length of elongated chr. to control	Range
MTX-TdR	*Misgurnus anguillicaudatus*	10	2980.40 ± 338.31	1.74	2516–3556
Control	*Misgurnus anguillicaudatus*	10	1708.63 ± 232.86	1.00	1340–1981
BUdR-MMC-AMD	*Monopterus albus*	10	2278.88 ± 246.99	1.53	1988–2757
Control	*Monopterus albus*	10	1491.86 ± 252.55	1.00	1088–1786

* Chromosome length was measured by self-made measuring instrument.

elongated, the number of banding increased (Fig. 3 A–C), for instance, in the No. 1 chromosome of *M. anguillicaudatus*, 11–12 bands appeared in the early-metaphase of the control, but it was difficult to reveal the bands in full-metaphase, (sometimes, 6 bands could be seen). After treated by MTX, 14–18 bands in full-metaphase and early-metaphase were revealed, even in late-metaphase, the number of the bands did not decrease (Fig. 3A). Another example showed that in the No. 1 chromosome of *M. albus*, 7 bands in full-metaphase of the control were revealed, whereas, there were 13 bands in elongated full-metaphase chromosome, 23 bands in late-prophase (Fig. 3B). The number of the bands was twice or three times as many as that of untreated chromosome. There were 4 bands in the full-metaphase of the control in the smallest pair of chromosomes (the 11th pair), but after the chromosomes were treated by BUdR, or BUdR-AMD etc., there were 7 bands in full-metaphase, 11 bands in late-metaphase (Fig. 3C). The number of bands of treated chromosome was 1.7 to 2.7 times as many as that of the control. It was obvious that after drug treatment the chromosomes were elongated, the number of chromosome bands increased, and even those in the smallest

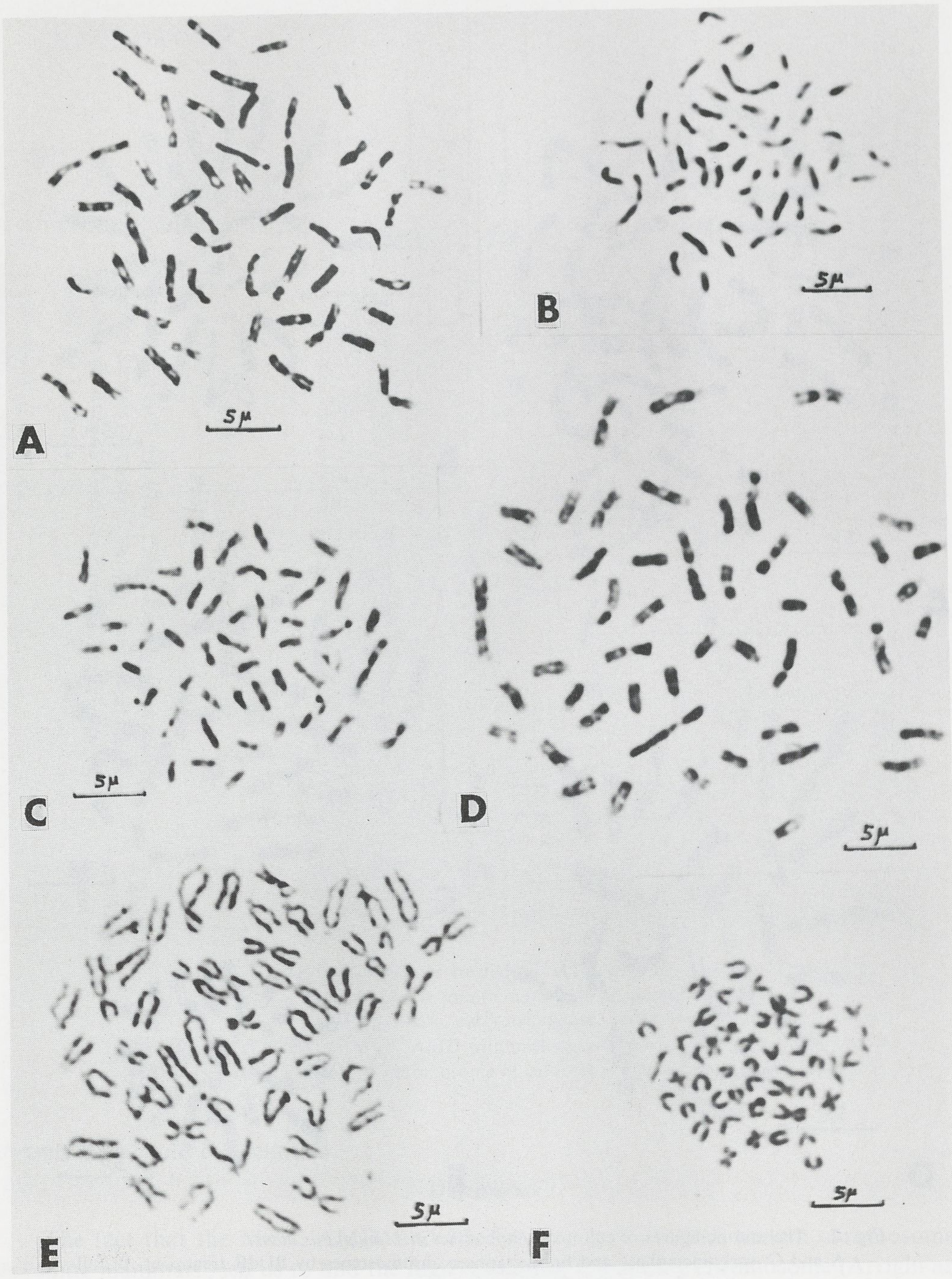

Fig. 1. The metaphase figures of cultured lymphocytes in *Misgurnus anguillicaudatus*.
Figs. A, D and E by means of MTX treatment, chromosomes in full-metaphase (A, D), near early-metaphase (A) and late-metaphase (E). Figs. B, C, F, control mitotic figures, early-metaphase (B), full-metaphase (C), late-metaphase (F).

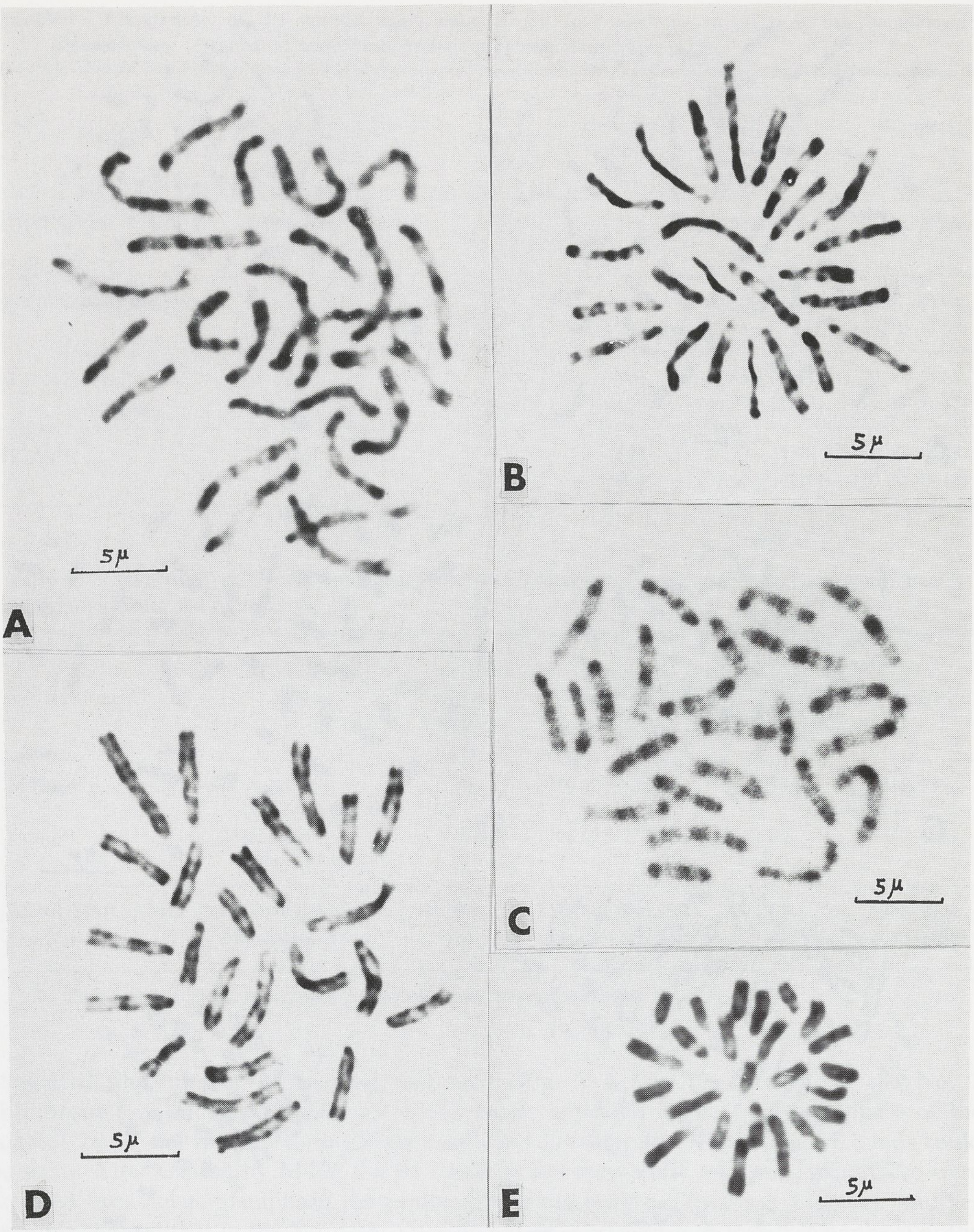

Fig. 2. The mitotic figures of cultured lymphocytes in *Monopterus albus*.
A and C: early-metaphase and full-metaphase chromosomes by BUdR treatment. B: full-metaphase mitotic figure by BUdR-MMC-AMD treatment. D: full-metaphase mitotic figure by BUdR-AMD treatment. E: control full-metaphase figure.

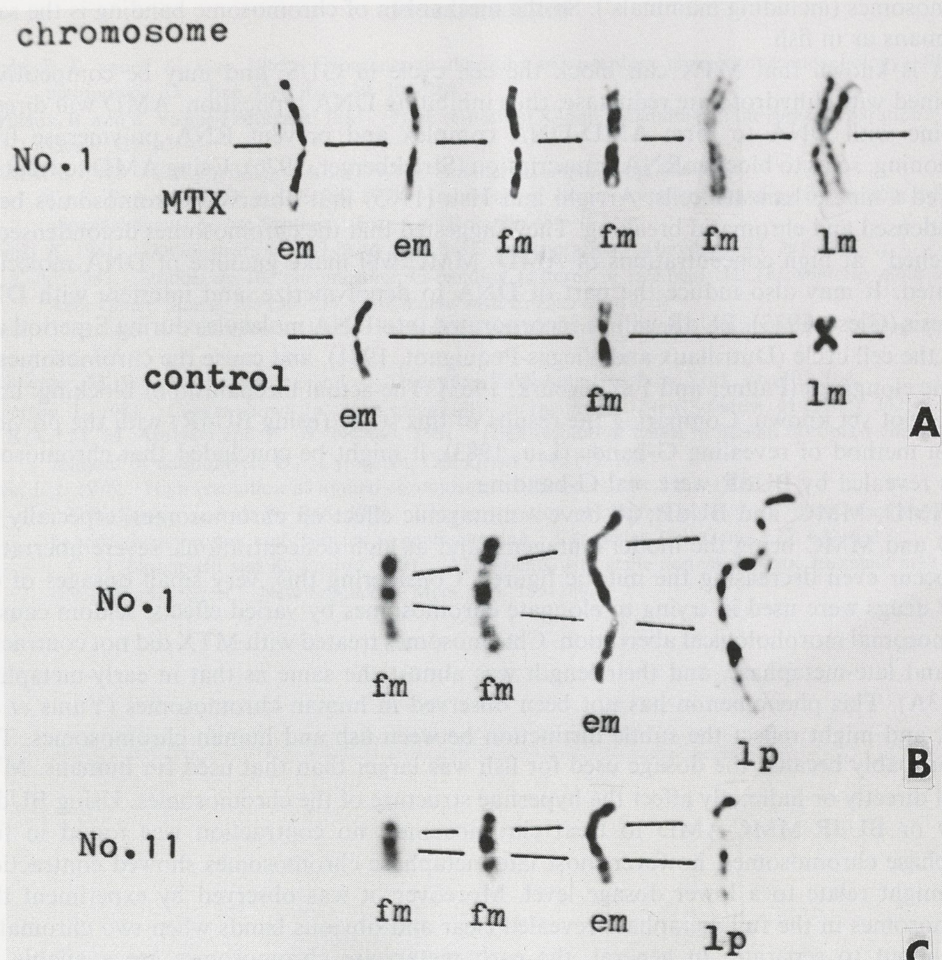

Fig. 3. Comparison of the chromosomes treated by MTX with the controls of nine No. 1 chromosomes in cultured lymphocyte mitotic figures of *Misgurnus anguillicaudatus* (A). B and C: comparison of full-metaphase, early-metaphase, and late-prophase chromosomes treated by BUdR or BUdR-MMC-AMD with unelongated full-metaphase chromosomes of No. 1 chromosome and No. 11 chromosome of cultured lymphocytes in *Monopterus albus*.

chromsomes could be identified.

Discussion

The fact that the MTX, AMD, and BUdR were used to treat human chromosomes, including mammals', led us to find the high resolution G-banding chromosome (Arrighi and Hsu, 1965; Hsu *et al.,* 1973; Yunis, 1976; Dutrillaux and Viegas-Pequignot, 1981; Kubiak, 1981; Yu *et al.,* 1981). In this paper, the MTX, BUdR, MMC, AMD etc. were used for the first time to treat the fish chromosomes to get the high resolution G-banding. The drugs used to treat human chromosomes could make fish chromosomes elongated with high resolution G-banding as well. From the results it may be stated that the basic construction and elementary chemical components of fish chromosomes are identical with those of human

Liu Lingyun

Professor

Standing Council Member, China Zoological Society
Deputy Secretary-general, Beijing Zoological Society
Member of Animal Genetics Committee, Chinese Society of Genetics

Department of Biology
Beijing Normal University
Beijing 100875, China

Tel: 2011144-139(H)

中國動物學會常務理事
北京動物學會副秘書長
中國遺傳學會動物遺傳委員會委員

劉 凌 雲 教授

中國·北京100875
北京師範大學
生物系

電話:2011144-139(家)

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Society of Genetics

Department of Biology
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劉　凌　雲 教授

中國・北京100875
北京師範大學
生物系
電話:2011144-139(家)

chromosomes (including mammals'). So the mechanism of chromosome banding is the same in humans as in fish.

It is known that MTX can block the cell cycle in G1/S, and may be competitively combined with dihydrofolate reductase, thus inhibiting DNA replication. AMD will directly combine with DNA to form AMD-DNA complex and prevent RNA polymerase from functioning, so as to block mRNA transcription (Strickberger, 1976). Using AMD to treat the cultured Chinese hamster cells, Arrighi and Hsu (1965) first observed chromosomes being decondensed and chromatid breaking. They suggested that the chromosomes decondensed or "stretched" at high concentrations of AMD. MMC will make guanine of DNA molecules alkylated. It may also induce the part of DNA to depolymerize, and interfere with DNA synthesis (Giese, 1973). BUdR will be incorporated into DNA molecules during S-period and block the cell cycle (Dutrillaux and Viegas-Pequignot, 1981), and cause the chromosomes to become elongated (Palmer and Funderburk, 1965). The actual mechanism of blocking, however, is not yet known. Comparing the results of this study (using BUdR) with the previous trypsin method of revealing G-bands (Liu, 1983), it might be concluded that chromosome bands revealed by BUdR were real G-banding.

AMD, MMC, and BUdR, all have a mutagenic effect on chromosomes, especially the AMD and MMC being the model mutagens, and at high concentrations, severe aberration will occur even decreasing the mitotic figures. Considering this, very small dosages of different drugs were used in trying to elongate chromosomes by varied effects, seldom causing chromosomal morphological aberration. Chromosomes treated with MTX did not contract in full- and late-metaphase, and their length was almost the same as that in early-metaphase (Fig. 3A). This phenomenon has not been observed in human chromosomes (Yunis *et al.*, 1978), and might reflect the subtle distinction between fish and human chromosomes. This was probably because the dosage used for fish was larger than that used for humans. MTX would directly or indirectly affect the hyperfine structure of the chromosomes. Using BUdR-AMD or BUdR-MMC-AMD to treat chromosomes, no contraction was found in full-metaphase chromosomes, however most late-metaphase chromosomes showed contraction. This might relate to a lower dosage level. Moreover, it was observed by experiment that chromosomes in the full-metaphase revealed clear and obvious bands when two chromatids were about to separate. In general, the early-metaphase chromosomes are available for studying chromosome banding. Using the methods outlined in this paper full-metaphase chromosomes do no contraction, and so exhibit clear banding almost the same as that in early-metaphase, making them equally useful in studying fish chromosome banding patterns. Even treated late-metaphase chromosomes may be used for reference in banding identification so these techniques provide a high enough frequency of mitotic figures for analysis.

In conclusion, the methods of the high resolution G-banding in fish are useful tools for identifying individual chromosomes in fish, for research of the heredity and variation in fish chromosomes, as well as for exploring the fine structures of chromosome and gene mapping. All these can also be applied to the problems of fish systematics, evolution, and the finer inter- and intraspecific relationships.

Acknowledgments

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表 4 青海湖裸鲤及雅鲁藏布江细鳞鱼各组织对痕量金属的富集情况

样 品	组织部位	富集系数 (以湿重计算)			
		Zn	Cd	Pb	Cu
湖裸鲤(♀)	肉	8.1×10²	8.0×10²	2.3×10³	3.4×10²
	卵	7.0×10²	6.0×10²	2.8×10³	2.3×10²
	皮	1.1×10³	1.4×10³	4.2×10³	5.1×10²
	骨	6.5×10²	6.0×10²	4.6×10³	4.1×10²
	鳍	5.4×10²	4.0×10²	2.8×10³	3.2×10²
	鳃	1.7×10³	1.8×10³	6.5×10³	6.8×10²
	内脏	2.2×10³	4.0×10³	6.1×10³	8.4×10²
	平均	1.0×10³	1.4×10³	4.2×10³	4.7×10²
藏布江鳞鱼(♀)	肉	7.1×10²	2.9×10³	1.5×10³	2.0×10²
	卵	9.7×10²	1.2×10³	3.1×10³	8.2×10²
	皮(鳞)	2.9×10³	4.2×10³	1.0×10⁴	1.0×10³
	骨	3.0×10³	1.4×10³	6.1×10³	1.6×10²
	鳍	3.2×10³	5.9×10³	3.4×10³	5.6×10²
	鳃	3.5×10³	6.4×10³	1.9×10⁴	1.8×10³
	内脏	4.7×10³	8.0×10³	1.5×10⁴	9.1×10²
	平均	2.7×10³	4.3×10³	8.4×10³	7.9×10²

海区鱼体的痕量金属含量比作者测定的我国一些海鱼及高原鱼类高得多。据 Патин
) 报道,黑海 11 种淡水鱼类平均含 Zn, Cd, Pb, Cu, 分别为 30.6, 0.4, 1.7, 0.6 μg/g
)。这与青藏高原鱼体的平均含量也基本相似。

owx[4] 报道英国北威尔斯 (North Wales) 两个相邻湖 (Peris 和 Padarn) 的鳟鱼 *trutta*) 和北极红点鲑 (*Salvelinus alpinus*) 各个组织含 Zn, Cu 的情况。Peris 湖 的鳞、骨、肝、肾和肉含 Zn, 分别为 424.4, 298.7, 255.0, 476.8, 50.7 μg/g (干重); 分别为 <3, <5, 392.7, <5, <1 μg/g。Padarn 湖的北极红点鲑含 Zn 分别为 269.5, 218.4, 550.6, 54.1 μg/g; 含 Cu 分别为 <3, <4, 413.1, <4, <1 μg/g。这 的鱼含痕量金属很高,尤其是鳞含量更高,说明鱼鳞对痕量金属有很强的吸着力。 青藏高原鱼类的皮(鳞)同样也具有较高的吸着力。

综上所述,我们所测定的青藏高原鱼类和我国的一些不同海区的鱼类,体内所含的以 痕量金属情况基本相似。与国外一些淡水鱼及海洋鱼类相比,有的大体相似,有的 很大。这可能与鱼类的生长环境、污染程度及鱼的种类、大小、性别等有关。另外,不 测定方法也会产生很大的偏差。

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CONCENTRATION OF HEAVY METALS IN THE TISSUES OF FISHES IN QINGHAI-XIZANG (TIBET) PLATEAU*

Liu Mingxing, Li Guoji, Bao Wanyou,
Zhang Shoulin and Gu Hongkan

(*Institute of Oceanology, Academia Sinica, Qingdao*)

Abstract

The paper deals with the concentrations of zinc, cadmium, lead and copper in seven tissues of *Gymnocypris przewalskii* from Qinghai Lake and *Brachymystax lenok* from Yarlung Zangbo River in Xizang (Tibet) Autonomous Region. The samples of fishes were collected from May to June, 1982.

The tissue samples were ashed by Muffle furnace at 450°C and their zinc, cadmium, lead and copper contents determined by anti-adsorption physical coating mercury electrode inverse polarography (ASV).

A comparison has been made between the concentration of trace metals in muscle, spawn, skin, bone, fin, gill and stomach of *Gymnocypris przewalskii* and *Brachymystax lenok*, the concentration factor of trace metals in several tissues are calculated.

The Zn, Cd, Pb and Cu mean concentrations in total body of *Gymnocypris przewalskii* are 32.9, 0.27, 1.12 and 1.87 μg/g dry weight respectively. Those in *Brachymystax lenok* are 54.1, 1.12, 1.36 and 2.45 μg/g dry weight respectively.

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中国江蓠属红藻所含琼胶的结构特征*

纪 明 侯
(中国科学院海洋研究所，青岛)
M. Lahaye, W. Yaphe
(麦吉尔大学，蒙特利尔，加拿大)

提要 用分级法和 ^{13}C-NMR 研究了从中国产江蓠属红藻(真江蓠、细基江蓠、芋根江蓠和凤尾菜) 提取的 6 份琼胶多糖的结构特征。这些琼胶主要由用 0.5mol/L 和 1.0mol/L NaCl 从 DEAE-Sephadex A 50 层析柱洗脱下的带电荷的琼胶糖分子组成。6.0mol/L 尿素级分是带低电荷密度的琼胶糖分子。各级分总得率达 80% 或以上。^{13}C-NMR 谱图表明各种江蓠琼胶的主要级分基本上由琼胶糖结构构成，但有的级分中琼胶糖含微量 6-SO_4-L-半乳糖，真江蓠和细基江蓠的琼胶糖含有 6-OCH_3-D-半乳糖，而凤尾菜琼胶中则主要含有 2-OCH_3-3,6-内醚-L-半乳糖。真江蓠和凤尾菜的个别级分的琼胶酶降解产物与 ^{13}C-NMR 分析结果相一致。

琼胶 (agar)，是从某些红藻的细胞壁中经热水提取出来的具有共同骨架结构的多糖。1922 年 Samec 等[20]将琼胶进行甲基化或乙酰化处理，产物能溶于氯仿者称为琼胶糖 (agarose)，不溶物称为硫琼胶 (agaropectin)。后来，经过荒木等[4]对石花菜琼胶的系统研究，确定了琼胶糖是由 C1,3 连接的 β-D-半乳糖与 C1,4 连接的 3,6-内醚-α-L-半乳糖组成的琼二糖 (agarobiose) 重复单位连接而成的直链聚合物 (图 1:II)；而硫琼胶基本上也是琼胶糖骨架所构成，但有些 3,6-内醚-L-半乳糖被硫酸基-L-半乳糖取代，并且有的 D-半乳糖被丙酮酸乙缩醛 4,6-O-(1-羧亚乙基)-D-半乳糖取代。这样，对石花菜、谷草[3]、鸡毛菜[26]、江蓠[5] 等所含琼胶的化学研究基本上证实琼胶糖为琼胶的主要构成骨架。琼胶糖的凝固能力比较强，是决定琼胶质量的重要组分。

近来，Duckworth 等[10] 将琼胶于 DEAE-Sephadex A50 层析柱上用水和离子强度递增的 NaCl 溶液进行洗脱分级，结果表明，琼胶不只是由琼胶糖和硫琼胶组成，而且是由一系列连续的多糖，即由中性琼胶糖到含丙酮酸和多量硫酸基的酸性琼胶糖的混合多糖组成。硫酸基主要结合在 L-半乳糖的 C6 上(图 1:I)，在专性酶[18]或碱[19]的作用下，可转变为 3,6-内醚-L-半乳糖。D-半乳糖单位部分地被 6-0-甲基-半乳糖取代，它分布在从中性直至带高电荷的整个区域中。这种分级方法能将具不同电荷的琼胶分子分离开来，对进一步研究琼胶的化学结构是很有意义的。其后，Усов 等[28]、Friedlander 等[11]都曾用

* 中国科学院海洋研究所调查研究报告第 1266 号。
本工作系 1983 年春于加拿大 McGill 大学完成的。在工作中得到加拿大国家科学和工程研究委员会 (NSERC) 的资助；Montreal 大学协助作 ^{13}C-NMR 光谱分析；中国科学院海洋研究所王玉君和徐祖洪协助琼胶样品制备；刘思俭、伍龙畅提供南方真江蓠和细基江蓠；在此一并表示感谢。
收稿日期：1983 年 12 月 23 日。

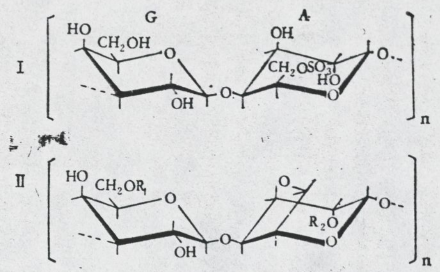

图 1 几种琼胶糖分子及其生物前体的重复单位

I. β-C1,3-D-半乳糖与 α-C1,4-6-硫酸基-L-半乳糖连接的二糖，即琼胶糖分子的基本重复单位的生物前体；

II. β-C1,3-D-半乳糖与 α-C1,4-3,6-内醚-L-半乳糖连接的琼二糖，即琼胶糖分子的基本重复单位。

$R_1 = R_2 = H$：琼胶糖分子的重复单位；$R_1 = CH_3$，$R_2 = H$：6-OMe-琼胶糖分子；$R_1 = H$，$R_2 = CH_3$：2-OMe-琼胶糖分子。

此分级法，而 Izumi[14] 则用 Dowex-1 × 2 分级法研究过红藻多糖的结构特点。已证实 ^{13}C-NMR 光谱在研究琼胶的结构中是比较快和有用的技术[22]。

中国沿海拥有丰富的红藻资源，如石花菜、江蓠等已用作琼胶生产原料。本文对中国沿海生长的 4 种江蓠(6 份样品)琼胶用阴离子层析法进行了分级，测定了各级分的得率分布和化学成分，并对个别级分用 ^{13}C-NMR 光谱法辅以酶解产物鉴定，阐述了这几种江蓠合成的琼胶聚合物中主要类型的重复单位。

实验材料与方法

1. 海藻样品

(1) 真江蓠1) *Gracilaria asiatica* (Zhang et Xia)，雌性配子体，于 1982 年 4 月采自广东省湛江。

(2) 真江蓠1) *Gracilaria asiatica* (Zhang et Xia)，四分孢子体，于 1982 年 4 月采自广东省湛江。

(3) 真江蓠1) (*Gracilaria asiatica* Zhang et Xia)，于 1982 年 6 月采自山东省青岛。

(4) 细基江蓠 (*Gracilaria tenuistipitata* C. F. Chang et B. M. Xia)，于 1982 年 3 月采自广东省海南岛。

(5) 芋根江蓠 (*Gracilaria blodgettii* Harv.)，于 1981 年 3 月采自广东省海南岛。

(6) 凤尾菜 (*Gracilaria eucheumoides* Harv.)，于 1959 年采自广东省海南岛。

2. 海藻的前处理[6]

称取 10.0g 剪细的干海藻，加 200ml 60% 丙酮溶液浸泡一夜，倾出，再加入 100ml 丙酮，摇动 1 小时。继而加 300ml 80% 乙醇，于热水浴中回流 1 小时，再加 200ml 无水乙醇回流半小时。然后以乙醚洗涤，吹干，放 P_2O_5 真空干燥器中至恒重。

1) 过去曾误订为江蓠 (*Gracilaria verrucosa* Huds.) Papenfuss，现已改为本名[23]。

3. 琼胶的提取

将上述藻块以 Apex 实验室切碎机（116AASS 型）切碎至 40 目。称取 5.0g 加 375ml 水浸泡一昼夜，放压力锅中于 120℃（1kg/cm² 压力）提取 1 1/2 小时，以尼龙布过滤。滤液中加入适量 Celite 545，用布氏漏斗两层滤纸抽滤。滤液放冷后切成条，放冰箱中－10℃ 冻结两昼夜。取出，加乙醇室温融化[1]，以 85% 乙醇、无水乙醇和乙醚依次洗涤脱水，放 P_2O_5 真空干燥器中至恒重。

凤尾菜琼胶的制备[6]是取 5.0g 脱色后的藻粉加 1200ml 0.5mol/L $NaHCO_3$ 溶液，于 90℃ 提取 1 1/2 小时，藻渣再加 300ml $NaHCO_3$ 溶液，同样提取半小时，同上法过滤。滤液中加入适量 2% CPC（十六烷氯化吡啶）水溶液，生成的沉淀经离心后以乙酸钠饱和的 95% 乙醇，95% 乙醇和乙醚依次洗涤，放 P_2O_5 真空干燥器中。

4. 琼胶的分级

参照 Duckworth 等[9]的分级方法，称取 0.50g 琼胶加 200ml 水，煮沸使全溶，以保温压滤器过滤。滤液分多次加入 DEAE-Sephadex A 50 (Cl^-)（Pharmacia，40—120μm）柱（ϕ1.5 × 38cm）中。柱保温在 70℃。样品加完后，依次以水，0.5mol/L，1.0mol/L 和 2.5mol/L NaCl 溶液洗脱。每种洗脱液的用量以苯酚-硫酸法检查流出液无糖为止。以 2.5mol/L NaCl 液洗脱完毕后，将柱内 Sephadex 凝胶移出，加入 50ml 6.0mol/L 尿素溶液[16]，煮沸 10 分钟，压滤。各级分洗脱液经定体积后均以苯酚-硫酸法测定糖含量。然后将含盐各级分减压浓缩、透析、冻干、称重。

5. 化学分析

（1）总糖：用 Dubois 等[7]的苯酚-硫酸法以半乳糖为标准测定。

（2）3,6-内醚-半乳糖(以下简称 3,6-AG)：根据 Yaphe 等[25]的方法以果糖为标准测定。

（3）硫酸基：按照 Tabatabel 的方法[21]以氯化钡-骨胶溶液与硫酸基反应，生成硫酸钡以比浊法测定 SO_4 含量。

6. ^{13}C-NMR 光谱

将琼胶级分溶于加热的 D_2O 中（约 4%，W/V），以 3μm 滤膜过滤。用 Brucker BZH-400/50 光谱仪，样品放于 100.62 MHz 磁场中（谱线宽度 20,000Hz，松弛时间 0.4s），于 80℃ 扫描 1200—4780 次，记录了质子去偶的 ^{13}C-NMR 谱图。化学位移 δ 对内标（DMSO）以 ppm 表示，换算成相对于外标 TMS 的值。

7. 琼胶的酶降解

用假单胞菌 *Pseudomonas atlantica* 分离的 β-琼胶酶，基本上按照 Duckworth 等[8]的方法，对琼胶的个别级分进行了降解。然后取其乙醇可溶部分经过 Sephadex G-25 柱分离，洗脱液进行了薄层色谱检查，由斑点 R_{gal} 值(还参考了 Усов 等[29]的资料)辨别了酶解产物寡糖的种类。

实 验 结 果

1. 层析柱分级

用 DEAE-Sephadex A 50 层析柱对 6 份江蓠属红藻的琼胶进行分级，各级分的得率分布如图 2。

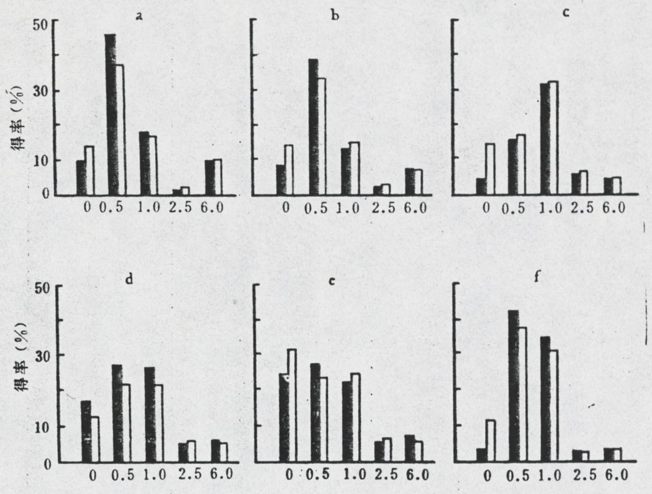

图 2 几种江蓠琼胶由 DEAE-Sephadex A 50 层析柱上洗脱下的各级分的得率分布图

A. 真江蓠琼胶(藻体为配子体，湛江采)；B. 真江蓠琼胶(藻体为四分孢子体，湛江采)；C. 真江蓠琼胶（藻体为青岛采)；D. 细基江蓠琼胶；E. 芋根江蓠；F. 凤尾菜 CPC 沉淀的琼胶。

洗脱液顺序：水(W)，0.5mol/L NaCl (0.5)，1.0mol/L NaCl (1)，2.5mol/L NaCl (2.5)，6.0mol/L 尿素(6)。

黑框：以苯酚-硫酸比色法测得的碳水化合物得率；

空框：实际重量得率

从图 2 可看到，4 种（6 份）江蓠琼胶的多数级分的重量得率与从比色得到的碳水化合物得率基本上相一致。但水洗脱级分的重量得率大多比比色得率较高，这反映在原始琼胶中有某些其他中性化合物存在，影响 Dubois 比色测定。琼胶主要由带电荷的多糖组成，可用 0.5 或 1.0mol/L NaCl 溶液由 DEAE-Sephadex A 50 洗下。南方真江蓠的雌配子体和四分孢子体两者的各级分分布图形基本相似，都是以 0.5mol/L NaCl 洗脱级分为主，但北方真江蓠的琼胶中以 1.0mol/L NaCl 级分为主。真江蓠的水级分与 6.0mol/L 尿素级分的得率大致相近。南方产芋根江蓠和细基江蓠两者的级分分布图形有些近似，其中性琼胶糖(水级分)和带电荷琼胶糖(0.5 和 1.0 mol/L NaCl 级分)的得率都较高。南方产凤尾菜的 CPC 沉淀琼胶则以 0.5 和 1.0mol/L NaCl 级分为主要组分，而水和 0.5 mol/L 级分极少。各江蓠琼胶的尿素级分，是 2.5mol/L NaCl 洗脱完后，从柱取出 Sephadex 凝胶，加 6.0mol/L 尿素溶液煮沸而洗下的，得率为 4—9%。

2. 化学分析

从表 1 的化学分析结果看，总的说来，各级分中 3,6-AG 含量随着洗脱液离子强度的增高而减少，硫酸基含量则逐增。除细基江蓠的水级分中 3,6-AG 含量比原琼胶中的含量较高外，其余各样品的水级分中的含量都低于原琼胶，而含量较高的却是 0.5mol/L NaCl 级分(本来水级分应为具很高结构规则性的琼胶糖分子)，这表明，水级分中琼胶分

表 1　几种江蓠琼胶由 DEAE-Sephadex A 50 层析柱上洗脱下的各级分的化学分析

海　　藻	级分	各级分的得率**(%,对琼胶)	各级分中 3,6-内醚-L-半乳糖的含量(%)	各级分中 SO_4 含量*(%)
真江蓠 (*Gracilaria asiatica*)(配子体,采自湛江)	琼胶		35.2	5.0
	蒸馏水	9.1	23.2	—
	0.5 mol/L NaCl	45.9	31.9	3.7
	1.0 mol/L NaCl	17.1	18.4	—
	2.5 mol/L NaCl	1.5	13.9	—
	6.0 mol/L 尿素	9.2	43.1	—
真江蓠 (*Gracilaria asiatica*)(四分孢子体,采自湛江)	琼胶		34.8	3.9
	蒸馏水	8.0	30.5	—
	0.5 mol/L NaCl	38.5	41.4	2.9
	1.0 mol/L NaCl	13.1	26.8	8.5
	2.5 mol/L NaCl	2.5	22.7	—
	6.0 mol/L 尿素	7.6	46.5	2.4
真江蓠 (*Gracilaria asiatica*)(采自青岛)	琼胶		29.6	3.8
	蒸馏水	5.0	13.6	—
	0.5 mol/L NaCl	15.2	29.8	4.4
	1.0 mol/L NaCl	31.4	28.9	6.7
	2.5 mol/L NaCl	5.6	17.3	7.3
	6.0 mol/L 尿素	4.7	42.2	—
细基江蓠 (*Gracilaria tenuistipitata*)(采自海南岛)	琼胶		25.1	—
	蒸馏水	16.8	35.5	—
	0.5 mol/L NaCl	27.6	25.7	3.6
	1.0 mol/L NaCl	26.4	16.3	—
	2.5 mol/L NaCl	5.3	18.8	—
	6.0 mol/L 尿素	6.6	34.9	—
芋根江蓠 (*Gracilaria blodgettii*)(采自海南岛)	琼胶		26.0	6.8
	蒸馏水	24.4	23.4	—
	0.5 mol/L NaCl	27.5	34.1	3.4
	1.0 mol/L NaCl	22.8	17.4	—
	2.5 mol/L NaCl	5.4	20.0	10.0
	6.0 mol/L 尿素	7.2	32.0	—
凤尾菜 (*Gracilaria eucheumoides*)(采自海南岛)	CPC 沉淀的琼胶		22.8	3.2
	蒸馏水	2.4	3.5	—
	0.5 mol/L NaCl	43.2	28.6	6.3
	1.0 mol/L NaCl	34.9	24.0	—
	2.5 mol/L NaCl	3.1	21.4	—
	6.0 mol/L 尿素	4.0	33.3	—

* 某些级分因得率不高,或因分析别项,故未能全作 SO_4 测定。
** 碳水化合物比色得率。

子的不规则性或者是带入其他热水可溶中性多糖或含氮化合物。尿素级分的 3,6-AG 含量在 33—47% 之间,表明这个级分的琼胶分子具有高度的结构规则性。当 Sephadex 凝胶以尿素溶液煮沸时 pH 逐增至 8,是否会导致 L-半乳糖的 C6 上的硫酸基在此碱性下被

游离而形成 3,6-AG? 当将琼胶分别以尿素和水(对照)煮沸后,并没有观察到 3,6-AG 含量的差别,说明此级分的 3,6-AG 高含量与尿素溶液的加热无关。凤尾菜琼胶是加 CPC 沉淀的含有硫酸基的多糖。其水级分的得率及其 3,6-AG 含量都低,它们是同 CPC 共沉淀带人的。其他 0.5,1.0 和 2.5mol/L NaCl 各级分中 3,6-AG 含量大致相近,这与其他种江蓠样品是不同的。南方真江蓠的雌配子体与四分孢子体各级分的 3,6-AG 含量没有较大差异,但后者略高于前者,各级分分布趋势大致是一样的。有的级分得率比较低,不足于测定硫酸基。粗琼胶的硫酸基含量在 3.2—6.8% 之间。

3. ^{13}C-NMR 光谱分析

^{13}C-NMR 光谱对解析那些具有重复单位结构的多糖的主要结构特征是一个简便而快速的测定技术。本工作因为所得各级分的量比较少,只取了 0.5 和 1.0mol/L NaCl 主要洗脱级分以及南方真江蓠琼胶的尿素溶液煮沸级分,记录了其 ^{13}C-NMR 谱图。因为有一些样品的谱图彼此很近似,故本文只列出南方真江蓠(配子体)琼胶的 0.5mol/L NaCl

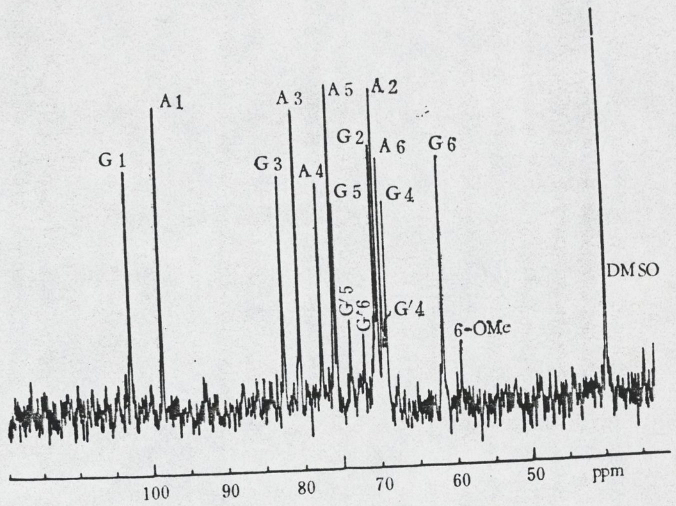

图 3　真江蓠(配子体,湛江采)琼胶 0.5 mol/L NaCl 级分的 ^{13}C-NMR 谱图

表 2　几种琼胶糖和硫酸半乳糖胶的各碳原子的 ^{13}C-NMR 化学位移文献值 (ppm,相对于 TMS)

琼胶糖与硫酸半乳糖胶	G(D-半乳糖)								A(3,6-内醚-L-半乳糖)							
		1	2	3	4	5	6	OCH_3		1	2	3	4	5	6	OCH_3
琼胶糖 (agarose)[23](图 1:II)	G	102.4	70.1	82.2	68.4	75.3	61.4		A	98.4	69.8	80.1	77.4	75.6	69.3	
6-OCH_3-琼胶糖[23](图 1:II)	G′	102.4	70.1	82.2	68.6	73.6	71.8	59.1	A	98.4	69.8	80.1	77.4	75.6	69.3	
2-OCH_3-琼胶糖[22](图 1:II)	G″	102.6	70.2	82.7	68.7	75.6	61.4		A″	98.7	78.8	78.4	77.6	75.3	69.8	59.1
β-C1,3-D-半乳糖与α-C1,4-6-硫酸基-L-半乳糖联接的重复二糖[23](图 1:I)	G‴	103.7	70.5	81.1	69.1	75.9	61.8		A‴	101.2	69.8	71.0	79.0	67.7	67.5	

表 3 琼胶级分中各碳原子的 ^{13}C-NMR 化学位移 (ppm, 相对于 TMS)

琼胶级分		G(D-半乳糖)	1	2	3	4	5	6	OMe	A(3,6-内醚-L-半乳糖)	1	2	3	4	5	6	OMe
真江蓠 (*Gracilaria asiatica*) 配子体,南方湛江采	0.5mol/L NaCl 级分	G	102.4	70.2	82.2	68.8	75.4	61.5		A	98.2	70.0	80.1	77.3	75.6	69.2	
		G'				69.0	73.6	71.8	59.1								
真江蓠 (*Gracilaria asiatica*) 配子体,南方湛江采	1.0 mol/L NaCl 级分	G	102.4	70.2	82.2	68.8	75.3	61.4		A	98.2	69.9	80.1	77.3	75.6	69.4	
		G'''		70.5		69.1		61.7		A'''	101.3		71.0			67.5	
真江蓠 (*Gracilaria asiatica*) 配子体,南方湛江采	6.0 mol/L 尿素级分	G	102.4	70.3	82.2	68.8	75.4	61.4		A	98.2	69.9	80.1	77.4	75.6	69.4	
		G'				69.0	73.6	71.8	59.1								
真江蓠 (*Gracilaria asiatica*) 北方青岛采	0.5 mol/L NaCl 级分	G	102.4	70.2	82.2	68.8	75.4	61.5		A	98.2	69.9	80.1	77.4	75.7	69.4	
		G'				69.0	73.6	71.8									
		G'''		70.5		69.1	75.8	61.7		A'''	101.1						
真江蓠 (*Gracilaria asiatica*) 北方青岛采	1.0 mol/L NaCl 级分	G	102.4	70.2	82.2	68.7	75.3	61.4		A	98.1	69.9	80.1	77.3	75.6	69.3	
		G'''	103.5	70.6		69.1	75.8	61.7		A'''			70.8			67.5	
细基江蓠 (*Gracilaria tenuistipitata*) 南方海南岛采	1.0 mol/L NaCl 级分	G	102.4	70.1	82.2	68.8	75.3	61.4		A	98.2	69.9	80.1	77.3	75.6	69.4	
		G'				69.0	73.6	71.8	59.0								
		G'''		70.5		69.1		61.7		A'''	101.1		70.8				
芋根江蓠 (*Gracilaria blodgettii*) 南方海南岛采	1.0 mol/L NaCl 级分	G	102.4	70.2	82.2	68.7	75.3	61.4		A	98.2	69.9	80.1	77.3	75.6	69.4	
		G'''	103.7	70.5				61.7		A'''		69.8	70.9				
凤尾菜 (*Gracilaria eucheumoides*) 南方海南岛采	0.5 mol/L NaCl 级分	G		70.3		68.8	75.3	61.4		A	98.2	69.9			75.8	69.5	
		G''	102.7		82.8					A''	98.7	78.9	78.6	77.6			59.2
凤尾菜 (*Gracilaria eucheumoides*) 南方海南岛采	1.0 mol/L NaCl 级分	G		70.2		68.8	75.3	61.4		A	98.3	69.9			75.8	69.5	
		G''	102.7		82.8					A''	98.7	78.9	78.6	77.6			59.2
		G'''		70.6		69.1	75.8	61.6		A'''		69.8	70.8	78.9			

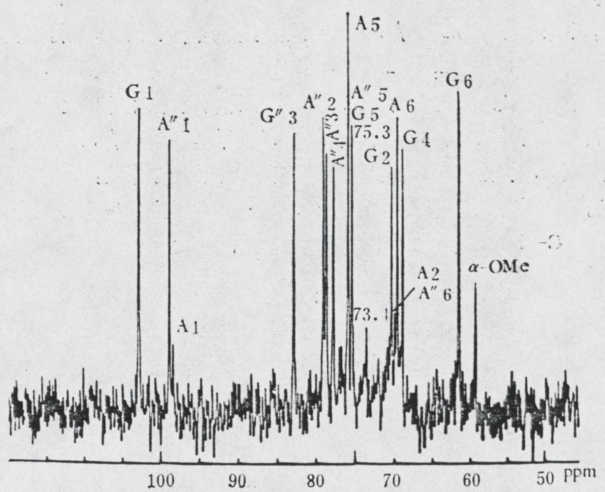

图 4 凤尾菜琼胶 0.5mol/L NaCl 级分的 ^{13}C-NMR 谱图

级分(图 3)和凤尾菜琼胶 0.5mol/L NaCl 级分(图 4)的谱图以作比较。从 D-半乳糖(G)和 3,6-AG(A) (图 1:II) 的化学位移值与文献结果(表 2)相对照，可以确定琼胶分子中的主要的和微量的重复单位。真江蓠、细基江蓠和芋根江蓠的琼胶各级分谱图都表示出琼胶糖重复单位所特有的 12 个主要信号[23](表 3)，说明琼胶糖为这些琼胶的主要组分。南方真江蓠琼胶的 0.5mol/L NaCl 级分和 6.0mol/L 尿素级分，北方真江蓠琼胶的 0.5mol/L NaCl 级分以及细基江蓠琼胶的1.0 mol/L NaCl 级分的谱图都显示出 3 个微量的化学位移信号，即 G′4, G′5 和 G′6 (表 3)，表明有 6-甲基化的 D-半乳糖存在。但只在南方真江蓠琼胶的 0.5mol/L NaCl 级分和尿素级分的谱图中看到有甲基碳信号 (59.1ppm)。北方真江蓠琼胶中没有检出。 这表明甲基化琼胶糖在南方真江蓠中的含量比北方者较高。 定性地看，在 0.5mol/L NaCl 级分中，甲基化琼胶糖单位的信号强度比 1.0mol/L NaCl 级分较高。在真江蓠、细基江蓠和芋根江蓠的 1.0mol/L NaCl 级分中，观察到微弱的表示 6-硫酸基-L-半乳糖存在的信号。 尿素级分与南方真江蓠琼胶 0.5mol/L NaCl 级分的谱图彼此很相似(图3)，即都含有低含量的 6-O-甲基-D-半乳糖，但几乎测不出 6-硫酸基-L-半乳糖。

凤尾菜所含琼胶具有不同类型的重复单位，它不象有的江蓠琼胶在 L-半乳糖的 C6 上甲基化，而是在 3,6-内醚-L-半乳糖的 C2 上甲基化 (图 1:II)。 其化学位移(图 4 和表 3)与 Usov 等[22]提出的数值是一致的。但 G5 和 A5 的位置相反。由于大量 2-OCH_3 的存在，使得 A1 98.2 和 A2 69.9ppm 信号显著地受影响而减弱。 在凤尾菜琼胶的 1.0mol/L NaCl 级分中，检出了微量 6-硫酸基-L-半乳糖的信号。在 0.5mol/L NaCl 级分的谱图中，还出现了 73.4ppm 未知信号。

在上述琼胶中，可能会存在低浓度的其他类型取代的重复单位，特别是与硫酸基相结合的不同类型的重复单位，但 ^{13}C-NMR 谱图却未能显示出来。

4. 酶降解

取南方真江蓠琼胶的 0.5mol/L NaCl 级分，加入 β-琼胶酶进行酶降解。对酶解液的乙醇可溶部分经过 Sephadex G 25 柱，流出液以薄层色谱法处理，从显色的 R_{gal} 值[8,29]观察了中性寡糖的分布。检出有新琼二糖、新琼四糖、新琼六糖以及 6-O-甲氧基-新琼二糖系列的寡糖(图 5)。从凤尾菜琼胶水解液(0.5mol/L, 1.0mol/L NaCl 级分)得到的含 2-甲氧基-3,6-内醚-L-半乳糖的寡糖，其 R_{gal} 值是不同的，并且，糖与间萘二酚指示剂生成浅黄色斑点。这些 β-琼胶酶的降解产物进一步证实了 ^{13}C-NMR 谱图显示出的主要重复单位，即与 ^{13}C-NMR 所测出的结构是一致的。

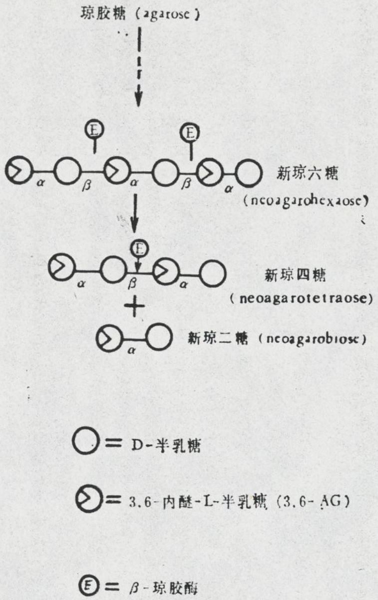

图 5　β-琼胶酶对琼胶糖的降解

讨　论

从 4 种 (6 份) 江蓠属红藻琼胶的层析分级所得级分分布图看，这些琼胶主要由带电荷的聚合物，即 0.5mol/L 和 1.0mol/L NaCl 洗脱级分组成。各种琼胶的水级分的重量得率与比色得率间的差异以及水级分中 3,6-AG 含量比较低，都表明琼胶中含有非琼胶成分，如糖苷、红藻淀粉或含氮化合物。这可能与所用的冻结-乙醇融化法[1]的脱水步骤有关。乙醇能使水溶性非琼胶聚合物与琼胶凝胶吸附沉淀在一起，从而干扰了对琼胶特别是对 3,6-AG 的测定。已有报道，从红藻的水提取液中分离出藻胆素[12]、红藻淀粉[24]、直链淀粉1)等。Usov 等[28]还从江蓠凝胶的融化水中分离出除半乳糖和木糖以外的葡萄

1) Yaphe 等未发表资料。

糖。

各琼胶样品用水和不同浓度 NaCl 溶液洗脱后，都用 6.0mol/L 尿素溶液[16]对 DEAE-Sephadex A 50 凝胶加热煮沸处理，得到的各级分总得率为 68—91%，一般大于 80%，比前人[10,28]的 50—70% 都要高。尿素级分中的 3,6-AG 含量都在 30% 以上。此级分的 ^{13}C-NMR 谱图表明是含有 6-O-甲基-D-半乳糖的低硫酸含量的琼胶糖。为何低硫酸含量和甲基化的琼胶糖分子保留在 DEAE-Sephadex 上，还不清楚。但当增高 NaCl 浓度时，可能会产生琼胶糖微凝胶，或者 DEAE-Sephadex 微粒在高离子强度溶液中膨胀时，琼胶糖分子会被包住。另外，琼胶糖的分子量也可能会影响在 Sephadex 上的滞留。

用阴离子交换层析法分级后的琼胶级分的主要重复单位，其化学结构在 ^{13}C-NMR 谱图上极易看出。真江蓠和细基江蓠琼胶的带电荷级分的谱图清楚地表明，这些级分含有低浓度 6-O-甲基-D-半乳糖的重复单位的琼胶糖聚合物。在真江蓠的 1.0mol/L NaCl 级分中，甲基化的重复单位含量很低，这与 Izumi[14] 报道琼胶中的甲氧基含量随 SO_4 含量的增加而降低的结果相符合。南方真江蓠和北方真江蓠琼胶的甲氧基含量差异，可能反映藻体的生长地理位置和环境影响到琼胶的生物合成，因而引起品系的差异。由于影响琼胶结构的变因的复杂性，对南方和北方的真江蓠所含琼胶的某些差异，本文尚难作出有意义的推断。只在真江蓠、细基江蓠和芋根江蓠的 1.0mol/L NaCl 级分中测出微量 6-硫酸基-L-半乳糖，这个组分可能在 2.5mol/L NaCl 级分中较多。

凤尾菜琼胶的 ^{13}C-NMR 谱图显示出的特有的 2-O-甲基-3, 6-半乳糖，曾在松节藻 (*Rhodomela larix*) 中以微量成分描述过[29]，但在琼胶海藻凤尾菜中作为主要类型的琼胶糖聚合物，本文是首次报道。可以认为这种甲基化重复单位是凤尾菜琼胶的特点。过去对凤尾菜的分类从外形上曾与麒麟菜属 (*Eucheuma*) 混淆过。后者所含多糖属于卡拉胶 (Carrageenan)。卡拉胶是一类由 D-半乳糖组成的具不同构象的、硫酸基结合量和结合位置不同的半乳糖胶 (galactan)，基本上不含甲基化半乳糖[17]；而凤尾菜多糖则具有琼胶糖骨架(图 1a)，故不仅从形态上不应隶属于麒麟菜，从化学结构上也应归属于琼胶类型。但凤尾菜多糖又具有与其他江蓠多糖不同的结构特点，因此，一方面表明江蓠琼胶在结构上的多样性，同时为分类学家提供了一个待研究的饶有兴趣的问题。

琼胶海藻的不同世代对细胞壁多糖结构的影响，不象在卡拉胶海藻中那样明显[15]。

用 DEAE-Sephadex A 50 对琼胶聚合物分级和对各级分的化学分析，可以对聚合物的电荷密度得出其相对分布的资料。^{13}C-NMR 光谱是表征各级分中主要重复单位的一种有用的技术，但是这种技术对于鉴别那些构成与聚合物电荷密度有关的微量重复单位的存在，还不够灵敏。因此，尚需探讨另外的方法，以测定这些能影响琼胶物理性质(凝胶强度)的微量重复单位。琼胶中的主要重复单位在江蓠各种类的分类学研究中可能具有一定意义。

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STRUCTURAL FEATURE OF AGAR FROM CHINESE *GRACILARIA* SPP. (RHODOPHYTA)*

Ji Minghou

(Institute of Oceanology, Academia Sinica, Qingdao)

M. Lahaye and W. Yaphe

(McGill University, Montreal, Canada)

ABSTRACT

The structural feature of six samples of agar polysaccharides extracted from fo Chinese *Gracilaria* species, *G. asiatica, G. tenuistipitata, G. blodgettii* and *G. eucheum ides* was investigated. These agars composed mainly of charged agrarose molecules th were eluted from DEAE-Sephadex A 50 with 0.5 ad 1.0 mol/L NaCl. The yield of fra tions of agar from the DNTE-Sephadex was increased to 80% or more after a treatme with 6.0 mol/L urea, with the recovery of agarose molecules having a low charge de sity. Analysis by ^{13}C-NMR spectroscopy showed 6-sulfate-L-galactose as a minor cons tuent in the repeat units of agarose from the main fractions of *G. asiatica, G. tenu tipitata* and *G. blodgettii*. Substitution of hydroxyl groups with methoxyl was detect by ^{13}C-NMR spectroscopy; 6-OMe-D-galactose was present as a minor sugar in agaro from *G. asiatica* and *G. tenuistipitata*, and 2-OMe-3,6-anhydro-L-galactose as a major s gar in agarose from *G. eucheumoides*. Differences were noted in the fractionation pa tern and 6-OMe-D-galactose content of the agars from *G. asiatica* collected in North a South China possibly from a combination of different biological factors. Agars fro gametophytes and tetrasporophytes of *G. asiatica* yield similar fractionation patterns DEAE-Sephadex, but the concentration of 3,6-anhydro-galactose in the latter fractio was somewhat higher than that of the former ones. ^{13}C-NMR spectroscopy was not su ficiently sensitive to detect the minor repeat units contributing to the charge density agarose molecules, but it was proved to be a rapid and simple procedure to determi the types of sugars in the principal repeat units of agarose molecules that may be of xonomic importance.

* Contribution No. 1266 from the Institute of Oceanology, Academia Sinica.

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The programs's intent is to rapidly promote advancements in processing capabilities in high temperature superconducting materials in US universities. Initiation grants of up to $50,000 will be made for periods from 6 months to 1 year. Successful completion of the initiation grant could provide a basis for a follow-on proposal. Synthesis and characterization of superconducting materials and processing for fabricating electronic devices are covered under other NSF programs. Candidate processing methods given below are only illustrative examples and not restrictive:

- production of superconducting fibers and their incorporation in a metal matrix
- deposition of thin films on a ductile matrix by various techniques such as chemical vapor deposition, sputtering,

lasar, plasma spray, etc.
- infiltration of a metal matrix throughout a porous superconducting material
- coating of superconducting materials on ductile rods, wires, etc.
- tape casting of superconductive materials into ribbons.

National Science Foundation

Division of Cellular Biosciences

Deadlines: 01-FEB
01-JUL
01-NOV

Research in this division is directored toward how plants, animals, and microorganisms grow, reproduce, and function, and how life processes are initiated, regulated, expressed, and integrated at the level of the gene, cell, and organism. Five programs are currently active:
- Cell Biology
- Cellular Physiology
- Developmental Biology
- Eukaryotic Genetics
- Regulatory Biology Program

The Divisions of Cellular Biosciences and Molecular Biosciences together award 20 postdoctoral fellowships in plant biology. Cellular Biosciences also takes part in the collaborative research at the interface of biology and chemistry.

National Science Foundation

US-China Cooperative Science Program

Deadlines: 01-NOV
01-APR

All fields of science, including social sciences, and engineering normally supported by NSF are suitable for this program. While other NSF international programs also accept proposals for joint seminars/workshops and travel, the US-China program only accepts proposals for cooperative research. Projects must clearly demonstrate benefits for both countries. Chinese collaborators in an NSF US-China Cooperative Research project must submit a parallel proposal to a counterpart Chinese institution.

Commission on the Bicentennial of the United States Constitution

Educational Grant Program

Deadline: 15-OCT-87

The Commission anticipates issuing 40-60 grants for special projects and 100-200 in-service training grants to elementary and secondary schools in the area of the principles and foundations of constitutional government. A university may apply provided the proposed project or program is designed for use in elementary and secondary schools. In 1988 the Commission emphasizes specific constitutional themes relating to the development of the three branches of the Federal Government.

American Philosophical Society

Research Grants

Deadlines: 01-DEC
01-FEB
01-APR
01-AUG
01-OCT

The Society estimates a 1:3 funding ratio for its $2,500-$3,000 grants. The intent of the Society is to contribute toward the cost of scholarly research, with the organization paying special attention to those projects most likely to promote useful knowledge by producing publications. The grants will cover most disciplines, but not journalistic or other writing for general readership; the preparation of textbooks, casebooks, anthologies, or other materials for classroom use by students; or the work of creative and performing artists. Costs covered include $30 per diem living costs away from home; microfilms, photostats, photographs necessary for research; consumable supplies at the applicant's institution; necessary foreign and domestic travel.

Fangtooth
~~Anoplogaster~~

– Karen LaMark
~~4248~~ E. Maplewood Way
Littleton CO 80121

Feb. 28, 1988

Professor Bob Behnke
Dept. of Natural Sciences
Colorado State University
Fort Collins, Colorado 805XX

Dear Bob,

Following up on our mid-January conversation on salmonid distribution in China, I am enclosing an article on what appears to be taiman fishing in the Greater Higgan Range of northwest Heliongjiang province/northeast Inner Mongolia. It's short on detail, but as informative as most articles on fishing in China.

I'm currently planning a trip into the region in late August/early September and hope to obtain a better understanding of the fishery. I'll let you know my findings.

Jim Hanley
Hewlett-Packard Asia
Hong Kong

P.S. I'm working on getting that Japanese article translated. Will send you a copy when available.

Japanese anglers [illegible]

tourist brochure
Fishing for Magic fish
deep in the mountain
by Xiong Yang

with tour groups
→ Jeeps
– guides

stayed at hotels

Amur pike Ezer Neidorf

lenok Brachymystax lenok

Zhang R. N.E. Heilogjiang near Soviet border

Higgan Mtns.

Duobukur R

'zheluo' – Hucho taimen

哲罗 鮰

Frontiers

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P.O. BOX 161
PEARCE MILL ROAD
WEXFORD, PA 15090

February 26, 1988

Dr. Robert Behnke
Colorado State University
Department of Fisheries
Fort Collins, CO 80525

Dear Dr. Behnke:

Earl Worsham, Chairman of the International Committee of Trout Unlimited, requested that I send the enclosed slides to you. These were taken last August by Chris Child, who went on an exploratory venture in China.

Earl felt that you could confirm identification of the trout (I also sent a slide of a pike, which seems to have quite distinctive markings compared to our North American pike).

These fish were taken in the Zhang River in the northeastern Heiloongjiang province bordering Russia.

We would be very grateful for any information that you can provide to us. As you may know, we are working with Trout Unlimited, trying to develop a viable fishing program in the USSR and are looking at the possibility of a similar exercise in China if we can find reliable fishing.

Would you be kind enough to return the slides to me as soon as you are through with them. I look forward to hearing from you and thank you in advance for any information you may be able to provide.

Sincerely,

Mike Fitzgerald

W. Michael Fitzgerald
President

js
enclosures

cc: Mr. Earl Worsham

INTERNATIONAL SPORTSMEN'S EXPOSITIONS

March 30, 1988

Mr. Robert Behnke
COLORADO STATE UNIVERSITY
Department of Fishery & Wildlife
Fort Collins, CO 80523

Dear Bob:

Sorry I haven't been in touch. Last June my wife became seriously ill, which led to a liver transplant at Baylor University in Dallas.

Needless to say, my fishing trips and plans for China were put aside. However, I did have the papers you gave me translated, as you will see. Parts were missing, but I'm sending everything that I have.

In a year or so, if everything goes well, I will pursue my desire to make an extended exploration of the fishing possibilities in China.

I will keep in touch, certainly, as plans develop. Hope things are going well with you, and I'm looking forward to visiting with you again.

Best personal regards,

Ed

Ed Rice
President

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[1988]

Chinese Journal of Genetics
Volume 15, No. 2

Analysis of High-Resolution G-Banding Pattern in Fish Chromosomes Treated with BUDR

Liu Ling-yun

(Department of Biology, Beijing Normal University, Beijing)

The chromosome high-resolution G-banding technique was applied to the study and analysis of the high-resolution G-banding pattern in fish, especially in Monopterus albus chromosomes treated with BUDR. A comparision of the high-resolution G-banded karyotype of full-metaphase chromosomes with that of chromosomes of different length showed that band numbers increased with an increase in chromosome length. However, not all of the chromosome bands experienced such an obvious increase. The band numbers of each chromosome appeared definite. The increase of chromosome band numbers in our experiment showed apparent subdivisions of dark bands. When the chromosomes gradually contracted and shortened from prophase to metaphase, these sub-bands also fused into original bands. The degree and time of contraction for each band in one chromosome were not equal. A large dosage of BUDR not only blocked the fish cell cycle in the middle of the S phase, but also caused the chromosomes to elongate; a small dosage had no apparent effect.

Key words: Fish; chromosome; G-band

Following the development of fish cytogenetics, the G-banding technique (especially high-resolution G-banding technique) has played an important role in research into aspects of fish heredity, variation, systematics and evolution, as well as gene mapping. Since fish chromosomes are rather small, it is rather difficult to identify G-bands. Therefore we first developed a technique to elongate fish chromosomes using high-resolution G-banding (Liu, 1986). In this paper we utilized the technique to analyze and study identified high-resolution G-bands with the chromosomes in M. albus as major material treated with 5-bromodeoxyuridine (BUDR).

MATERIALS AND METHODS

Experimental fish were obtained from markets in Fuzhou and Beijing. Sixteen samples of M. albus and six Ctenopharygodon idellus samples were used for this study. Fish blood lymphocytes were cultured using the conventional method as follows: 1) the method of preparing high-resolution chromosomes was the same as that used in our previous research (Liu, 1986); 2) in order to determine the effect of the dosage on fish chromosomes, we added different dosages of BUDR (10 μg/ml), 50-100 μg/ml) to cultures and cultured them for two cell cycles before harvesting the cells. The SCDs were identified in the air-dried chromosomes using a modified FPG method (Liu, 1984).

RESULTS

Many elongated chromosomes with high-resolution G-bands were observed in cells treated with BUDR (Plate I, 1-6; Plate II, A-B). However, not all full-metaphase mitotic figures possessed elongated chromosomes. Although all mitotic figures were of full-metaphase chromosomes, different contractional states were observed in these chromosomes (Plate I, 1-3). Most late-metaphase chromosomes contracted but still showed clear G-bands.

Full-metaphase mitotic figures with chromosomes of different lengths were made into G-banded karyotypes and compared; it was found that chromosomes of different lengths had different numbers of bands. As chromosome length increased, band numbers also increased. As shown in Plate II, A, from three full-metaphase mitotic figures with chromosomes of different lengths (of which the G-band numbers in each pair of elongated chromosomes nearly exceeded that of the shortened chromosomes), the bands of early-metaphase chromosomes showed a more obvious increase. In the same mitotic figure, however, not all of the chromosome bands showed such an obvious increase; although some chromosomes of elongated early-metaphase were longer than that of the full-metaphase, the band numbers, such as in chromosome pairs No.4 and No.6 (Plate II,B), did not increase. The band numbers of each chromosome in mitotic phase in M.albus appeared definite. Therefore, when chromosomes became too elongated, the bands were not as clear as those of full-metaphase chromosomes.

An increase in the number of chromosome bands treated with BUDR clearly showed the subdivision of dark bands. Although some light bands of chromosomes divided into sub-bands, such as chromosome pair Nos. 2, 3, 8 (Plate II, A), one light band became subdivided into three sub-bands. Dark bands of chromosomes were also observed to subdivide into sub-bands. For example, one dark band in the shortened chromosome subdivided into 3, 5 or 7 sub-bands in the elongated chromosomes (Plate II, A, chromosome pair Nos. 1, 2, 4, 5 and X chromosome; and Plate II, B). The subdivided degree of dark band in the centromeric region was also different. During mitosis from prophase to metaphase, chromosomes became shorter; these sub-bands fused into the original number of dark bands. The degree and time of contraction of each band of one chromosome were uneven (Plate II, A, chromosome pair Nos. 1-5). The middle dark bands and the distal end of the centromere contracted more and earlier than that of the other bands.

Results showed that, after large dosage treatment through two cell cycles, two strands of DNA double helix substituted by BUDR ("BB" chromatids) become longer than that of one strand of DNA double helix substituted by BUDR ("TB" chromatids). This caused the chromosomes to arc (Plate I,4); for small dosage treatment (Plate I,5), such phenomenon was not observed. In shortened late-metaphase chromosomes it was evident that the "BB" chromatids were longer than the "TB" chromatids (Plate I,6).

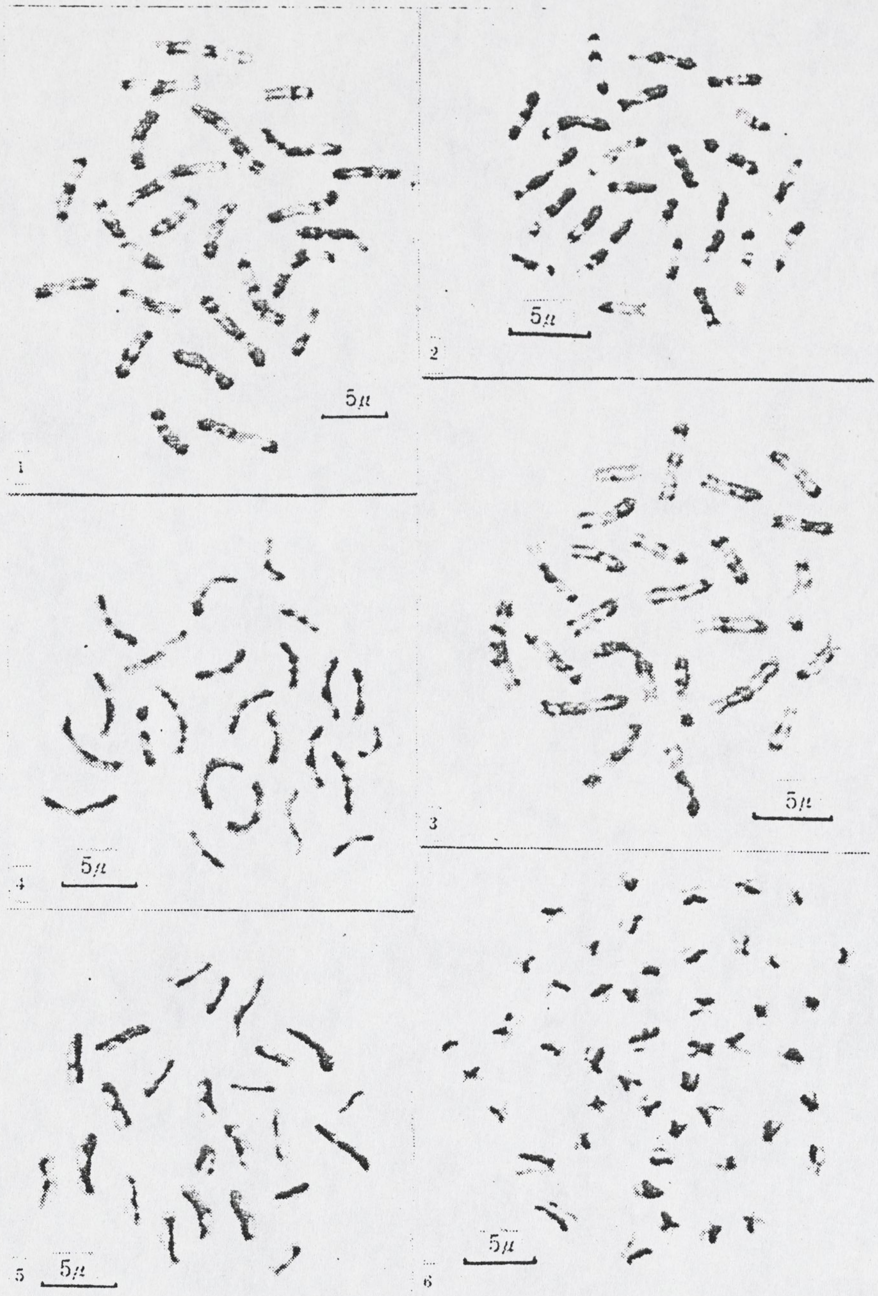

PLATE 1. Liu Lingyun: Analysis of High-resolution G-banding Pattern in Fish Chromosomes Treated with BUDR
Mitotic figures of cultured blood lymphocytes in Monopterus albus (1-5) and kidney cells in Ctenopharyngodon idellus (6)
1) Metaphase chromosomes with high-resolution G-bands;
2,3) Metaphase chromosomes with G-bands in different contractive degrees;
4) "BB" chromatids treated with large dosages of BUDR show obvious elongation;
5) "BB" chromatids treated with small dosages of BUDR do not show obvious elongation;
6) Shortened late-metaphase chromosomes; "BB" chromatids are longer than "TB" chromatids.

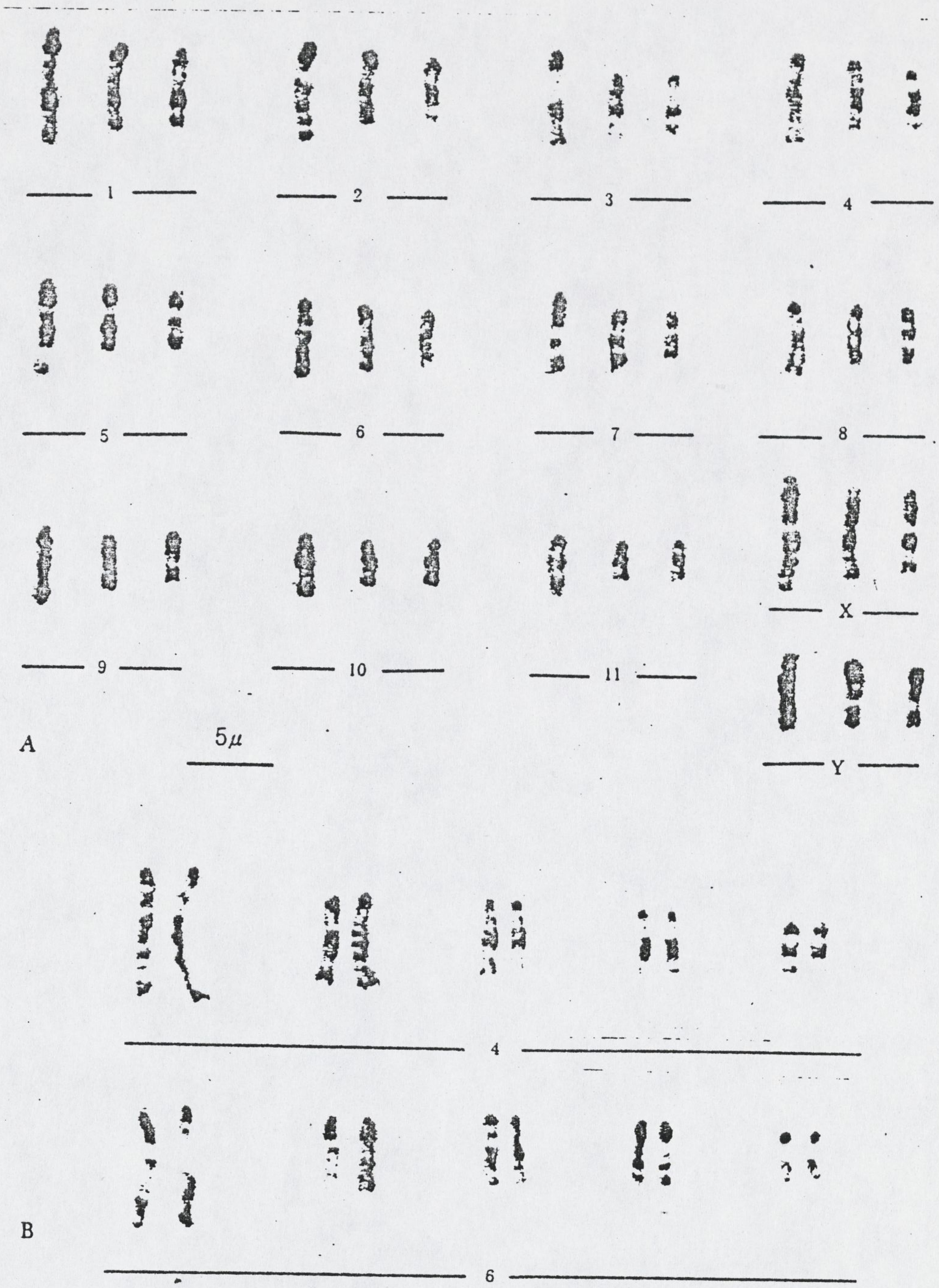

PLATE 2. Liu Ling-yun: Analysis of High-resolution G-banding Pattern in Fish Chromosomes Treated with BUDR
A) Comparison of G-band karyotypes from three mitotic figures of different length chromosomes in the cultured blood lymphocytes of M.albus. The chromosomes of each No. from left (high-resolution) to right became gradually shortened (Tentatively named XY); B) Chromosome Nos. 4 and 6 of five mitotic figures from left to right elongated early-metaphase, elongated full-metaphase and shortened full-metaphase chromosomes.

DISCUSSION

1. Relationship between BUDR treatment and G-banding

It is known that during the S phase of a cell cycle, BUDR is incorporated into chromosomal DNA substitute thymine(T) and combines with adenine(A). At different times of BUDR incorporation, G-bands, R-bands or BG-bands can be observed. It had been proved experimentally that chromosomal DNA has a clear sequence of replication (Adegoke and Taylor, 1977; Braun and Wili, 1969;Cawood, 1981; Dutrillaux et al., 1976; Taylor, 1960), and that each band of each chromosome may have its own replication time (Dutrillaux et al., 1976). In general, the pale (light) G-bands replicate before dark G-bands (Cawood, 1981; Calderom et al., 1973; Dutrillaux et al., 1976; Ganner et al., 1971). When BU is incorporated into early S phase, it forms light G-bands and is then eliminated. In normal culturing during the late S phase, the dark G-bands become replicated and G-banding is thus obtained. If BUDR is incorporated into late S phase, R-banding is obtained. By incorporating two cell cycles, BG-banding is obtained. Dutrillaux et al. (1981) found that BUDR at a final dose of 200 μg/ml appears to block the cell cycle at the middle of the S phase, resulting in high-resolution G-banding. In fish chromosomes, a final BUDR concentration of 50-100 μg/ml, may block the cycle; even a concentration of 30 μg/ml can trigger the block function. The mechanism of BUDR block is still unknown, but it is assumed to be similar to the mechanism of thymidine block in that it inhibits the synthesis of deoxycytidine (Dutrillaux and Viegas-Pequignot, 1981). The results of this study using BUDR are identical to results obtained with the previous trypsin method of revealing G-bands (Liu, 1983) and confirms that the results of this study were high-resolution G-banding.

2. On the relative constancy of chromosome band numbers

It can be seen from the results that, under the same experimental conditions and with the same BUDR treatment, chromosomes with different lengths and different number of bands were obtained. With increased chromosome length, the band numbers also increased, and each had its own characteristics. This indicated that chromosomes undergo dynamic and regular change and that the bands of chromosomes are relatively constant and exist naturally. When the chromosomes became contracted, the bands fused and therefore decreased in number. When the chromosomes became elongated, the intrinsic bands were revealed. Findings from chromosome scanning electronmicroscopy are similar to our conclusions (to be published in a separate paper). As observed under a scanning microscope, the chromosomes without banding treatment had many regular bands appearing along chromosomal long axes in a perpendicular direction; these bands were made of chromatin fiber and were coiled and folded in different degrees of density. The bands in which the chromatin fiber was closely coiled appeared to be the dark G-band position of chromosomes. This is consistent with the views of other scholars (Comings, 1976, 1978; Jhanwar and Chaganti, 1981; Okada and Comings, 1974) who proposed that dark G-bands of somatic chromosomes corresponded to the pachytene chromomeres of meiosis. The chromosome band numbers are relatively constant. It appears that relative constancy is not only related to the advanced organization of chromosomes, but may also be related to the composition and arrangement of base pairs of chromosomal DNA.

It was found that the A-T base pairs are distributed along the whole length of chromosomal DNA; the dark G-bands were rich in A-T and the light G-bands rich in G-C (Yunis et al., 1977). Zakharov et al. (1974) considered that the BUDR might cause elongation of late-replicated chromosome segments. In fish chromosomes, after BUDR treatment, one of the dark G-bands can become subdivided into 3, 5 or 7 sub-bands. It appeared that the light G-bands formed after subdivision were the early-replicated sub-bands. In the sub-bands the BUDR replaced T. With large dosages of BUDR, full replacement replication, and therefore chromosomal elongation is possible. An increase in chromosome band numbers is related to band subdivision. In fish chromosomes with BUDR treatment chromosomal dark G-bands became divided into sub-bands more than that of light G-band subdivision.

3. Chromosomal elongation and shortening

Based on ISCN in human high-resolution G-bands from prophase to metaphase, it had been assumed that all chromosomal regions contract equally and simultaneously (ISCN, 1981). In our study of fish chromosomes, the contraction of each band of one chromosome was unequal and did not occur simultaneously. When chromosomes contracted and shortened, the subdivided sub-bands of the original dark band contracted experienced much more contraction; light band contraction was uneven.

For fish chromosomes, it was found that incorporation of large dosages of BUDR could block the cell cycle at the middle of the S phase and could cause the chromosomes to elongate. It appears that chromosome elongation is not the same as inhibited contraction. With BUDR-treated late-metaphase chromosomes, most chromosomes became shortened; this showed treatment did not inhibit contraction. This case differs from our study using MTX-treated fish chromosomes (1986). With MTX-treated chromosomes, most late-, full- and even early-metaphase chromosomes were almost the same length. It may be said that MTX played a role in the inhibited contraction of the chromosomes. Since the 1960s, with BUDR-treated chromosomes, scholars have noted that BUDR may cause chromosomes to elongate (Hsu et al., 1961; Palmer et al., 1965; Zakharov et al., 1972). We investigated the possibility that BUDR's ability to facilitate elongation is related to dosage size. With large and small dosages of BUDR and incorporation of cells after two cell cycles, it may be seen that the SCD chromosomes incorporated with large dosage of BUDR, "BB" chromatids and "TB" chromatids cause chromosomes to arc. This phenomenon was not evident for chromosomes treated with small dosages. This showed the BUDR in large dosages may fully substitute the T of DNA base pairs and make the chromatids longer than that of one strand incorporated. BUDR or 5-bromouracil (BU) are the analogues of thymidine (TdR) or thymine (T). In DNA, BU differs from T in that the 5 site C of BU combine with Br, and 5 site C of T combine with CH_3. In general, BUDR's elongation function relates to interference in the tertiary structure of DNA (Hsu et al., 1961; Palmer et al., 1965; Yunis et al., 1977; Zakharov et al., 1972) and appears also to relate to the function of 5-bromouracil in the DNA molecule.

ACKNOWLEDGEMENTS

This project was supported by the National Natural Science Foundation of China.

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[1988]

Chinese Journal of Genetics
Volume 15, No. 3

Studies on Chromosome Ultrastructure in Several Animal Species*

Fei Qing and Liu Ling-yun**

(Department of Biology, Beijing Normal University)

The metaphase chromosomes prepared by a surface-spreading technique and critical point drying method in mammalian and fish cells were observed with SEM. The chromosome bands were observed without treatment of G-banding. The stereographical examination revealed that chromosomes were composed of chromatin fibers with diameter of about 300 Å. Two chromatin fibers arranged parallel to the axis of the chromatid stretched into the chromosome arm.

Key words: Mammalian cell; Fish cell; Chromosome; Ultrastructure

Many studies on the chromosome ultrastructure using transmission electron microscopy were performed in the 1950s (Ris, 1956; Dass and Ris, 1958; Nebel, 1959). At that time, due to the limitations in the technique of ultrathin sectioning and the electron microscope (EM) itself, these studies were limited to the diameters of chromatin fibers and the electron densities at different parts of the chromosome body. The chromosomes prepared by an ordinary air-drying technique were first examined with scanning electron microscopy in 1967 (Christenhuss et al.; Neurath et al.). They seemed to be covered with membrane and concavity was observed in the centromere regions; the structure of the chromosome was obscure. To peel off the membrane, the chromosome were treated with trypsin and the bands were observed. In 1970, the spiral structure of chromosomes and the chromatin fibers extending from them were observed by scanning electron microscopy combined with transmission replica method (Tanaka, 1970).

Golomb and Bahr (1971) first used the surface-spreading technique and the critical point drying method to prepare human chromosomes under scanning electron microscope (SEM) and observed the twisted looping fibers of chromosomes, but the ultrastructure of chromosomes was still obscure. Since then, scientists have used different procedures, such as the surface-spreading technique, the isolation and fixation method (Dascal, 1979), the whole mount technique (Rattner and Uamkalo, 1978) and the frozen-resin cracking method (Tanaka and Iino, 1973) to prepare the specimen. Using the

*The subject was supported by the National Natural Science Foundation of China.
**Now a Researcher of Cancer Institute, Chinese Academy of Medical Science.

surface-spreading technique and a high resolution SEM, the appearance and features of chromosomes which are composed of nodular twisted looping fibers (about 300 Å in diameter) have been clearly observed (Utsumi, 1981;1982).

Although many investigations have been conducted abroad on chromosomes with EM, only a few discernible photographs were obtained. This was due to the difficulty in preparing the specimen. At home, although a few studies were done on chromosomes examined by EM (Zhao et al.,1980; Zhou et al.,1983), details of chromosomes composed of chromatin fibers (about 300 Å in diameter) were not identified. To date, the problem of chromosome advanced ultrastructure remains unsolved; it is not yet known how the chromatin fibers of 300 Å fold and twist to form chromosomes and what is the structure of the centromere, secondary constriction and banding.

Generally, human and mammalian chromosomes are widely used in studies on chromosome ultrastructure by SEM, but until now, fish chromosomes have not been studied. This paper deals with SEM observation of chromosome ultrastructure in CHO, IB-RS-2 cell lines and fish cells, and in particular, the ultrastructure of fish chromosomes.

MATERIALS AND METHODS

1. Materials

CHO and IB-RS-2 cell lines, the kidney cells of *Carassius auratus* and the lymphocytes of *Monopterus albus* were used in our experiments.

2. Methods

1) Cell culture in vitro: The kidney cells of *Carassius curatus* and lymphocytes of *Monopterus albus* were cultured mainly by the routine culture method of our laboratory (Liu, 1980;1981).

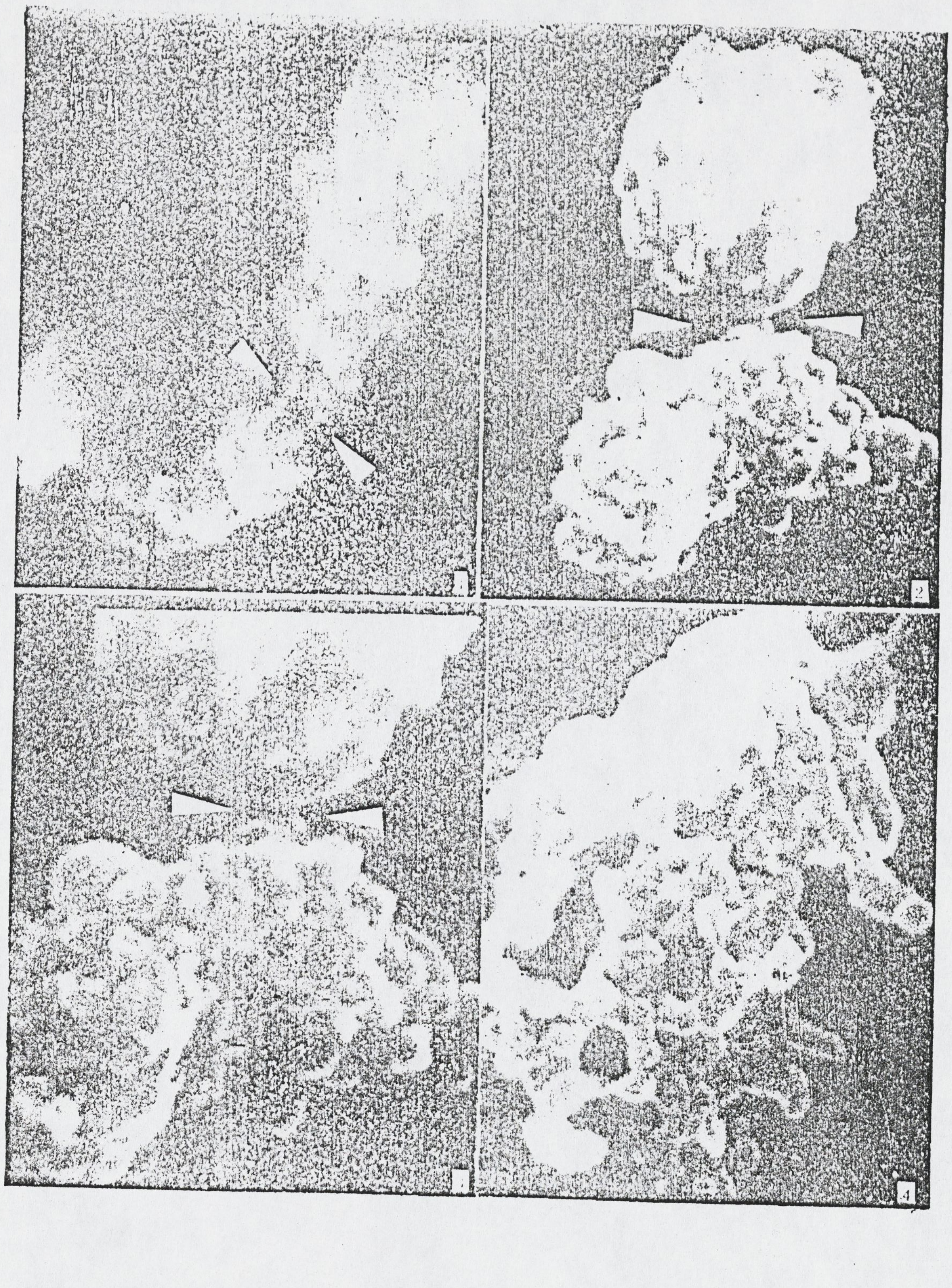
2) Chromosome preparation: On the basis of the methods developed by Gall (1966), Kleinschmidt (1968), Golomb and Bahr (1971) and Utsumi (1982), some modifications have been incorporated into our experiments.

a) Surface-spreading technique and critical point method: The cultured cells were centrifuged at 1000 rpm for 10 min then resuspended in a small amount of Hank's buffered saline solution. A tiny amount of this cell suspension was placed upside-down on a piece of Formvar-coated glass, touching the convex surface of water in a trough filled to the

PLATE 1 Fei Qing et al.: Studies on Chromosome Ultrastructure in Several Animal Species
1) The chromosome of CHO cell line prepared with culture in situ surface-spreading technique and critical point method; without treatment of G-banding, the chromosome bands are observed. In the centromere region, two chromatin fibers, parallel to the axis of the chromatid, stretch into the chromosomes arms. Arrowheads indicate the centromere (× 11,000); 2-4) The chromosome of the IB-RS-2 cell line, prepared with the surface-spreading technique and critical point drying method: 2) The twisted looping fibers are arranged orderly throughout the entire chromosome body. Arrowheads indicate the centromere region (× 15,000); 3) At the centromere region, two chromatin fibers are arranged parallel to the axis of the chromatid and stretch into the chromosome arms; in the relatively loose parts, the chromatin fibers resemble radial loops. Arrowheads indicate the centromere region (× 23,000); 4) A portion of the chromosome; twisted looping fibers spread from the chromosome body at random (× 25,000).

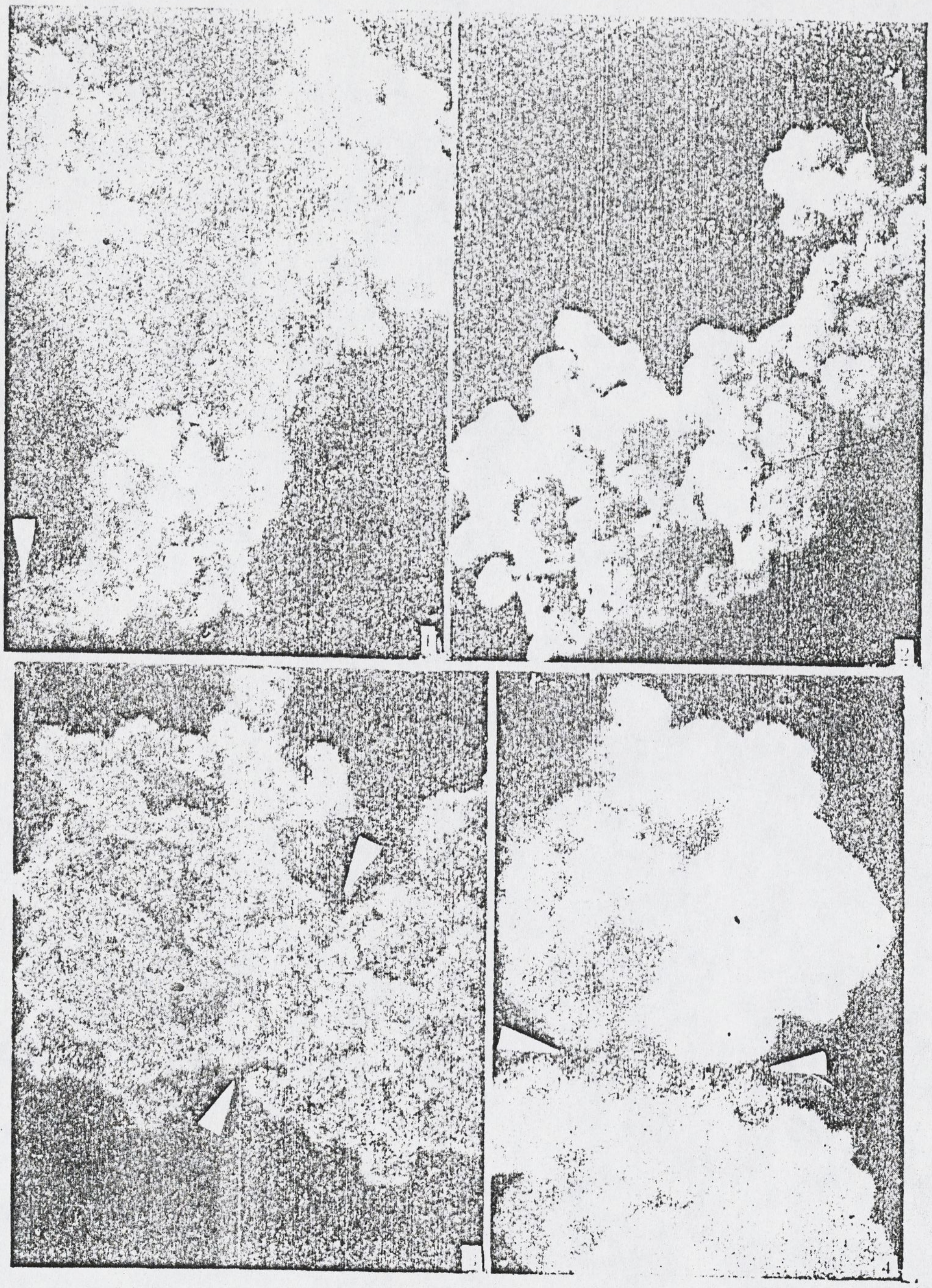
Fei Qing et al.: Studies on Chromosome Ultrastructure in Several Animal Species

Plate I



Fei Qing et al.: Studies on Chromosome Ultrastructure in Several Animal Species

Plate II



brim with distilled-deionized water. The surface tension of the water ruptured the cells, releasing the nuclei and chromosomes. The wet specimens were quickly submerged in 30% ethanol and dehydrated in ascending concentrations of ethanol (50%,70%,90% and absolute ethanol). The specimens were then put through isoamyl acetate and critical point-dried with vaporizing liquid carbon dioxide.

b) Culture in situ surface-spreading technique and critical point method: The sterilized micropieces of glass (9 mm^2) were made from cover glass and placed in a culture bottle. After generation, the cells grew on the micropieces of glass and became cultured in situ. These cells were prepared into chromosomes with the surface-spreading technique.

At the same time, chromosome preparations were made by the ordinary air-drying method in an effort to compare this method with those mentioned above.

c) Sputter-coating: The specimens were sputter-coated with gold in an ion-coater (Eiko, Engineering, IB-3); the coating was made at 2 mA for 3.5 min.

3) Scanning electron microscopy: SEM examinations of surface-spreading chromosomes of CHO, IB-RS-2 *Carassius auratus* and *Monopterus albus* were made with an Hitachi Scanning electron microscope, X-650. High resolution examination of surface-spreading chromosomes of CHO which was cultured in situ were made with a Coates Welter field emission type SEM, HPS-5OB.

RESULTS

The chromosomes of four animal species were observed clearly with SEM and FESEM. The separation between two chromatids and the centromere region were discernible (Plate I, 1,2,3 and Plate II,1,4). As shown in Plate I,1,2, the chromosomes were composed of twisted looping fibers. The chromosome bands were observed without treatment of G-banding, but the chromosome membrane was not observed.

In the centromere region the chromatin fibers were distinguishable. Two chromatin fibers which passed through the centromere were parallel to the axis of the chromatid and stretched into the chromosome arms.

For different degrees of the chromosome spread, the spreading states of chromatin fibers were not the same. Chromosomes that showed some spreading possessed bands composed of different spreading chromatin fibers that were orderly arranged (Plate I,1). In regions of densely coiled chromatin fibers, the fibers formed rather wide and convex bands. In regions of sparse, rarely coiled chromatin fibers, the fibers were rather narrow,

PLATE 2 Fei Qing et al.: Studies on Chromosome Ultrastructure in Several Animal Species

1-3) The chromosome of the kidney cell of *Monopterus albus* prepared with surface-spreading technique and critical point drying method.

1) The telo-centromere and the separation between the chromatids are discernible. Arrowhead indicates the centromere region, (× 26,000); 2) A centromere region between two separated chromatids and twisted looping fibers are present. Arrowheads indicate the centromere region (× 32,000); 3) Twisted looping fibers are clearly observed (× 33,000); 4) The chromosome of the lymphocyte of *Carassius auratus*, prepared with the air-drying method. Two chromatin fibers can be seen between the arms parallel to the axis of the chromatids. Arrowheads indicate the centromere region (× 26,000).

undulating bands, and were present among wide bands. In areas of minimal chromosome spreading, the band structure was present and symmetrical in the two chromatids.

For chromatin fibers in the looser state (Plate I,2,3), the twisted looping fibers were arranged in an orderly fashion throughout the entire chromosome body. Relatively loosely arranged parts in the chromatin fibers forming a structure that resembled a "radial loop" could be seen. In the relatively dense regions, band traces may be present.

At the chromatin fibers in full spreading state (Plate I,4 and Plate II, 2,3), chromatin fibers were in a nodular twisted loop form.

The diameters of chromatin fibers were measured on highly extended chromosomes. The diameter of IB-RS-2 cell chromatin fibers were 300-400 Å and the *M. albus* fibers were 300-350 Å. Thus, the diameters of these two species were nearly identical.

From these results, the ultrastructure of fish chromosomes, such as the diameters of fibers, the state of twisted fibers and the centromere region were similar to that of CHO and IB-RS-2 cells. However, the coiled arrangement of chromatin fibers in *M. albus* was looser than those in CHO and IB-RS-2 cells, and appears to have the feature of radial loops. Since it has a looser structure, the bands did not show as clearly as those of CHO and IB-RS-2 cells prepared by the same method.

DISCUSSION

Scanning electron microscopes (SEM) has been applied in chromosome studies for 20 years. SEM possesses advantages over the transmission electron microscope (TEM) for chromosome study; SEM can be used to identify details of unstretched chromosomes in thin-sections that are sometimes too dense to be detected using TEM, or stretched chromosomes that are too loose to allow TEM observation of the entire fine structure. Also, TEM examination lacks stereoscopic imaging. In its early stage, however, SEM did not have these advantages. Although SEM resolution was much higher than light microscopy, more information about chromosome structure still could not be obtained using SEM studies because specimen preparation had not yet developed to SEM standards. In order to clearly determine chromosome ultrastructure, it is necessary to select and explore suitable methods for preparing chromosome specimens, identifying details of chromosome structure, and maintaining the original morphological character.

Using SEM, the chromosomes of CHO and IB-RS-2 cells appeared in different degrees so that the bands were composed of coiling and folding chromatin fibers. As to the ultrastructure of chromosome banding, Gormely and Ross (1973) first reported on the G-banding of human chromosomes treated with hot salt and examined with SEM. The G-banding of Giemsa stains observed under LM was thought to result from the over-absorption of stain by the chromosome ridges. This viewpoint was later supported by several investigations (Burkholoder and Duczek, 1980; Swenoy, 1978). Furthermore, human chromosome G-bands were compared under LM and SEM (Harrison, 1981;1983); the G-bands revealed in chromosomes were thought to resemble the chromosome structure of both the folded-fiber model (DuPraw, 1965) and radial loop model (Marsden and Laemmili, 1979). Our experiment was different and had no treatment with G-banding; the appearance of the bands of chromatin fibers was better defined than that with G-banding treatment in terms of twisting, folding and density striations. Our results were consistent with those obtained by the fixation method and details of chromosome structure were clearer, truer, more discernible and more stereoscopic than those observed by TEM.

In the centromere region of human chromosomes, bundles of chromatin fibers appeared and were parallel to the axis of the chromatid (Utsumi, 1982). In our experiment, the chromatin fibers were distinguishable in the centromere region and two chromatin fibers passing through the centromere were arranged parallel to the axis of the chromatid and stretched into the chromosome arms. This result may reflect a difference between human and animal chromosomes and supports the unineme hypothesis of chromosome structure.

The chromosomes are composed of nodular, twisted looping fibers. A looping fiber is actually a continuous fiber from the chromosome body, returning to itself. This result agrees with the findings of Utsumi (1981;1982), and Takayama (1985). Similar looping fibers were also seen in the thin-sections of TEM (Angelier et al.,1984). In our examination, the chromatin fibers of IB-RS-2 and *M. albus* were also similar to those in good spreading condition. The nodular state of chromatin fibers was possibly due to chromosome treatment which caused the chromatin fibers to recontract by dehydration after water-surface spreading.

The diameter of the chromatin fibers (about 300 Å in our study) was consistent with results of others. Rattner and Hamkalo (1978, a,b) used the method developed by Miller to prepare chromosome specimens and reported that chromatin fibers of 200-300 Å in diameter were composed of a series of nucleosomes. This confirms Finch and Klug's (1976) claim that the fibers of 300 Å diameter are composed of chromatin filament of 110 Å diameter by spiralization. It has generally been recognized that the chromosome is composed of 300 Å fibers. But how these chromatin fibers condense to form metaphase chromosomes still remains to be studied.

By observing the ultrastructure of mammalian and fish chromosomes, it was found that the diameter of fish chromatin fibers was identical with that of mammalian chromatin fibers, and the coiled arrangement of fish chromatin fibers was looser than that for mammalian fibers. This may indicate that chromosome bodies in different animal groups have a different advanced structure.

According to his study of chromosomes with EM, Marsden and Laemmili (1979) once proposed the "radial loop model." The twisted looping chromatin fibers observed in our experiment appear to be similar to this "radial loop" structure. On the question of chromosome bands, our experiments also indicated that the band structure exists in the chromosome body. Although it was evident that the metaphase chromosomes were composed of chromatin fibers, the problems of the details of constructing the higher-order structure of chromosomes and of the relation between its structure and banding remains to be studied further.

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鱼类染色体高分辨G-带的特征及黄鳝染色体高分辨G-带带型的研究†

刘凌云　费　青*　刘　彦

（生　物　系）

摘　要

结合染色体带纹及超微结构分析了鱼类染色体高分辨G-带特征，做出了黄鳝染色体高分辨G-带核型并对其进行了分析．

关键词　鱼，染色体，G-带．

鱼类染色体一般很小，进行G-带研究难度较大，而G-带能区分染色体组中每条染色体，便于同源染色体的识别配对，它对深入研究鱼类的遗传变异、分类进化、杂交育种、以及探索染色体的超微结构、基因定位和遗传工程等都有重要意义．为此我们曾首次发展了使鱼类染色体伸长高分辨G-显带的技术[1]，本工作在此基础上应用这一技术又进一步分析了鱼类染色体高分辨G-带的特征，做出了黄鳝染色体高分辨G-带带型．

1　材料和方法

实验用的黄鳝（*Monopterus albus*）购自福州菜市场，10尾，鲇鱼（Silurus asotus或Parasilurus asotus）购自北京北太平庄农贸市场（采自沙河），4尾．实验方法按〔1〕的方法(3)，(4)，即BrdU-AMD法、BrdU法及AMD法，后者AMD为1～2μg/mL在收细胞前2.5～4 h加入培养基中．其他玻片标本处理方法与过去工作相同．扫描电镜染色体标本制备与观察另文发表于遗传学报．

2　结果和讨论

2.1　鱼类染色体高分辨G-带的特征

以上3种方法都能使鱼类染色体伸长，获得大量晚前期、伸长的早中期和伸长的正中期染色体，在伸长的染色体上一般都显示出较清晰的G-带带纹（图版Ⅰ，图1～4）．从本实验以及我们以前的工作，可以看出鱼类染色体高分辨带有其一定特征：

伸长的正中期染色体与早中期的几乎等长，且带纹较早中期的清楚，带纹数目也大体一致或极为相似（图版Ⅰ，图1～3），这可能与鱼类染色体本身结构有关．人类染色体G-带单倍染色体组的带纹数目，过去在正中期染色体一般可看到320～554条带，经高分辨

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* 现在中国医学科学院肿瘤研究所工作．

G-带方法处理，在早中期染色体组可观察到高达842条带，在晚前期可达1 256条带[2]，在中前期可达2 000条带[3]．而鱼类染色体带纹再分的限度比人类染色体者小得多．随着染色体的伸长，有些染色体带纹数目随之增加，但是看来增加是有限度的，有些染色体（如第4对）虽然伸长了（如早中期的），可是带纹数目未见增加（图版Ⅱ，图2）．从染色体的扫描电镜工作来看（图版Ⅱ，图3），鱼类的染色体与哺乳动物的相比，同样条件处理，哺乳动物染色体可看到丰富的缠绕折叠的染色质纤维，而鱼类的染色质纤维则缠绕得较为松散．按单系学说，1条染色体的染色质纤维，鱼的远比哺乳动物的短，所以鱼的染色体再伸长，带纹反不及正中期的清楚．

晚中期染色体，由于处理的药物不同，浓缩的情况也不同．用MTX或AMD处理的晚中期染色体几乎不缩短，而用BrdU处理的不缩短的很少．但即使染色体缩短了，带纹仍清晰可见（图版Ⅰ，图5,6）．

不同的药物处理，虽然染色体的主要带纹是一致的，但染色体显带又各有其特点，BrdU处理的染色体深染带再分的较为明显，1条深染带再分为3条、5条、7条，甚至多达9条（图版Ⅱ，图2），而AMD处理的深染带的再分不如BrdU处理的那样明显，似乎浅染带伸长较多（图版Ⅰ，图2）．这可能与不同药物与DNA作用的机理不同有关．BrdU取代A-T碱基对中的T与A结合，而AMD主要与G-C碱基对中的G-结合形成AMD-DNA复合物．

2.2　黄鳝染色体高分辨G-带带型分析

高分辨G-带染色体更便于同源染色体配对．我们以黄鳝（福州产）染色体为重点，测量了10个染色体形态及带纹清晰、分散良好的分裂相，做出了高分辨G-带核型（图版Ⅱ，图1右）．黄鳝染色体2n＝24，全为端部着丝点染色体，着丝点一般为深染带，这与过去的工作是一致的[4~7]．染色体相对长度及带纹数目见附表．单倍染色体组带纹数目为132～162条．按162条计，为取自正中期（接近早中期）分裂相胰酶G-带[7]数目的1.59～1.93倍，为BrdU所做一般G-带带纹数目的1.88～2.49倍，实际上，染色体的带纹数目并不是绝对的，因为染色体是处在动态变化中，在染色体一定长度时，有大体一致的数目，但随着染色体伸长或缩短以及带纹复制时间差异，染色体带纹的数目也会增加或减少．

在12对染色体中，仍可见第1对、第4对、“X”染色体具有较明显的特征，其带纹数目较胰酶G-带[7]及BrdU G-带带纹增多了，如第4对染色体在胰酶G-带早中期为9条带，正中期为5～7条带，BrdU G-带（短的正中期染色体）为5条带（图版Ⅱ，图2），而在高分辨G-带则为13～15条带．带纹数目增多主要是中间的深染带再分的结果，且再分后的各带的大小较为均匀．

将12对染色体排队后，仍有1对异型染色体（暂定为XY），其带纹数目和特征与胰酶法早中期染色体基本一致，为BrdU G-带（缩短染色体正中期）9条带的1.67倍．至于暂定的XY这对异型染色体，是性染色体还是多态性或其他[8]有待进一步研究．

在同源染色体间带纹相同或极为相似，有的有些差异，如在第1,5对染色体(图版Ⅱ，图1右)．但在不同细胞间同源染色体带纹的差异表现不一致，有的表现在这对同源染色体，有的表现在另一对同源染色体，并不固定在某对同源染色体或固定在某一带纹上，这说明它们不是结构的多态性．染色体是一个动态结构，随着从前期向中后期过渡，染色体

附表　黄鳝染色体相对长度及高分辨G-带

染色体编号	相对长度		带纹数	
	$\overline{X}\pm SD$	P	深染带	浅染带
1	10.78±0.55		8～10	7～9
2	9.42±0.54	<0.01	8～9	7～8
3	9.04±0.31	>0.05	7～8	6～7
4	8.63±0.23	<0.01	7～8	6～7
5	8.42±0.27	>0.05	6～7	5～6
6	7.96±0.38	<0.01	6～7	5～6
7	7.42±0.23	<0.01	5～7	4～6
8	7.10±0.35	<0.05	5～6	4～5
9	7.01±0.18	>0.05	4～6	3～5
10	6.28±0.29	<0.01	4～5	3～4
11	5.57±0.75	<0.01	4～5	3～4
X	11.57±0.66	<0.001	8～9	7～8
Y	7.87±1.62	<0.001	5～6	4～5

X,Y为暂定.带纹数包括着丝点带，深染带着色深浅有差异.

逐渐缩短，带纹数目也发生变化，在此变化过程中，同源染色体一般是同步的，但在染色体各个节段带纹变化也不会完全一致．有学者[9]认为经BrdU处理的染色体，在同源染色体间带纹是会有差异的，并认为带纹的存在或不存在是重要的，而且根据带纹的存在与否以差异指数(DI)来表示．看来，某带纹的显现与否及其大小深浅虽与染色技术条件不无关系，但更重要的可能与同源染色体带复制开始或复制速率不完全同步密切有关．

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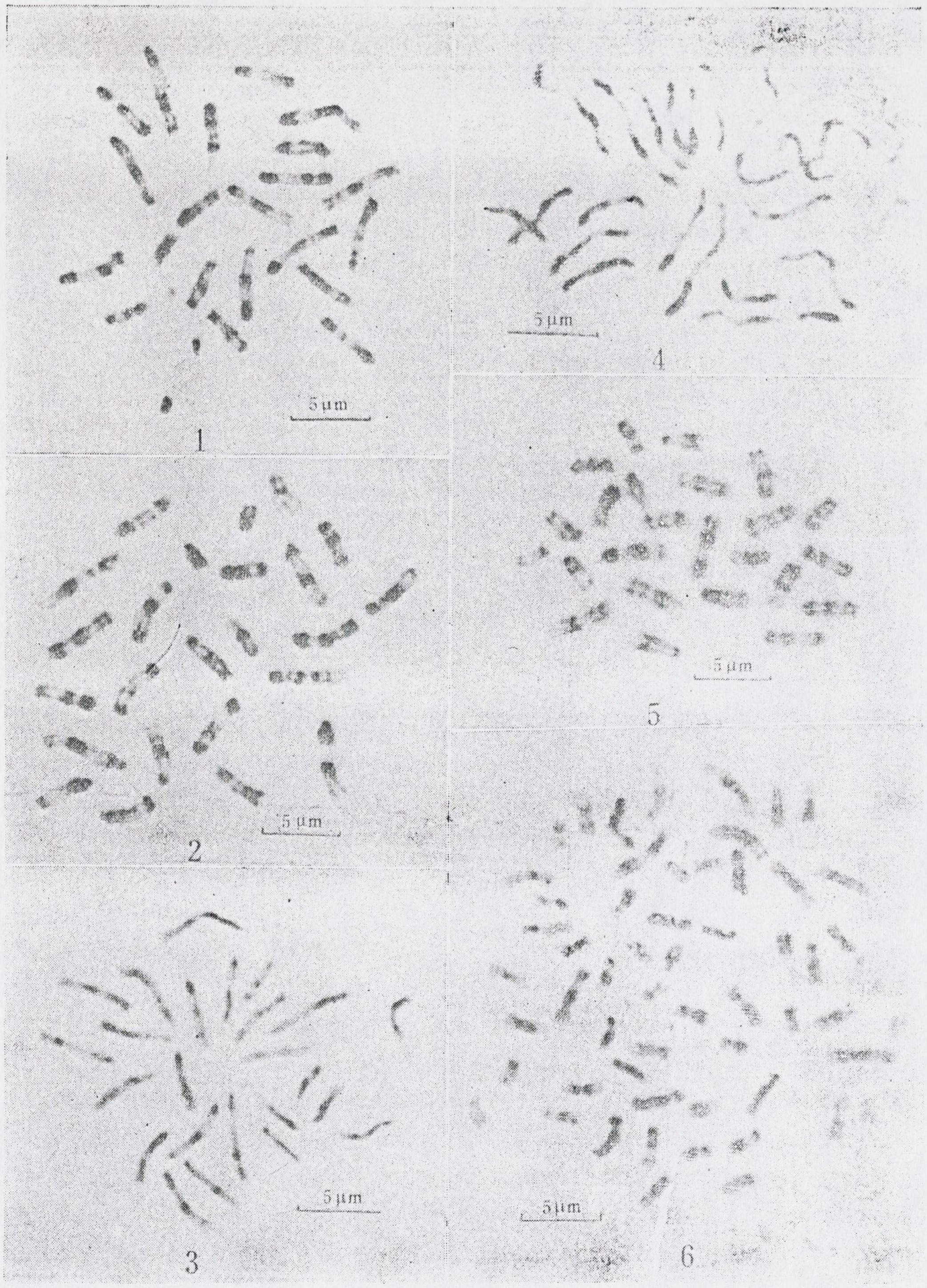
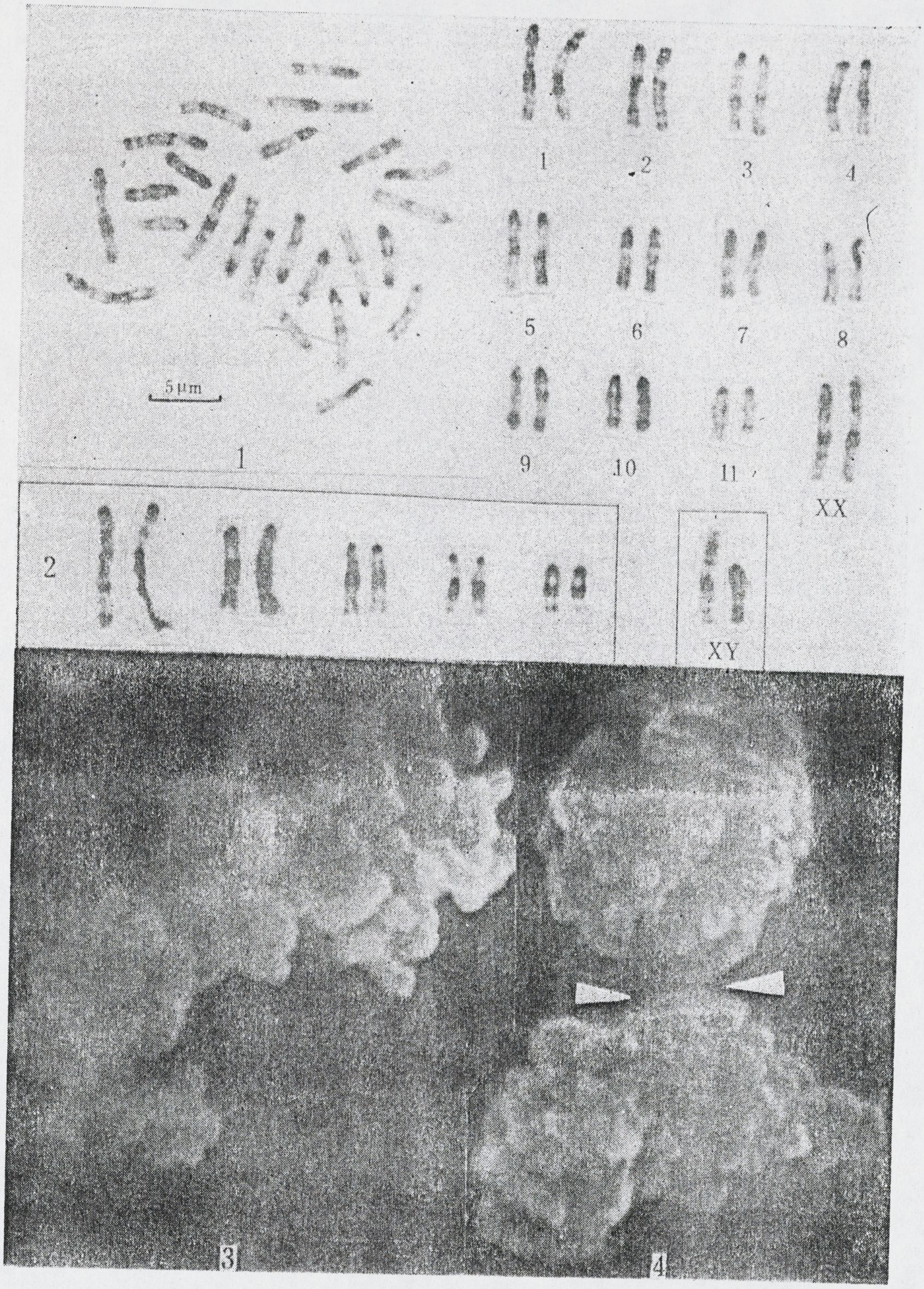


图版 I

1～4黄鳝染色体高分辨G-带：1）正中期分裂相（BrdU处理）；2）正中期分裂 相（AMD处理）；3）早中期分裂相（BrdU-AMD处理）；4）晚前期（BrdU处理）；5）黄鳝染色体G-带正中期分裂相（BrdU处理）；6）鲇鱼染色体G-带正中期分裂相（BrdU处理）



图版Ⅱ

1）黄鳝染色体高分辨G-带分裂相及其核型；2）黄鳝5个分裂相的第4对染色体；3）黄鳝染色体扫描电镜照片（放大33 000倍）；4）猪肾IB-RS-2细胞系染色体扫描电镜照片（放大15 000倍）

CHARACTERISTICS OF HIGH-RESOLUTION G-BANDING IN FISH CHROMOSOMES AND STUDIES ON HIGH-RESOLUTION G-BANDING PATTERN IN *MONOPTERUS ALBUS*

Liu Lingyun　Fei Qing　Liu Yan

(Department of Biology)

The methods of fish chromosome high-resolution G-banding and chromosome scanning electron microscopy are used. Combining the chromosome bands with the chromosome ultrastructures, the characteristics of fish chromosome high-resolution G-banding is analysed. The high-resolution G-banded karyotype of *M albus* is made and analysed.

Key words　fish, chromosome, G-banding.

简　讯

我校 4 篇论文获北京市青年优秀论文奖

1988年上半年，北京市科协举办了青年优秀论文评选活动．参评论文共2 247篇，涉及600多个专业．市科协学术委员会邀请 180 余名专家对参评论文进行了认真评审，共评出二等奖13篇，三等奖50篇，鼓励奖100篇（未评一等奖）．

专家们认为，这些获奖论文具有较高学术水平和较大实用意义，许多论文已在科研、教学、生产、医疗等方面发挥了重要作用．

我校青年科学工作者撰写的 4 篇论文榜上有名．化学系青年教师丁燕波在傅孝愿教授指导下，发表于《国际量子化学》杂志上的研究论文《卤化氢与甲醛形成氢键的质势从头算研究》荣获二等奖，环科所陈飞星撰写的《一种新的水质评价模式》和分析测试中心的王欢、承继成、徐希孺合著的《利用NOAA 气象卫星磁带数据监测冬小麦长势》两篇论文被评为三等奖，天文系房耕、童彝、毛信杰、储齐人合写的论文《密近双星中等离子体湍动加速导致的X-射线辐射机制》获得鼓励奖．

（卞辑）

Colorado State University

Department of Fishery and Wildlife Biology
Fort Collins, Colorado 80523

December 30, 1988

Dr. J. Holcik
Laboratorium Rybarstva a Hydrobiologie
Drienova 3
826 24 Bratislava
Csechoslovakia

Dear Dr. Holcik:

I was most happy to receive a copy of the English translation of the huchen book. It is a treasure of information as a reference source on this genus. I would like to thank and congratulate you and your coauthors.

I obtained a copy of the Annual Bulletin of the Freshwater Fish Protection Association (Japan), No. 11, 1985 (in Japanese). In this bulletin are two papers (translated from Chinese into Japanese): "Discussion on the geographical distribution of the salmonid fishes of China" by Li Sizhong and "A study on the Yangtzekiang salmon, Hucho bleekeri Kimura" by Liu Chenhan.

I had English translations made, but found little detailed data for clarifying the taxonomic position of bleekeri. Scale counts "along" the lateral line are given as 120-146, 36 scales above the lateral line and 72 scales before the dorsal fin. Gill rakers 5 + 9 and "10 or more relatively large teeth are present on the hyoid bone." Since no illustrations accompanied the article, I suspect the "hyoid" teeth are teeth on the tongue rather than basibranchial teeth. The article by Li points out that in the late Pleistocene (and probably previous glacial epochs), conditions were favorable for fishes such as salmonids from the north to invade the Yellow and Yangtze rivers. The implication is that bleekeri is not an ancient relic but perhaps of rather recent origin -- only a subspecies of Hucho hucho. The taxonomic data provided in Liu's paper is not sufficient to adequately classify bleekeri, however. Liu had previously described the southernmost form of Brachymystax as a new subspecies, B. lenok tsinglingensis (18-23 gill rakers and 51-75 caeca) from small areas of the Yellow, Lo, and Han river basins.

I also have a Chinese book on Sinkiang (or Xinjiang) Province. A color photo of huchen appears in this book (mainly close-up photo of head with reddish coloration around the eye). The pertinent text translates as follows: "In Hannas Lake, a kind of fish called redfish of the genus Hucho occurs. They attain a size to more than 10kg. Five other species of fish also occur in Hannas Lake, the northern pike, Siberian bream, and three "Cyprinid" species.

From maps I have examined, Hannas (or Manas) Lake is a lake in a desiccating basin in northern Sinkiang, just to the south of the headwaters of the Irtysh River basin. I believe the Hannas Lake huchen is a new distributional record. It probably represents a late Pleistocene origin from the Irtysh basin.

[1989]

BIOLOGICAL STUDIES OF *BRACHYMYSTAX LENOK* (PALLAS) IN THE YALU RIVER

Huang Haoming, Zhang Delong, Zhuang Longjie and Du Xiaoyan

(Fisheries Research Institute of the Jilin Province, Changchun)

Abstract

Brachymystax lenok (Pallas), a landlocked salmonid fish, is one of the most important commercial fishes in the Yalu River. Morphologically, its characteristics generally agree with the description of the same species reported from other river-systems; the numbers of pyloric caeca, gillrakers, and scales along the lateral line among different populations appear to have certain overlapping.

Reproduction of this fish was studied, at one of its spawning grounds located about 5 kilometers above the mouth of Shi-san-dao-gou stream. Spawning takes place from early April to late May, but mostly in late April. Spawners are mainly 4 years of age and the smallest mature female collected was 309 mm in length. The absolute fecundity of individual fish ranging 285—438 mm in length and 315—1098 g in weight varies from 1629 to 3119 (2194 in average). The relation ship between fecundity and body length can be described as $N = 9.54924L - 1297.3246$, and that between fecundity and body weight as $N = 2.2207W + 641.634$. Eggs, 3.5—4.0 mm in diameter, are deposited in gravels. Under indoor conditions and at a temperature of 5.3—9.0°C, the hatching of the artificially fertilized eggs takes about 625 hours.

Brachymystax lenok is a voracious fish, feeding mainly on benthic insects and small fishes, such as fry and juveniles of *Leuciscus waleckii*, *Lota lota*, etc.

Scales have been used for the determination of age and growth of the fish. It shows that a three-year-old individual attains 356 mm in length and a five-year-old individual reaches 389 mm in length. The length-weight relationship for females can be described by the equation $W = 0.004509L^{2.8378}$ and that for males by $W = 0.002486L^{2.9146}$.

Suggestions concerning fishery management of this fish are proposed.

Key words *Brachymystax lenok* (Pallas), Biology

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鸭绿江细鳞鱼的生物学

黄浩明　张德龙　庄龙杰　杜晓艳
(吉林省水产科学研究所，长春)

提　　要

细鳞鱼是鸭绿江的重要经济鱼类。幽门垂数、鳃耙数及侧线鳞数与国内其他产地相比呈现明显交叉。支流十三道沟河口以上的 5 公里江段为主要产卵场。产卵期为 4—5 月，盛期 4 月末。成熟个体多数 4 龄，最小成熟雌鱼体长 309 毫米。体长 285—438 毫米，体重 315—1 098 克的个体绝对怀卵量 1 629 至 3 119 (平均 2 194)，与体长 L 的关系式 $\hat{N}=9.54924L-1\,297.3246$，与体重 W 的关系式 $\hat{N}=2.2207W+641.6345$。卵径 3.5—4.0 毫米。水温 5.3—9.0℃ 时，受精后 625 小时孵出。

用鳞片测定年龄及生长。3 龄鱼体长可达 356 毫米，5 龄鱼体长一般为 389 毫米。体长与体重的关系式 $W_{♂}=0.002486L^{2.9146}$，$W_{♀}=0.004509L^{2.8978}$。

关键词　细鳞鱼，生物学

细鳞鱼 *Brachymystax lenok* (Pallas) 为鲑形目、鲑科、细鳞鱼属鱼类，分布于苏联、蒙古、朝鲜、中国，在我国见于黑龙江、松花江、图们江、鸭绿江、辽河支流太子河、河北小滦河上游、秦岭以及额尔齐斯河等。肉肥脂多，为鸭绿江极为重要的经济鱼类。1983 年至 1985 年，我们在鸭绿江八道沟以上的十三、十四、十六、十九、廿三道沟采集标本 590 尾，其中 14 尾为鸭绿江渔业资源调查所采集的标本。

本文仅就鸭绿江细鳞鱼的性状变异、年龄与生长、食性、繁殖、胚胎发育等方面进行初步研究，并提出资源保护与开发利用的意见，为进一步开展人工养殖及资源增殖提供生物学基础资料。

性　状　变　异

测定了 143 尾经福尔马林固定的标本，体长 15—497 毫米(表 1)。鸭绿江细鳞鱼的比例性状与苏联、朝鲜[4,6,8]的比较无明显差异，而可数性状的鳃耙数低于苏联的，幽门垂数略高于朝鲜的 (59—78)，与国内黑龙江、图们江[3]、河北小滦河上游、秦岭[2]、额尔齐斯河[1]相比，鳃耙数及幽门垂数等可数性状表现出明显的交叉 (表 2)，也无明显的差异。用酯酶同工酶方法，比较了河北小滦河上游与鸭绿江细鳞鱼的肝和心脏，结果谱带数相同。

本文承中国科学院动物研究所 郑葆珊 研究员，水生生物研究所陈宜瑜副研究员指导与审定；动物所于延芬同志协助拍摄鱼鳞照片；初云鸣同志协助绘图；许欣欣同志协助生化测定并得到长白县水电局的支持和帮助。在此一并致谢。
1987 年 5 月 9 日收到。

表 1　鸭绿江细鳞鱼的主要性状

Tab. 1 Morphological characters of *Brachymystax lenok* from the Yalu River

测定项目 Items	体高/体长	头长/体长	吻长/头长	眼径/头长	眼间距/头长	尾柄长/头长	尾柄高/头长	纵列鳞数	幽门垂数	鳃耙数	脊椎骨数
变幅 Range	4.0—5.1	4.1—4.7	3.1—4.0	3.4—4.9	2.9—3.5	1.2—1.5	2.5—3.3	111—158	61—84	20—24	58—60

表 2　各地细鳞鱼的主要可数性状的比较

Tab. 2 Comparison of morphological characters of *Brachymystax lenok* from various rivers

地点 Place	鳃耙数 No. of gill-rakers	幽门垂数 No. of pyloric caeca	纵列鳞数 No. of lateral line scales
鸭绿江	20—24	61—84	111—158
图们江	20—24	60—77	132—166
松花江	24	98—104	132—168
秦岭	17—23	63—95	115—156
额尔齐斯河	21—27	80—102	113—129
黑龙江	19—22	91—111	135—175
河北小滦河上游	19—21	63—91	119—164

我们认为不同水系的细鳞鱼无法区分不同的种或亚种，鸭绿江的细鳞鱼应为 *Brachymystax lenok* (Pallas)

繁　　殖

1. 产卵期与成熟系数

初春 4 月清明前后，鸭绿江解冻时，栖居大江深处的细鳞鱼就顶着冰流上溯开始生殖洄游。成熟细鳞鱼通常喜在水质清晰，砂砾底质的支流山溪中产卵。历年 4 月中旬，细鳞鱼首先在十三道沟河产卵，产卵期自 4 月中旬(沟河旬平均水温 6.7℃，沟口江水旬平均水温 7.8℃) 至 5 月末。随着江冰的逐渐消溶，成熟细鳞鱼亦逐渐游向鸭绿江上游的各支流

表 3　十三道沟细鳞鱼性腺发育百分比 (1984 年)

Tab. 3 Percentage of *B. lenok* from Shisandaogou at different stages of gonad development in 1984

性别 Sex		♀				♂			
性腺发育期 Stage of gonad development		I II III	IV	V	VI	I II III	IV	V	VI
4 月中、下旬	尾数 (%)	10 28.5	20 57.1	2 5.7	3 8.6	-	31 67.4	11 23.9	4 8.6
5 月	尾数 (%)	2 12.5	8 50	3 18.7	3 18.7		17 80.9	4 19.1	

中产卵。4 月下旬至 5 月上旬进入十五、十六道沟河，抵达最上游的廿三道沟产卵时，已是 6 月初（沟河上旬平均水温 7℃）。

十三道沟河细鳞鱼个体雌雄性腺发育百分比（表 3）清楚地表明，该地细鳞鱼的产卵期为 4 月中、下旬至 5 月下旬，这与我们历年捕获成熟个体数较多的日期相符。4 月中、下旬的成熟系数平均为 17.89，5 月份为 7.14。

2. 性成熟最小型、性成熟年龄与性比

在 289 尾标本中，最小的成熟雌鱼体长 309 毫米，体重 450 克，年龄 4^{+}。最小的成熟雄鱼体长 214 毫米，225 克，年龄 3^{+}。生活于鸭绿江里的细鳞鱼雌性一般 4^{+} 成熟，少数为 3^{+}，雄性 3^{+} 成熟少数为 2^{+}，而水库放养增殖的细鳞鱼除性成熟年龄与生活于鸭绿江的相同外，性成熟个体的一般体长与体重均明显低于生长于鸭绿江的。细鳞鱼雌雄的性比见表 4。

表 4 细鳞鱼的雌雄性比

Tab. 4 The sex ratio of *Brachymystax lenok*

日期 Date	地点 Place	尾数 Number of specimens	♀	♂	性比 Sex ratio
1983.4.9—4.22	十三道沟河	102	31	71	1:2.29
1984.4.16—4.28	十三道沟河	144	22	122	1:5.55

3. 怀卵量

计算 82 尾具有 IV 期卵巢的细鳞鱼卵粒，结果表明体长 285—438 毫米，体重 315—1 098 克的个体绝对怀卵量为 1 629—3 119 粒，平均为 2 194 粒。

个体绝对怀卵量与体长、体重成直线关系(图 1, 2)；个体绝对怀卵量 N 与体长 L 的相关系数为 0.6914，其关系式为 $\hat{N} = 9.54924L - 1297.3246$，与体重 W 的相关系数为 0.7479，其关系式为 $\hat{N} = 2.2207W + 641.6341$。

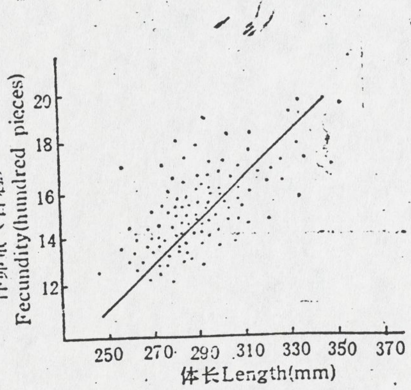

图 1 怀卵量与体长的关系

Fig. 1 Relationship between fecundity and body length in *Brachymystax lenok*

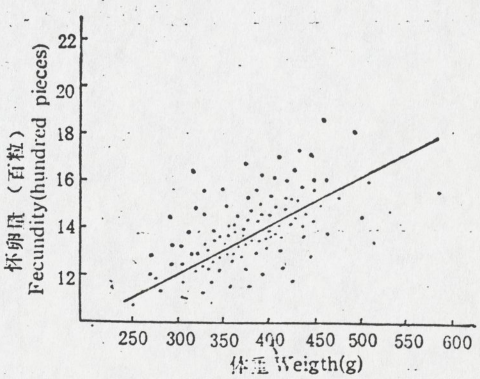

图 2 怀卵量与体重的关系

Fig. 2 Relationship between fecundity and body weight in *Brachymystax lenok*

4. 产卵习性

每年 4 月中旬，随着江冰解冻，成熟细鳞鱼开始成群逆冰凌上溯，此时卵巢大多为 IV 期中，江水混浊，水温 7—8℃。细鳞鱼在鸭绿江支流中产卵，上游江段的十三、十五、十六、十九、廿三道沟河为细鳞鱼的习惯产卵场。细鳞鱼喜在凌晨溯河，阴雨天气尤为理想，甚至能跃过 90 厘米高的跌水坝，溯河而上，寻找产卵场。产卵场一般选择在河道的缓流荫蔽处，流速 1.5—2.0 米/秒，产卵场水深 50—70 厘米，底质为砂砾，产卵时一般为 1 尾雌鱼伴有 2—3 尾雄鱼追逐，雌鱼先选择适当的场所，并用咀与尾鳍不断地摆动石砾，筑产卵床，此时雄鱼不断地追逐，产卵完毕后，双方共同将细小的砂砾覆盖受精卵以保护不受敌害的侵袭。卵沉性，色浅黄，卵径 3.1—4.3 毫米。在水温 9—10℃ 的条件下，一般约 29—31天孵出。

5. 产卵场

十三道沟河为鸭绿江细鳞鱼的主要产卵场，该河流总长 26.4 公里，天然落差 713 米，河流多年平均流量为 2.14 米^3/秒。产卵场位于离河口约 5 公里处（图 3），该处河道弯曲，长、宽分别约为 100 米、10 米，水深 50—70 厘米，平均 63 厘米，水质清晰，河床多为砂砾，水温 7—10.5℃，流速 1.58—1.95 米/秒。

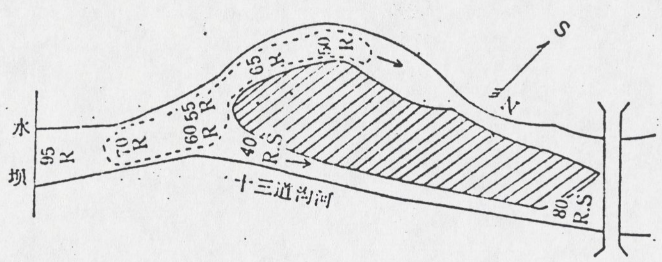

图3　十三道沟河细鳞鱼产卵场示意图

Fig. 3　The spawning ground of *Brachymystax lenok* in the shisandaogou stream

/// 滩地，--- 产卵场，R——石砾，S——砂，数字为水深(厘米)

食　　性

细鳞鱼终年摄食，从检查的 274 尾细鳞鱼肠管来看，空肠率几乎为零，充塞度为 IV 以上的占 98%（表 5）。4—5 月间，虽是细鳞鱼的产卵季节，但平均胃肠的饱满指数仍高达 98.4—109.7。

细鳞鱼贪食，1 尾体重 510 克、体长 529 毫米的雌性个体，胃肠食物团竟重达 12 克，饱满指数高达 235.29。细鳞鱼摄食对象无明显的选择性，食物组成随栖息环境的饵料状况和季节有所不同。无脊椎动物的蜉蝣幼虫、摇蚊类、毛翅类、襀翅类，瓦氏雅罗鱼、江鳕的幼鱼，蛙卵以及植物的水草，均为细鳞鱼摄食的对象。

年龄与生长

1. 年龄鉴定特征

表 5 细鳞鱼摄食频率和摄食强度表

Tab. 5 Changes in the frequency and intensity of feeding of *Brachymystax lenok*

日 期 Date	检查样品数 Samples for exmined	摄食个体的% Pecentage of feeding individuals	充塞度* Gastric fullness degree	平均胃肠饱满指数** Average stomach and intestine fullness index
1983.4	52	100	III—IV	98.4
1983.9	21	100	IV—V	193.8
1984.6	17	100	III—IV	131.4
1984.5	34	100	III—IV	109.7
1984.10	28	100	IV—V	198.3
1985.2—3	8	87.5	II—III	75.7

* 按 Лебедев 0—5 级标准

** 饱满指数公式为(食物团重/鱼体重) × 10 000

细鳞鱼鳞片的鳞中心位正中，鳞片前部狭长，后部圆钝，呈梨形。其两侧的距离短于前后的距离。

鳞片上环片清晰，呈 O U 型或 O( ) 型，环片相应排列，疏密且侧区切割部分即为年轮标志（图 4）。

2. 生长速度

鳞长与体长呈直线正相关（图 5），其关系式为 $L = 40.5930 + 171.90345S$ $r = 0.6894$，依 Lea 公式 $\left(L_n = \frac{V_n}{V} \cdot L\right)$ 进行生长推算，结果见表 6，由表所示，同龄组鱼雄性小于雌性。

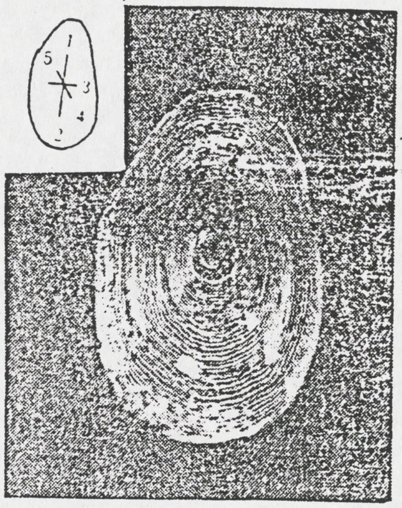

图 4 细鳞鱼的鳞片（体长 37.6 厘米，年龄 3+）

Fig. 4 Annulus on the scale of *Brachymystax lenok* (body length 37.6cm, age 3+)

1. 前区， 2. 后区， 3. 侧区， 4. 后侧， 5. 前侧

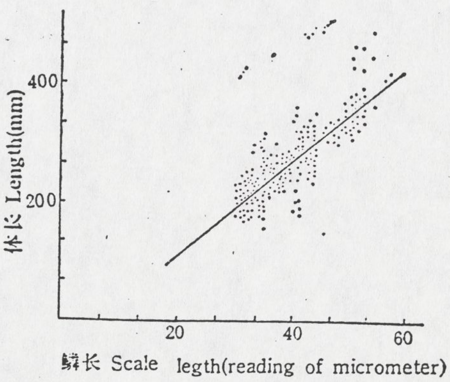

图 5 鳞长与体长关系点构图

Fig. 5 Relationship between scale length and body length in *Brachymystax lenok*

表 6 细鳞鱼的生长率

Tab. 6 Growth rate of *Brachymystax lenok* (body-length: cm)

		实测 Value of measurement		推算 Value of calculation				
年龄	性别	尾数	体长范围	L_1	L_2	L_3	L_4	L_5
2+		37	13.1—21.7(19.4)	13.49	16.75			
3+	♀	59	21.0—39.0(36.4)	13.50	18.41	25.94		
	♂	30	17.0—24.5(21.0)	10.74	14.65	18.05		
4+	♀	94	29.0—46.5(44.1)	13.89	17.94	27.16	37.95	
	♂	47	19.0—26.0(24.2)	9.04	12.33	17.68	21.47	
5+	♀	10	38.0—55.0(48.5)	14.50	18.50	32.43	40.50	49.81
	♂	5	25.0—30.9(29.4)	10.39	14.17	20.32	25.51	27.09

3. 体长和体重关系

取 145 尾♀鱼和 167 尾♂鱼，分别按 Key 公式 ($W = aL^n$) 计算体长体重关系。其结果 $W_♀ = 0.004509L^{2.8978}$，$W_♂ = 0.002486L^{2.9146}$。

胚胎发育

1985 年 4 月 22 至 5 月 18 日进行了细鳞鱼的人工授精，卵径 3.5—4.0 毫米，在水温 5.3—9℃ 的条件下，受精卵经 7 小时胚盘隆起；445 小时发眼；受精后 625 小时孵出仔鱼。我们参考有关文献[5,7]把细鳞鱼的胚胎发育分为 32 期(表 7，图 6)。

资源及其渔业利用

细鳞鱼是鸭绿江沿岸居民视为极其珍贵的经济鱼类。在北方低温条件下，具有生长较快，摄食旺盛，繁殖力强等特点。所以如何保护并提高自然水域中细鳞鱼的产量以及开展细鳞鱼的人工增养殖是值得水产科技工作者注意的问题。据长白县志(1937)记载，细鳞鱼在鸭绿江干流及八道沟至廿三道沟的支流中的年产量为渔业总捕捞量的36%。50年代长白全县的细鳞鱼产量达 5 万公斤(访问记录)。尽管鸭绿江中上游基本上属于不被利用的江段，但资源量日趋下降，而作为中、上游仅有的几种经济鱼类(细鳞鱼、瓦氏雅罗鱼、鸭绿江茴鱼)来说，细鳞鱼每年还能捕获上万斤的产量，也是我国目前仅有的几处细鳞鱼分布点中较为集中的产地。近年来，捕捞数量逐年降低，细鳞鱼产卵群体的最小性成熟个体

表 7 细鳞鱼卵的胚胎发育时期

Tab. 7 The embryonic development of *Brachymystax lenok*

发育期 Developmental stage	受精后时间(小时) Time after fertilization (h)	主要特征 Main characters
受精卵	0	卵呈圆球形,含丰富的卵黄,胞质向动物极聚集,胚盘开始形成
1 细胞期	7.00	胞质聚集在卵球动物极,形成隆起的胚盘
2 细胞期	13.00	胚盘经裂,分为两个大小相等的细胞
4 细胞期	19.30	第二次分裂,亦为经裂,分为大小相等的 4 个细胞
8 细胞期	23.30	第三次经裂,两个分裂面与第一次分裂面平行,分成 8 个细胞,排成 2 行
16 细胞期	25.40	第四次经裂,两个分裂面与第二次分裂面平行,分成 16 个细胞,大小不均
32 细胞期	31.45	细胞继续分裂达 32 个细胞
桑椹期	46.35	细胞继续分裂,出现纬裂,细胞数增加,变小如桑椹状
囊胚早期	66.05	分裂球很小,细胞界限不清,囊胚层高举在卵黄上,如土堆状
囊胚中期	89.45	囊胚层较早期低,其边缘开始向四周扩展
囊胚晚期	137.15	囊胚层渐趋扁平,变得很低,其边缘继续扩展,面积增大,加厚形成环状
胚环出现期	167.40	胚盘周缘部分的细胞向内卷入隆起一胚环
胚盾出现期	180.20	背唇的前方出现一个盾形的隆起,即胚盾,囊胚层下包 1/4
神经胚期	205.00	胚盾表面出现神经沟,囊胚层下包 1/3
体节出现期	217.00	体节隐约可见 2 对,囊胚层下包 1/2,神经沟明显,胚盾明显变长
眼原基出现期	229.00	在前脑两侧有一对椭圆形突起,即眼原基囊胚层下包约 3/4
眼囊期	236.00	眼囊长椭圆形,3 个脑泡出现
胚孔形成期	241.00	卵黄栓形成,3 个脑清晰可辨,体节 12—16 对
胚孔封闭期	265.00	胚孔封闭,视杯形成,体节 24—26 对
尾芽期	277.00	胚体后端出现圆锥形增厚隆起,即尾芽,体节 28—30 对
耳囊期	289.00	在后脑两侧出现小泡状耳囊,体节 30—32 对
晶体出现期	301.00	眼杯口出现圆形晶体,胚体隆起,耳囊后出现鳃板,体节 36—38 对
嗅窝期	325.00	眼的前下方出现 1 对嗅窝,体节 44—46 对,后肠形成
胸鳍原基出现	337.00	胚体前部两侧出现胸鳍原基,体节 47—50 对
心搏开始	361.00	胚体左侧前部出现心血管膨胀,卵黄囊背半部表面构成一片小血管网,胸鳍隆起
尾鳍出现期	373.00	尾的边缘表皮外突,呈皮褶状尾鳍,胚体呈“C”形
发眼期	445.00	眼球透过卵膜清晰可见,胸鳍直立成盘状,卵黄血管形成 4/5
心跳明显期	469.00	在卵黄囊头端,可见心脏跳动
臀鳍出现期	481.00	在肛门后部腹面出现臀鳍原基
背鳍出现期	504.40	胚体背部出现背鳍原基,胚体开始扭动
出膜前期	613.00	胚体环绕卵黄球一周,头与尾相接触
出膜期	625.00	胚胎破膜而出,卵黄囊由圆形变成长圆形

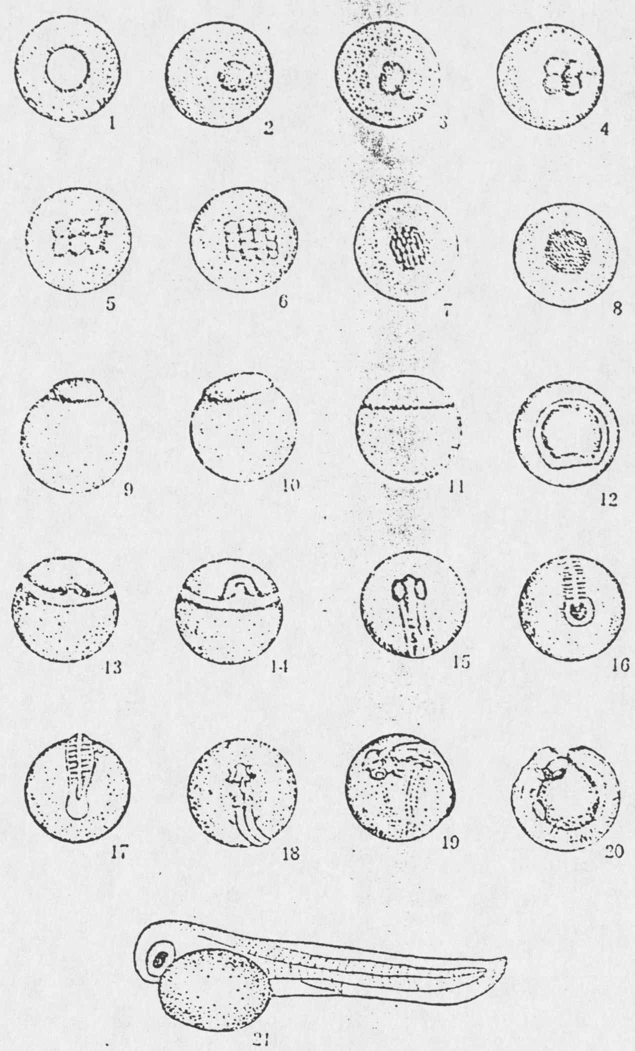

图 6　细鳞鱼胚胎发育图

Fig. 6. The early development of *Brachymystax lenok*

1. 受精卵；2. 1细胞期；3. 2细胞期；4. 4细胞期；5. 8细胞期；6. 16细胞期；7. 32细胞期；8. 桑椹期；9. 囊胚早期；10. 囊胚中期；11. 囊胚晚期；12. 胚环形成期；13. 胚盾形成期；14. 神经胚期；15. 眼囊形成；16. 胚孔形成期；17. 胚孔封闭期；18. 胸鳍原基出现期；19. 心博开始；20. 出膜前期；21. 出膜期

1. Fertilized egg; 2. One cell stage; 3. Two cells stage; 4. Four cells stage; 5. Eight cells stage; 6. Sixteen cells stage; 7. Thirty-two cells stage; 8. Morula stage; 9. Early stage of blastula; 10. Middle stage of blastula; 11. Last stage of blastula; 12. Germ ring stage; 13. Embryonic shield stage; 14. Neurula stage; 15. Eye sac stage; 16. Stage of blastopore formation; 17. Stage of blastopore sealing; 18. Primary stage of pectoral fin; 19. Heart pulsation stage; 20. Pre-hatching stage; 21. Hatching stage

长度亦逐渐变小。雌鱼 1969 年为 382 毫米，1985 年为 309 毫米，缩小了 71 毫米。绝对繁殖率增加，1969 年为 1 846 粒，1985 年增加至 2 194 粒，最小性成熟个体的长度自1976—1985 年已趋于稳定。这说明了细鳞鱼群体的自然结构破坏后，它的自动调节能力已趋于

最大值。如果今后不改变渔法，继续无限制的增加捕捞强度，那么鸭绿江的细鳞鱼资源将因得不到足够的补充群体而趋于枯竭。造成资源下降的原因：

1. 目前鸭绿江细鳞鱼渔业主要采用旋网及其它不合理的渔具。每年4—6月细鳞鱼在鸭绿江中、上游各沟川中产卵时，大量捕获。炸鱼等毁灭性捕捞方式，使产卵亲鱼日益减少。这种不加控制的捕捞，必然严重影响细鳞鱼的繁衍。

2. 鸭绿江干流及支流上的不合理筑坝拦水及上游梨树沟与十八道沟河之间造纸废水的排入致使江水污染，直接阻碍着细鳞鱼的生殖洄游。据统计，鸭绿江八道沟河以上的干、支流的各种水利设施多达20余处。干流的长白水闸及支流十三道沟河、十五道沟河均为鸭绿江细鳞鱼的传统产卵场所及通道，也因林业流木及电站枢纽严重影响了亲鱼的上溯产卵。

为保护及增殖利用鸭绿江的细鳞鱼资源，以其生物学特性提出下列几点意见：

1. 开展细鳞鱼的水库人工放养增殖及池塘养殖。细鳞鱼历来为栖息江河的冷水性鱼类。贪食，生长较快，其产肉量可与同科的其它的鲑鳟类相比。细鳞鱼繁殖生物学的某些特性与鲑科的其它种鱼类相似。我们通过对长白县十三道沟电站水库（1980—1985）细鳞鱼人工放养增殖试验的成功经验，认为在我国三北地区的低温性水库中增殖细鳞鱼，并进行池塘高密度流水养殖，使成为我国又一种特有的珍稀鲑科的养殖鱼类是有可能的。

2. 加强鸭绿江细鳞鱼的繁殖保护措施。确定细鳞鱼的禁渔区及禁渔期；严格保护产卵群体及产卵场的生态环境；限制或完全禁止一切对细鳞鱼资源有损害的渔具、渔法。

3. 积极消除人为因素所造成的危害。确定适合鸭绿江主要经济鱼类的渔业水质标准及日常监测方法，改善细鳞鱼的栖息场所，保证上溯及降河路线的畅通。

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The biological Study of *Brachymystax lenok* (Pallas) in Yalu River

The *Brachymystax lenok* only exists in Russia, Mongolia, Korea and China. In P. R. China, it exists in the Heilongjiang River, the Tumenjiang River, the Yalu River, the Taizi River (a branch of the Liao River), the upper Xiaoluan River, the Tsingling Mountain, and the Erqisi River. The *B. lenok* is one of the most important commercial fish of the Yalu River. A total of 590 specimens were collected from branches of the Yalu River (13^{th}, 14^{th}, 16^{th}, 19^{th} and 23^{th} branches) from 1983 to 1985.

The Characterization

The main characteristics are listed in Table 1.

Table 1: Morphological character of the *B. lenok* from the Yalu River.

Characteristics	
Body depth to body length ratio:	4.0-5.1;
Head length to body length ratio:	4.1-4.7;
Snout length to head length ratio:	3.1-4.0;
Eye diameter to head length ratio:	3.4-4.9;
Eye distance to head length ratio:	2.9-3.5;
Caudal peduncle length to head length ratio:	1.2-1.5;
Caudal peduncle depth to head length ratio: .	2.5-3.3;
Lateral line scale number:	111-158;
Number of pyloric caeca:	61-84;
Number of gill raker:	20-24;
Vertebrate bone:	58-60.

Esterase isozyme of livers and hearts from specimens collected in the Xiaoluan River in the Hebei Province, and the Yalu River in the Liaoning Province were analyzed. This analysis proved the *B. lenok* from the two rivers are the same species. See Table 2.

Table 2: Comparison of morphological characters of *B. lenok* from various rivers.

River	Gill rakers	Pyloric caeca	Lateral line scales
Yalu	20-24	61-84	111-158
Tumen	20-24	60-77	132-166
Songhua	24	98-104	132-168
Tsingling	17-23	63-95	115-156
Erqisi	21-27	80-102	113-129
Heilongjiang	19-22	91-111	135-175
Xiaoluan	19-21	63-91	119-164

From our study, we conclude that the fishes from different rivers belong to one species, *Brachymaystax lenok* (Pallas).

Reproduction

The spawning season is from April to May each year. The ratio of fertile to infertile fish during the spawning season was 17.89 - 7.14.

The minimum mature female fish weighs 450 g, has a 309 mm body length, and is 4 years old. The minimum mature male fish has a 214 mm body length, weighs 225 g, and is 3 years old. Table 4 lists the sex ratio of the *B. lenok* species (in the 13th branch).

Fishes of a 285-438 mm body length and 315-1098 g body weight have a fecundity of 1629-3119 eggs. See figures 1 and 2.

Spawning-ground

Shisandaogou (13th branch of the Yalu River) is the main spawning ground.

Natural Resource Protection

From the Annals of Changbai County (1937), we know that in the Yalu River and its branches the B. lenok annual production was 36 percent of the total annual fish production. During the 1950's, the total production of the fish in Changbai County was 50 tons. Since then, the production has dropped dramatically. The body length of the minimum mature female became shorter. For instance, in 1969 the mature female's body length was 382 mm; in 1985, it was 309 mm. However, the reproduction ratio has increased. The fecundity was 1846 pieces in 1969, and 2194 in 1985. We concluded from above figures that the natural population structure of *B. lenok* has been destroyed, and its self-adjustability has reached its maximum. Therefore, the protection of this fish is urgent.

Reasons for decline

A. Over fishing during spawning season;
B. Dams blocking migration and altering river flow;
C. River pollution.

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台北市動物園之友協會
The Zoological Society of Taipei
台北市木柵區11628新光路二段30號
No.30, Sec.2, Hsin-Kuang Road, Taipei
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April 18, 1993

My dearest Dr. R. Behnke,

First of all, I would like to welcome you on behalf of all of us to the symposium.

It is our honor and most valued pleasure to have had you join us in this symposium. The Zoological Society of Taipei was established seven years ago by a group of people who love animals as their close firends. Since its establishment, over a dosen of activities are held each year, especially 1991, in which we helped send ORANGUTANs back to their homeland--Indonisia. Our efforts going into this activity have received a great deal of response from all over the world. It is our earnest hope, that through our love and efforts towards animal, the species on the brink of extinction may be better taken care of and eventually grow in number.

Greeting a great image not only as a world-renowned scholar, but also as someone who has in your life contributed a great deal to the protection of animal, we, including myself, should like to express our most sincere hope that we may be imparted from you the most treasured expertise and experiences, which I, as an animal lover, trust will not only brighten the future of animal, but also that of the human being.

With my best wishes and regards,

Yours sincerely,

Wenton Hung

Hung, Wen-Ton
Director
The Zoological Society of Taipei

Prof. Si-Zhong Li
Institute of Zoology, Academia Sinica
Zhongguancun Street, Haidian, Beijing
P.R. China 100080

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Dear Dr.R.Behnke

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★ Have a nice trip, and enjoy yourself.

International Symposium on the
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please do not hesitate to contact us. We thank you again for your participation and look forward to seeing you in Taipei.

Sincerely Yours,

Ping-Shih Yang

Ping-Shih Yang

Attached: 1. Tentative schedule of the symposium
2. Required form of presented paper

From: Prof. Pin-Shih Yang Dept. of Plant Pathology & Entomology

國立臺灣大學

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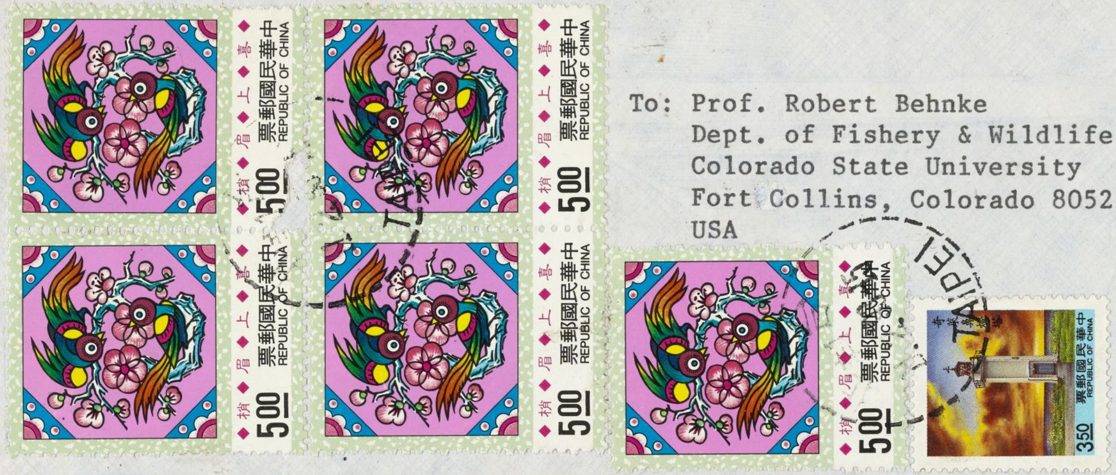

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論 文 集

目錄

content

台灣野生動物保育現況與趨勢

李三畏

摘要

台灣位於亞熱帶地區，是個多山的海島，高溫多雨，地形陡峻而複雜，致野生動物資源非常豐富，數百年來，由於人口增加，經濟產業的發展，尤其是近二、三十年來，人口劇增，經濟產業之快速發展，使得許多野生動物棲息地受到破壞，使動物無以為居，或因商業上之需求過度捕捉野生動物；使得野生動物之族群量驟減，部份品種甚至瀕臨絕種。鑑於此種情勢，如繼續發展，將使台灣的野生動物趨向絕滅之途，政府於七十三年起決定加強野生動物及自然生態之保護，從宣導教育、法規制度之建立、人才培育、基本資料之建立、保育類野生動物貿易管制及走私之查緝，以及試驗研究等多管道推行；並分別設立專責機關負責推動野生動物及自然生態保育。本文仍將近年來推行之情況及其成果分別敘述。

關鍵字：野生動物保護法規制度、宣導教育、試驗研究、珍稀動植物、國際交流。

1.前言

台灣是個海島，南北狹長，位於亞熱帶地區，高溫多雨，雨量充沛；地勢陡峻，全島山巒綿亘、溪谷縱横，因而沙洲、平原、盆地丘陵、台地、高峯等地形無不齊備；景觀互異，孕育著豐富的動物及植物資源。尤以高山林立，不僅熱帶及亞熱帶植物種類繁多，寒帶與溫帶之植物亦甚多。在動物方面，計有哺乳類六十一種（不含亞種）、鳥類四百多種（其中39%為留鳥），爬蟲類九十二種，兩生類三十種，魚類二千餘種（其中約三十多種屬於迴游性海中產卵魚類），昆蟲類五萬多種（其中蝶類四百多種）。台灣之動物相中，特有種及特有亞種甚多；在僅約三萬五千多平方公里的土地上，有如此豐富之物動資源，實屬難得；在各種動物中，依記載較為人所知者包括台灣黑熊、雲豹、台灣獼猴、梅花鹿、羌、帝雉及長鬃山羊，以及其他中大型

野生動物。吸引許多候鳥停棲、渡冬或過境，並提供海棲生物之棲息場所。河海交會處之濕地孕育著極為豐富的生態資源。在類型之植物相，其中高等維管束植物約四千多種，包括台灣蘇鐵、台灣穗花杉、台灣杉、南湖柳葉菜等特有種及稀有種，彌足珍貴。在地形方面，台灣之山脈縱貫全島南北，形成地形上之脊樑，河川源至此山脊，向東及向西流入太平洋及台灣海峽，將本省雕塑成許多複雜地形，形成優美之景觀。

近年來由於經濟發達、人口增加，導致自然資源大量開發，部份土地超限利用、優良農地不當轉用、森林過度砍伐、林地濫墾、集水區之管理與保育不夠週全、野生動物遭濫捕與毒殺、外來種動植物引進造成之災害及大量製造公害與環境污染等行為，使得本省珍貴之自然生態體系正逐漸遭到人為之改變及破壞，若不及時設法阻止其繼續惡化並改善，其後果堪慮。

台灣地區之自然生態保育工作萌芽於民國五十年代；當時一些有識之士，即著手調查台灣的鳥類、植物及景觀等，以建立基礎資料；並由林務局先後設立若干森林保護區；民間團體方面，中華民國保護動物協會亦宣告成立，協助政府推行自然生態保育工作，由於當時之社會環境未能有效配合，以致推展之速度及成效並不盡理想。民國七十年代初期，由於台灣之經濟成長快速，人民生活水準提高，各種破壞生態環境之問題，逐漸受到國人之重視；同時民衆濫捕濫殺野生動物之行為遭受國際間之批評與指責，使我國之國際形象低落，國際保育人士以「台灣為觀光之樂園，是野生動物之地獄」相譏。國內之保育人士乃大聲疾呼自然生態保育的重要性，政府亦開始重視自然保育工作，並逐年度編列預算推動之。民國七十三年七月間，由經濟部依文化資產保存法之規定，公告帝雉、藍腹鷴及櫻花鉤吻鮭為珍貴稀有動物，爾後有關自然生態保育工作之推行逐漸加速。民國七十三年九月間，行政院農業委員會改組並接辦本項工作。近年來，該會結合學者專家，相關機構及熱心人士，共同加強推行，從法規整理；配合華盛頓公約(CITES)規定，嚴格管制保育類野生動物、植物之國際貿易，並加強查緝保育類野生動植物走私。建立基本資料、珍稀動植物保護復育、試驗研究、人才培育及國際合作等方面分頭並進，積極進行

。在民國七十八年六月總統公布野生動物保育法，七十九年三月發布該法細則，併同文化資產保存法及施行細則作為自然保育之依據。並據以加強宣導，查緝野生動植物之不法行為，二年多來已查獲處分者有157項，均經司法機關判決定案者。

2.野生動物保育政策及執行

台灣地區之自然環境及生態體系，經過近數十年來之快速開發改變，已受到嚴重之破壞，珍貴的台灣雲豹已難得一見其蹤影，二、三百年前活躍在平原地區之台灣梅花鹿已在原野中絕跡；其他優美之景觀也受到嚴重之改變或破壞，如不及時予以保護或復育，將可能自台灣地表上消失。有鑒於台灣之自然生態體系因蓬勃之經濟建設而逐漸遭受破壞，且其惡化之程度日益加劇。若不及早謀求補救之道，將使之陷於無可挽回之地步。政府及國內學者專家，乃於數年前即呼籲全民重視自然生態之保育，並研擬下列各項工作目標，以供推行自然保育工作之參考依據。

2.1 提昇國人之自然生態保育觀念，促進保育工作全國全民化。

自然生態保育工作範圍廣泛，龐雜度高，牽涉社會經濟層面大衆及私人之利益，有賴全體國人共識之並共同努力推行，方能獲致理想之成果及目標。而國人現對於自然生態保育觀念非常淡薄，或模糊不清；再受傳統觀念作用以及近年來經濟迅速發展，受功利主義等心態之影響，捕捉野生動物做為寵物飼養或做為補品進食之習慣未改，且製作野生動植物標本供商業性用途之風氣仍非常興盛，致許多珍貴或稀有之動植物常遭捕殺或濫伐、濫採，使其族群量愈來愈少，甚或已至瀕臨絕種之邊緣，嚴重影響自然生態體系之平衡。更有許多優美珍貴之地景資源，經人為無知地開發或不當地利用後，已不復存在，殊屬可惜。誠如衆所週知，自然生態保育與經濟發展之間，具有某種程度之衝突性，如何求取兩者間之平衡點，則有待國人就自然生態保育之重要性與經濟利益兩者之間的衡量與取捨。建立國人正確之自然生態保育觀念，仍為推行自然生態保育重要而基本之工作環節。

2.2 健全保育法規及組織，落實自然生態保育工作。

我國自然生態保育，現尚未建立整體性法規及行政管理組織之體

系。致使工作之推行，尚難達成事權劃一的地步，因此，工作之成效亦遭受其影響。我國現有自然生態保育之法規分散在相關之法令中。野生動物保育法、文化資產保存法、國家公園法、森林法等均由不同機關主管其事；因各種現有法令均有其事業目的，因此使自然生態保育之工作僅能在局部性或地區性範圍內推展，且其重要性亦依附在各種相關法令之目標下，未能受到應有之重視，難以發揮其功效。另從執行機關而言，亦分屬於各種不同之目的事業機關，未能統一其事權。現有法令中之野生動物保育法由農委會主管；森林法亦屬農委會主管，省（市）政府林務機關執行。文化資產保存法中對於經公告之珍貴稀有動植物及自然保留區之保護具有規範，由農委會主管，其執行機關，雖屬省（市）政府及縣（市）政府，或經指定之機關辦理，但規定之劃分並不明確。國家公園法由內政部主管，雖較有明確之範圍及執行機關，但其範圍無法涵蓋全部地區。而山坡地保育利用條例及水利法，則分由農委會及經濟部主管，其保護標的係以水土資源為目標。對於野生動物保育及瀕臨絕種野生動物之進出口管理，則尚有部份以行政命令為之，誠屬不足。為求更有效推行自然生態之保育，健全法規及組織，仍為重要工作。目前本會已完成野生動物的保育法第一次修正，並擬函報行政院審查後轉送立法院審議。

2.3 珍貴稀有動植物及自然景觀之保護及復育。

台灣地區之自然環境孕育豐富自然資源，由於以往經濟發展需求，許多珍貴動植物資源已受到嚴重的破壞，為及時挽救已瀕臨絕種之族羣，及優美的自然景觀；如帝雉、藍腹鷴、櫻花鉤吻鮭、水獺、雲豹、台灣黑熊。朱鸝、蘭嶼角鴞、珠光鳳蝶等二十三種動物，政府已依據文化資產保存法公告為珍貴稀有動物（即國寶級動物），加強保護，對於族羣量已近乎絕種之櫻花鉤吻鮭、蘭嶼珠光鳳蝶及梅花鹿等已實施人工復育，以繁衍其族羣，使其數量能穩定成長並長期生存於自然環境中。在珍貴稀有植物方面，亦依同法公告台灣穗花杉、台灣油杉、紅星杜鵑、烏來杜鵑、南湖柳葉菜、台灣水韭、台灣蘇鐵、水青岡、蘭嶼羅漢松、清水圓柏、鐘萼木等十一種植物為珍貴稀有植物，並對鐘萼木、桃園池沼水生植物等稀有植物實施復育及移植工作。

需以地區性保護才能達到目的者，則設置自然保留區。迄民國七十八年十月為止，已公告關渡等十五處自然保留區，總面積共六萬二千六百七十七公頃，各自然保留區所保護之對象不同，包含候鳥、淡水魚、山鳥、稀有植物，特殊生態系及特殊地理景觀等（詳如附表一）。今後將繼續依照實際需要及依據各項調查研究成果報告，公布各種保護措施，以期達到完善保護之目的。

2.4 基本資料庫之建立，提供教學研究及保育之依據。

依據國內外資料記載，台灣地區自然資源豐富，且其龐雜度大，甚具學術研究價值。但長年以來對於完整資料之建立，尚無基礎，殊為可惜。各種資料分散於各處。缺乏有系統之整理，因此在資訊的取得及資料的運用上均感不便及不足。為長遠之教學、研究、保育及行政管理上之需要，建立基本資料庫乃為急要之工作。目前本項工作係由調查研究及資料收集兩方面並行。調查研究方面，因限於人力、經費及工作場所，採分年分期實施，第一階段以較稀有之動植物及地景為對象；如蘭嶼角鴞、珠光鳳蝶、台灣獼猴、長鬃山羊、山羌、紅樹林、稀有植物羣落以及南部泥岩惡地形、火炎山等為對象，實施調查研究。自（七十九）年度開始，擴大調查研究領域至淡水魚類之研究。國內有關自然生態保育工作推行之歷史尚短，許多資料及圖書尚不充裕，有待收集國內外已有資料，供為教學研究及管理上之參考；數年來政府投入經費數百萬元，收集期刊五十八類圖書數百冊，並繼續辦理中，希望未來能成立國內自然保育圖書資料中心。並配合六年國建，擬訂自然保育五年中程計畫，預定於八十二年度起開始執行。另，台灣省政府農林廳亦於八十一年七月成立台灣省特有生物保育研究中心，在調查研究人力上，將稍有助益。

2.5 人才培育，充實國內人力。

依據近年來推行自然保育工作經驗，深覺現有國內相關專業人士甚感不足。為奠定長遠之自然保育基礎，人才之培育工作實屬刻不容緩。但人才需求層面頗為廣泛，學術、技術、教育、行政及推廣等方面均需予以包羅。因此人才培育之工作千頭萬緒，實應有完善之規劃，但因國內之生態保育工作推展速度極快，人才需求孔急，人才培育

只得先從技術性重點之方式進行，其實施方式採用國內外培育並進方式辦理。國內之訓練方面採用大型研討會、講習班方式辦理，邀集訓練國內實務工作之人員，提昇其工作效率及品質。國外訓練以選派國內優秀之學者、專家或技術人員赴國外考察、進修及研習，以吸取外國之經驗、技術、制度及長處等供國內之參考，並藉此促進國際間相關工作之交流。多年來在國內已舉辦野生動物及野生植物資源及自然景觀保育之大型研討會若干次，參與人員有數千人次。

七十七年十二月間在台北中央研究院舉辦之國際性自然生態保育研討會，邀請美、日、菲、泰等國專家以及華盛頓公約(CITES)組織，世界野生動物保護組織(WWF)等人士參與盛會。七十八年四月在台北市立動物園舉辦「台灣動物淵源」研討會；辦理溪流研討會，邀美、日溪流專家蒞臨演講；中日櫻花鈎吻鮭研討會等等，並每年定期舉辦自然文化景觀調查研究成果發表會，以促進技術交流，再者，又促進國內野生動植物及其產品的鑑定及分辨技術，陸續舉辦象牙、犀牛角管理研討會等活動。

技術訓練方面，舉辦候鳥繫放演講、野生動物調查研習會，邀請美國、日本、澳洲專家來台指導，參加受訓之人員包括民間及政府等各級單位之代表等。野生動物調查研討會於七十六年二月間在台北舉行，由來自美國紐約動物協會之Dr. Alan主持，共約二百餘人參加。國內相關機構林務局等亦自七十九年起定期舉辦各種技術研習會，邀請國內外學者專家指導專業性技術，增進工作人員技術，迄目前為止，已調訓一百多人次增加工作人力。在科技方面訓練方面舉辦調查技術，無線電追踪野生動物技術，鳥類辨識，野生動物經營管理，保育技術，野生動物疾病臨床病例診斷技術，環境教育解說教育等研討會及講習會，以提昇國內各種管理科技之水準，參加人數有數百人次。而在政策法規之宣導上亦積極推動，以加強宣導及執行，自然生態保育方向與策略研討會，台灣犀牛角買賣方案之研討會，野生動物檢疫辦法草案修正會議，海岸土地開發對濱海線生態自然環境資源之影響座談會，文化資產保存法修正草案會議等均陸續推展，希望國內有關自然生態及野生動物之保護更為落實。此外為落實野生動物保護工作，自八十年度起，中央政府編列經費全面補助各地方機關及保育團體

執行及協助政府推行保育業務及工作，省（市）及各縣（市）政府也紛紛運用經費開辦相關技術訓練班及講習會。

在國外訓練方面，每年均派遣專家或學者前往日本、英國、南非、美國及澳洲等先進國家研習自然保留區之經營管理技術，野生動物調查、復育技術，保育類野生動物及產製品鑑定技術以及相關法規政策等，以供促進國內相關工作推展之參考。

2.6 加強法令之執行，查緝及消弭非法野生動物交易與走私行為

民國七十九年野生動物保育法公布實施，因屬國內新法，民間不易全面瞭解及接受；為使法令能貫徹實施，一方面經由政府組織體系，省（市）、縣（市）及鄉鎮村里之文宣工作，加強法令之宣導，舉辦基層工作人員法令研習班，加強基層人員法令執行能力，參與各種文化環保之活動等以增加野生動物保育法規之傳播層面及執行能力外，並由省（市）縣（市）政府成立野生動物違規查緝小組，配合警力，每年定期舉辦宣導及掃蕩不法之野生動物買賣等行為，每年一～二次，遇有重大及特殊情況，則予機動查緝。經二年多之執行，經查獲205件違反野生動物保育法案件，而經法院判刑確定者157件。

台灣是個四面環海之島嶼，利用船舶走私甚為容易，致走私保育類野生動物之行為經常被發現，其走私動機可分為不知情之情況及蓄意謀財二類，前一類者以遊客攜入為多，後一類者以大量進口，利用漁業及貨櫃，虛報假貨或闖關方式為多。為消彌走私行為本會配合海關及警政署等機關加強查緝，並配合國際間查緝工作，二年來已查獲之走私犀牛角案共八件，共272支（附表2）。同時為宣示我國政府保護犀牛及消除走私之決心，自民國七十九年五月起先後焚毀走私沒入之保育類野生動物產製品達五次之多，焚燒犀牛角42支，重67.55公斤及象牙等製品，共重三千九百餘公斤（如附表3）。

2.7 提昇我國之國際形象

國人由於傳統習性與觀念，一向不太重視野生動物保護，食補的的觀念仍深植人心；致當街宰殺鹿、殺蛇、虐待動物之行為，仍習以為常，不斷發生。民國七十四年間，台南縣白河鎮當街宰殺老虎之事件，經由媒體報導後，引起國際保育團體及人士的關切與不滿，國際

間指責及不滿之信函持續不斷，使我國之國際形象跌入谷底。戲稱〝台灣是觀光樂園，也是野生動物之地獄〞。為改善此種不良現象，並促進國際間之技術交流及相互瞭解；自民國七十五年起，以邀請國際保育組織人士來台訪問及派遣國內學者專家參加參與國際性會議及保育之雙管道並進方式，期以提昇我國國際形象。歷年來已邀請世界野生動物基金會(WWF)，國際野生動物及魚類保護協會(IAFWA)、國際鳥類保護同盟(ICBP)，世界自然及自然資源保護聯盟(IUCN)，國際野生動植物貿易記錄特別委員會(TRAFFIC)等保育團體人士及日本、澳洲及美國等國家保育界人士來台訪問，促進其對我國對野生動物及自然生態保育工作決心及成果之瞭解；多年來，經我國相關機關團體及民間人士之努力，已漸獲國際間的初步瞭解及肯定；但由於國內對於國內保育類野生動物之走私，如紅龍魚、娃娃魚、犀牛角、象牙等之走私，以及野生動物製品之出口，如鱷魚皮件之加工出口等仍多，欲使華盛頓公約組織(CITES)之國家常常批評我國保護動物不力。誠屬美中不足。國際保育活動之參與方面，歷年來多次派遣學者專家，前往馬來西亞、以色列、美國、加拿大、日本、委內瑞拉、瑞士、澳洲等國參加ICBP、IWRB、IAFWA、IUCN、CITES、CNPPA等國際性保育組織會議及參與部份活動。我國研究成果如蘭嶼角鴞、長鬃山羊及櫻花鉤吻鮭之復育等已深受國際間之好評。

最近由於犀牛角問題，英國環境調查委員會(EIA)及美國保育團體在我國及英美等地區展開批評我國政府保護野生動物不力，要呼籲歐美國家人民抵制我國之國際貿易，藉以對我政府施壓力，要求加強野生動物之保護，尤其是非洲犀牛之保護。又使我國際形象再度受創，多年來的努力效果受到了嚴重的破損，全國輿情激憤，為求紓解此一難題，正循外交管道，說明並澄清事實，以求解除國際間之誤解，消除不公平之抵制活動，並維護我國之良好國際形象。

3.結論與展望

自然生態系中包容許多再生資源，為民生及產業發展，具有密切之關連性，以致經濟產量發展與經濟建設活動與自然生態野生動物保護常有相互抵觸之處，尤其是開發中國家，為謀求經發展，常會犧牲

生態保育與野生動物保育。我國以往重視經濟發展，忽視生態及野生動物保育，致已有部份生態系及野生動物受到破壞或滅種，但經濟建設又屬民生建設之重要環節，不容忽視或放棄，故二者之間必須相互容忍，推行兼顧生態保育之經濟建設。近年來，我國自然生態及野生動物保護之觀念已快速上昇，各種法規制度也逐步建立，經濟建設之進行速度，因受此觀念之影響及法規制度之管制，已逐漸慎重處理而趨緩慢之現象。此種現象，從自然生態及野生動物保護觀點而言，誠屬可慶幸。但國家之經濟建設為國家發展之重要環節，不容過度忽視，今後如何繼續努力，尋求二者之平衡焦點仍屬重要任務，相信不久的將來，在大家共同努力之下，必能達成經濟建設與自然生態野生動物保育能平衡兼顧之發展模式，以維護自然生態及野生動物資源之永續利用。

附表2　查獲之國際間與我國相關的犀牛角走私案

年	內容	犀牛角量(支)
1990	荷蘭警方查獲企圖走私至台灣	20
1990	南非ESPU攔截九個寄往台灣的郵包緝獲，並逮捕台灣劉姓商人。我國台北關亦配合查驗案列，台灣之郵包，但未有所獲。	51
1990	南非ESPU在史瓦濟蘭緝獲九個寄往台灣郵包，我國海關亦配合逐個查驗由南非及史瓦濟蘭進口郵包，但未有所獲。	53
1990	南非ESPU逮捕兩名台灣商人，非法擁有犀牛角。	29
1991	高雄關查獲南非貨輪王子號走私。	6
1991	台北關稅局查獲走私犀牛角	36
1991	南非ESPU逮捕三名台灣商人，非法擁有犀牛角。	55
1992.12	航警局查獲走私犀牛角	22
	合計	227

註：ESPU＝Endangered Species Protection Unit。

資料來源：行政院農業委員會林業處

附表3　歷次銷燬走私保育類野生動物產製品活動之犀牛角數量

時　　間	地　　　點	主　要　銷　燬　貨　名	總　　　重	犀牛角隻數／重量
79.5.22	基隆南榮公墓	象牙及其產製品	約 700 公斤	無
79.11.27	家畜衛試所	象牙及其產製品熊掌等	約 75 公斤	無
80.1.30	家畜衛試所	象牙及其產製品犀牛角等	＞ 300 公斤	7 支／ 4.4 公斤
80.10.5	家畜衛試所	象牙及其產製品犀牛角等	2000 餘公斤	15 支＞ 34.9 公斤
81.2.28	高市萬壽山	象牙及其產製品犀牛角	600 餘公斤	20 支／ 28.25 公斤

犀牛公開銷燬次數共計三次，總共銷燬犀牛角 42 支，67.55 公斤。

資料來源：行政院農業委員會林業處

台灣瀕臨絕種鳥類之保育研究

（蘭嶼角鴞）

劉小如

一、緒言

蘭嶼角鴞(*Otus elegans*)在1928年被鳥類學家發現，當時認為是角鴞(Otus scops)的蘭嶼亞種(Otus scops botelensis)（蜂須賀正氏與宇田川龍男，1951）。馬竭爾（1978）根據亞洲各種角鴞叫聲的聲波及音形分析，判定蘭嶼角鴞不是角鴞的亞種，而與琉球角鴞同屬於另一種Otus elegans這種角鴞共有三個亞種，分別分佈在蘭嶼、琉球及戴脫(Daito)島上(Marshall 1978，King 1981）三個亞種的自然史及族群均未曾有人深入研究過，因此資料極少。

紅頭嶼產鳥類之生態分佈(鹿野忠雄，1931）中記載當時蘭嶼角鴞數量普遍。1969年我隨東海大學鳥類繫放小組到蘭嶼調查鳥類時，蘭嶼角鴞的數量尚稱普遍，但是1973年馬竭爾（1978）估計只存約10隻雄鴞，雌鴞數量不知。蘭嶼、綠島風景特定區之動物生態調查報告（林曜松，1982）中記載有蘭嶼角鴞在森林中活動，但未紀錄數量及普遍程度。蘭嶼地區自然及人文資源保育與開發研究（台灣大學土木工程研究所，1984）中，引用林曜松（1982）的資料，並未進一步從事現場調查，所以僅知蘭嶼角鴞的數量，自日據時代到1973年逐漸減少，其後是維持穩定或繼續減少則無確實數據。

二十年來，蘭嶼角鴞被認為是世上稀有鳥類，甚受國際矚目，政府有關單位屢次受到國外保育團體懇請，希望重視蘭嶼角鴞之保育，本計劃之目的在於判定蘭嶼角鴞現存數量，及基本生物狀況，研究其棲地需求，棲地存留狀況，族群變化趨勢等及社會行為等方面，以初步瞭解其瀕臨絕種狀況，並對其保育提出初步建議。

二、研究方法

㈠文獻資料蒐集整理：

詳細檢閱各種有關蘭嶼自然環境與生態的書籍與報告，將其中有

關蘭嶼角鴞部份加以彙集整理，以對蘭嶼角鴞既有資料，得到較完整之瞭解。並進一步蒐集國外鴞類之中類似種之相關文獻，以為研究蘭嶼角鴞之參考。同時，由錄取過蘭嶼角鴞叫聲之馬竭爾博士處，取得蘭嶼角鴞叫聲錄音帶，以為野外工作之參考。

㈡訪問與求證：

因既有資料少，調查研究之初期及期間，工作人員時常訪問蘭嶼島上各村莊、駐軍、及其他長住蘭嶼之居民，以獲得有關蘭嶼角鴞活動及被捕捉之資料，其中可追踪的線索，均實地加以求證，而不可追踪的資料，則用為本研究之參考，藉以彌補短期研究涵蓋面有限之缺失。

㈢野外實地調查：

因蘭嶼角鴞是夜行性鳥類，實地調查除需於白天探勘調查路線，繪製地形及基本植被圖外，主要觀察紀錄工作，均於夜間進行。主要工作方法及項目如下。

1. 全島角鴞分佈調查—以蘭嶼環島公路為外圍，經由登山小徑、山谷、及溪谷，逐步向內陸核心地區搜尋，由外向內設一系列的觀察點，以了解全島角鴞分佈情形。觀察點的選定，根究①文獻中所記觀察地點及植被特色，②當地居民的報導，③以航測圖為輔助，及④實地勘察。

2. 蘭嶼角鴞叫聲的記錄與分析—於傍晚到清晨時段，在觀察點分數個據點記錄角鴞鳴叫的時間、方位及鳴聲、事後三角定位法，根據鳴叫的時間，叫聲及方位，判定角鴞位置，並估算隻數。

3. 錄取叫聲——錄音機錄取角鴞叫聲，藉音波分析儀分析蘭嶼角鴞叫聲種類及特質。

4. 捕捉與標放—於適當地點張網，或設置以小白鼠為餌之陷阱，儘力捕捉蘭嶼角鴞。捕得之角鴞除做各種基本測量之外，並分別各套上一鋁製有編號的脚環，及一彩色塑環，以供日後辨認個體。

5. 特定點調查——根據實地觀察的結果，選擇數個蘭嶼角鴞叫聲較多，或確知角鴞時常出現地點。做進一步行為觀察及棲地特色調查。棲地特色調查包括植被結構，植物種類，及樹洞調查，並以P．C．Q方式調查樹木密度及樹種分佈(smith 1966）。調查資料記錄表見

附錄二。此外並廣設捕鼠夾及鼠籠，以期瞭解當地小型哺乳類族群變化對角鴞食物量之影響。

6. 行為觀察——非生殖季時，若夜間聽到角鴞叫聲，即設法尋找聲源，觀察記錄角鴞棲息位置及活動狀況。生殖季之行為觀察，除追踪個體觀察之外，並以巢為據點，記錄巢邊的各種角鴞行為。

7. 向國外定購了一套無線電追蹤器材，使用之頻道為151.313至151.552 MHZ，電池之有效壽命是4－5個月，裝佩好之發訊器總重均低於5 g，約為角鴞體重之4.5%，發訊器天線為30 cm。工作人員於獲得使用執照後，開始以接收訊號的方式追蹤角鴞之動態。追蹤方法有二種，其一適用於已知活動地區之個體，即二組人於不同地點同時接收同一類頻道的訊號，以便確定帶有發訊器個體之位置，其二是針對掛有發訊器但行蹤不明之個體，即工作人員攜帶收訊器到全島各地，不斷嘗試接收各標的頻道，以發覺失蹤之角鴞是否在左近活動。

結果與討論

根據前五年之研究結果，蘭嶼島上仍有約二百隻角鴞生存，此族群除被當地居民捕捉外，也面臨著棲地被開發破壞，以及良好的天然巢洞有限等的生存壓力。

蘭嶼角鴞生存在有巨大老樹的成熟林中，也有部分散佈在全島各地之邊緣地帶。成熟林中角鴞密度很高，個體活動範圍有極大重疊，常有數隻在彼此之附近覓食或休息；雖前五年之研究中從未見角鴞展現敵對行為，去年卻曾於一週之中見到多次打架，但其後又不見敵對行為。知此種敵對現象是數年才出現一次，或每年均短暫出現，只是往年研究人員均恰巧錯過，邊緣地帶之角鴞因密度低，並未見配偶以外之社會關係。

於成熟林中活動之個體，有些全年使用同一棲地，其他會在生殖季後移往他處，另有一些僅在求偶期會在特殊地點出現，其後移往他處繁殖。全年留在同一棲地者，似乎較能佔用品質較佳的巢洞。若此即表示位階高低，研究人員至今仍不知地位的維持或變動機制，但高位階者似乎每二三年即會被在附近等待者取代，而得移至附近另覓樹洞繁殖。此時雌鴞是隨著雄鳥遷走，或留下與新雄鳥成對則仍待進一

步研究。

部份角鴞有強烈領城行為，尤其在生殖期前期更為明顯。角鴞雖會廣泛利用邊緣地帶，但每地點之隻數均很少，繁殖成功率因人類干擾而幾近於零。邊緣地帶之面積與分佈，因人類開發範圍的擴張而增大，適於角鴞生存之棲地面積逐漸減少，邊緣地帶雖也可維生，卻不允許有社會行為。蘭嶼開發的脚步愈走愈快速，除了為建築所需大量挖採砂石（例虎頭坡），導致整片山林的消失外，過去一年中地方人士墾植的面積也不斷擴大，使原生或次生植被減少。墾植面積擴展的原因：①住民及大量遊客導致當地人口增加、需要也隨著增加。②傳統農地被改為房舍，只好另闢農地。③本地人之口味轉變，許多新闢田地上種植的是為滿足外地口味的白菜、花生、蘿蔔、及芫荽等。此種耕作，未來可能走向使用農藥及肥料之地步。對角鴞之主食昆蟲之數量，必有未可預知之影響。而如今已發生之棲地改變，對角鴞生存之壓力，有待進一步研究。

80 年9月份耐特颱風對蘭嶼之棲地造成嚴重破壞，但目前尚看不出對角鴞之族群數量有明顯之影響，惟部份實驗區發現巢洞利用情形有明顯之改變。在這一年的繁殖季中，許多原巢洞之擁有者均消失了，有的則換到不同的巢樹。此外，在去年所發現的巢中，每窩均有二至三個蛋，但大多僅孵出一隻幼鴞：，不同於往年的情形。這種現象不知是否因颱風導致嚴重棲地破壞所造成，或是有其他原因，有待進一步追蹤調查。

以無線電標記追蹤幼鳥活動狀況發現，幼鳥離巢後仍在巢樹附近活動，約二個月後才脫離親鳥飛離巢樹區。曾追蹤到一隻亞成鳥，於離開巢樹區後沿著山的邊緣移動，二天後在距巢樹區約三公里，山的邊緣處停下來，在附近活動兩個月後失蹤，雖以無線電繼續追蹤，卻未再發現其蹤跡。

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Conservation of Rare Marine fishes in Taiwan with Emphasis on the Coral Reef Fishes

Shao, Kwang-Tsao

Institute of Marine Biology, National Taiwan Ocean University
Keelung, TAIWAN, R.O.C.

Institute of Zoology, Academia Sinica
Nankang, Taipei, TAIWAN, R.O.C.

Abstract

Although a more precise estimate is needed, probably one-third of the 2,400 marine fish species in Taiwan are rare. Especially more than half of the 1,500 coral reef fishes species in Taiwan are rare, vulnerable, or endangered. Long-term overfishing, illegal fishing methods, pollution, habitat destruction, expanding trade in aquarium fish and other factors threaten coral reef fishes, sometimes even before we are aware of their presence. Unfortunately less attention has been given to the loss of the marine fishes than to the freshwater fishes or terrestrial animals. Certainly everyone agrees that marine biodiversity is at least as important as terrestrial biodiversity, but often it is given lower priority, no doubt because of presumed lack of information or difficulty of research. These should be recognized, but they should stimulate research rather than hinder it. Also, marine fishes clearly are wild-animals and should be included in any wild animal assessment and conservation.

Some marine conservation actions have been initiated or taken in Taiwan in the last ten years. These include the policy of zero-growth of annual fishery production, creation of several marine sanctuaries, promoting the projects of mariculture (including establishment of artificial habitat), encouraging marine biodiversity and ecosystem research project and establishing planning groups for several new marine museums and aquaria. To demonstrate the above points, our research experiences and the conservations status of marine fishes in Taiwan will be presented and discussed. However, to date only two species of marine fish have been listed in the endangered species list which has hindered legel efforts for protection. Thus, in future, We hope that the IUCN can help to increase awareness on the need for protection of marine fishes of the world, and that conservation of rare marine fish species can receive more attention by the government and the people of Taiwan.

台灣稀有海水魚類之保育

邵廣昭

國立台灣海洋大學海洋生物研究所

中央研究院動物研究所

摘　　要

根據初步的估計， 台灣產的2,400種海水魚類中約有三分之一的魚種爲稀有種類； 特別是1,500種珊瑚礁魚類中，有將近一半是屬於稀有或瀕臨滅絕的魚種。造成海水魚類稀有種數偏高的原因主要是來自於人們的過漁、毒魚、電魚、炸魚、污染、棲地破壞及流行飼養海水觀賞魚的風氣等；甚至於可能有不少種類是在尚未被發現或記錄到前，即已消聲匿跡。或許由於缺少足夠的調查與宣導，海水魚的保育過去一直未曾受到大家應有的關切與重視，比起淡水魚類與陸生動物的保育而言更有天壤之別。事實上生物歧異度之維繫應不分海洋或陸地，生物的品種也應不分貴賤，因此海水魚類也應被視爲「野生動物」之一類，而與其他野生動物一樣應積極展開調查與保育的工作。

過去十餘年來台灣在海洋生物資源方面的保育工作已開始起步，譬如漁業生產量的零成長政策，沿海保護區的劃定，栽培漁業（包括人工棲所）工作之持續推展，鼓勵與海洋生物歧異度與生態體系有關研究計畫的提出，以及若干大型海洋博物館或水族館之籌設等等。本報告係根據筆者個人過去在台灣研究海水魚類之經驗與資料，特別是珊瑚礁魚類的部份，整理報導有關台灣海水魚類的保育現況，並提供檢討與建議，希望能藉此拋磚引玉，喚起國人對海水稀有魚類保育工作的重視。總之，由於國際間迄今一共只有兩種海水魚類被列入瀕臨絕滅的保護動物名單之中，以致於海水魚類的保育工作在國內外一直無法有效推展。希望未來IUCN能在國際上更積極地來推動海水魚類的保育。

前　　言

據Nelson (1984)的估計， 全世界的魚類約有22,000種左右，其數目已超過所有其他脊椎動物的總和。事實上由於同種異名的問題，魚種總數的估計差距頗大，可從17,000到30,000種之間。魚類種名變動與新種類發現的速度也遠比其他

任何四足類要來的快。在這龐雜的魚族中，海水魚類估計佔了60%以上，至少應有15,000種，它們生活與分佈在佔地球面積達70.8%的海洋環境之中。而在海水魚類部份又以珊瑚礁魚類最應受到大家的關心與重視， 因爲將近三分之一超過4，000種以上的海水魚類是生活在僅佔地球面積不到0.2%的珊瑚礁海域範圍內。珊瑚礁在海洋生態系中之重要地位可以説是海中的熱帶雨林，其中單是魚類的種數即可與全世界共有的2,500種兩棲類，6,300種爬蟲類，8,600種鳥類與3,700種哺乳動物不相上下。

台灣的土地面積雖小，但四面環海，且有幸位在珊瑚礁分佈的地區，所以它的海洋生生物資源異常豐富。 其中海水魚類的種類據推測應在2,400種以上，遠比陸地上的初級性純淡水魚50餘種與所有淡水魚150餘種要多的多。 它的數目也遠比台灣已記錄到的30種兩棲類， 90餘種爬蟲類，420種鳥類和61種哺乳動物要多。或許海水魚類因爲種類多反而被大家誤以爲資源仍多，而遭到忽略。但是事實上台灣的海水魚類有將近三分之一到一半以上的種類現存的數量已甚少。就保護生物歧異度的眞正意義而言，地球上任何一個生物種類都應有它生存的價值與權利，種是不分大小、貴賤，也不分它們分佈的位置與環境，因此海水魚類也應被視爲野生動物的一類，受到同等的關注與保護。

由於本省過去漁業的過度發展，非法毒魚、電魚、炸魚、沿岸的不當開發利用，以及河川及沿海環境的嚴重污染等等，已使得本省的海水魚類的種類及數量有銳減或瀕臨絕滅的危機。譬如在近沿海魚類方面，中表層洄游魚類受流刺網、定置網、圍網等各型漁具的過漁壓力，已使不少魚種魚蹤杳然；沙泥底棲魚類則受數量龐大底拖船以細密網目的反覆拖曳，多已一掃而空；美麗珊瑚礁魚類在水族業者的蒐購下，也多半被捕撈殆盡。所謂全球性生物歧異度銳減的問題，對本省的海水魚類而言，可以説早已情況嚴重。雖然國內近年來環保意識抬頭，自然生態保育的觀念亦已漸植人心，但因缺乏有效的行動與尚偏重在陸生動物包括淡水魚類等少數種類的宣傳保育上，以致於許多海水魚類的數量已從過去的豐富、常見一一變成目前的偶見或罕見，甚至於有許多種類根本在尚未發現或記錄到它們之前即已消失殆盡。

根據筆者過去多年來從事本省海水魚類，特別是珊瑚礁魚類之調查，估計海水魚類中大約有三分之一是屬於稀有魚類， 特別是約1,500種珊瑚礁魚類中有將近一半以上已屬於罕見的種類。可惜這些足以令國人引以爲傲的自然生態資源卻始終未曾引起大家的重視與關切。在各種自然與人爲因素的威脅下，稀有終將變成滅絕（邵，1988） 。本報告之目的即在整理介紹本省海水魚類的種類、分佈及其特色，它們在學術研究、漁業或觀光資源利用方面之價值，並檢討目前各種危

害海水魚類的自然或人爲因素，最後提出應如何加以維護及保育之個人建議。希望能及時喚起社會大衆及有關單位的重視，共同努力來挽救這些珍貴的本土生態資源，使我們後世的子孫也可以親自下海觀賞到美麗的海水魚類，終生享用海洋中豐盛的魚類資源。

台灣的稀有海水魚類有那些

由於海水魚類分佈範圍甚廣，採集調查研究不易，過去所投入之人力與物力亦十分不足，因此目前對海水魚類種類、分佈、與生態習性仍所知甚少，特別是許多魚種的現存數量難以作精確估計。一般的經濟性食用魚類或可由歷年來漁獲量的變動而窺知一二，而沿岸或底棲非經濟性之魚種的數量資料則近乎闕如。根據筆者研究室多年來從事台灣近沿海魚類或漁業之調查資料，以及在全省各地實地潛水從事魚相分佈、群聚生態調查、與海域生態環境監測的結果，初步估計台灣產的2,400種海水魚類中約有三分之一的魚種爲稀有種類，特別是1,500種珊瑚礁魚類中，有將近一半的魚種是屬於稀有或罕見的種類（邵，1992）。表一所列即爲一些主要被利用作海水觀賞魚或熱帶魚的種類，它們目前在台灣存活數量的現況。

由於稀有海水魚種類太多，限於篇幅無法將種名一一列出。基本上能引起大家關心與愛護的魚種不外乎是那些色彩鮮豔、體型、形態與生態習性、行爲特殊的魚類。這些魚類也正是水族業中海水觀賞魚所獵捕的對象，因此由水族貿易的資料，也多少可以看出魚類稀有的程度。只是在物以稀爲貴和追求飼養海水魚的時尚的心態下，許多還不能人工繁殖的海水魚類在供不應求的濫捕壓力下，已近乎絕跡。海水魚類不像淡水魚類這麼容易界定爲「稀有」、「珍貴」、「瀕臨絕滅」或「固有種」的原因，乃因爲海水魚類的活動範圍廣，出現的數量與時間常不固定，分佈至其他各海域的資料亦多不完整。因此很難有把握去正確評估，一一列舉。

通常值得我們去妥善保護的海水魚類，除了因爲它們數量稀少之外，如果它們地理分佈範圍很窄，譬如全球只分佈在台灣海域的魚種也就是一般所謂的固有種 (endemic species) 自然最爲珍貴， 但是這些只在台灣發現的新種海水魚類，也有可能未來在其他鄰近海域被採獲，或現存數量仍多，故海水魚類很難像淡水魚類的高身鏟頜魚、櫻花鉤吻鮭那樣經由訂爲固有種或奉爲「國寶級」的魚類來引起大家的重視。事實上站在學術研究價值與保護物種歧異度之觀點，只要是分佈在台灣、琉球或從東海至南海一帶範圍窄的海水魚種都應值得我們去加以珍

惜與愛護。根據筆者目前所建魚類資料庫的資料，只分佈在台灣、琉球的就高達80種以上；只在日本、東海、台灣的有60種；日本到南海的也有80種之多。表二所列則爲最近十餘年來國內外魚分學者根據台灣採獲標本所命名之若干新種海水魚類，其中雖然有些種類已在鄰近之琉球或南中國海被發現，但它們的世界地理分佈甚窄，故在學術研究的價值上仍彌足珍貴。反過來說更有許多在世界其他地區所發現之珍稀魚種，也陸續在台灣被採獲。這些魚種多半以新記錄方式發表，種類之多更不勝枚舉，譬如筆者與實驗室同仁最近將發表之蘭道氏花鱸（Plectranthias randalli）、大青彈塗魚（Scartelaos gigas）、帕氏倒棘鯒(Rogadius patriciae）、羅氏紅鬚金眼鯛（Barbourisia rufa）、或是目前連分類地位均尚未明的外腸仔魚(exterilium larval fish of Ophidiiformes) 等等。累計筆者實驗室過去十年來所發表過之新記錄種魚類即已不下三百餘種。

在大型洄游魚類方面， 特別值得一提的是魚類體型最大的鯨鮫（Rhiniodon typus）以及性情溫馴，體態特殊可愛的翻車魚（Mola mola）。它們分佈的範圍雖廣，亦無攻擊性，但因國人視爲佳餚，而被捕獲殆盡十分可惜。反之，凶殘之鯊魚過去數量雖然龐大，但是由於國人嗜食魚翅或鯊魚煙，在過度捕撈之情況下，近年來亦和海豚一樣已成爲稀有的海中動物。這些大型海水魚類之資源已有全球性枯竭的現象，遲早台灣發達的漁業又將成爲衆矢之的。

台灣海水魚類之分佈及其重要性

海水魚類的分佈主要受海底地形底質、海流與水溫等因素影響最大。本省西岸皆爲砂質淺灘，棲息魚類除中表層洄游魚種外，均爲沙泥底棲性之魚種；而大洋性洄游魚類多出現在東岸中表層水域。東岸之深海直下數千公尺其間所孕育之深海魚類可惜迄今仍未調查與開發。岩礁或珊瑚礁棲性之魚種複雜，台灣之岩礁或珊瑚礁呈不連續之帶狀或塊狀分佈，多集中在北部、南部及離島地區。由於台灣恰位在黑潮主流（高溫高鹽）、閩浙沿岸水（低溫低鹽）及南中國海（高溫低鹽）等三水系之交會處，海流、水文、底質、水深各條件均備，故台灣海域面積雖小，卻擁有如澳洲大堡礁或菲律賓、新幾內亞般的豐富魚相。而且台灣南北之魚相顯著不同（西部在澎湖東吉或西吉一帶交會），許多魚種係南有北無或相反；亦有不少種類之分佈僅在日本及台灣，或是以本省北部爲其分佈南限；反之南部之魚種多爲廣佈種，以南部爲其分佈之北限的種類並不多（沈等，1990；邵等，1991）。總之本省之海水魚種具有甚高生物地理分佈之學術研究價值。

魚類是水域生態系中營養層最高之成員，不但主宰海洋，也是人類動物性蛋

白質的主要來源。它不論對海洋生態系之平衡、漁業經濟、及觀光遊憩各方面均十分重要。經濟性魚類之重要性姑且不論，就珊瑚礁魚類而言，它本身也可以被人類直接獵捕食用（如表一中所註有*之魚科），此外還有非採捕性之利用價值，如推展海底觀光，利用浮潛、水肺潛水、或玻璃底遊艇、水中瞭望塔等來從事「賞魚」或水中攝影等正當之新興遊憩活動。相信未來在觀光旅遊方面極具發展潛力。據報導目前未開發或開發中國家之沿岸漁民仍以傳統之漁法捕珊瑚礁魚類爲食每年高達500萬噸，佔總漁獲量的7%。其比例雖低，但因珊瑚礁魚類較大洋性洄游魚類更易受到「過漁」之傷害，故實應儘量避免。台灣目前直接獵捕珊瑚礁魚類之數量雖不多（尚無統計數字），但在礁區仍屢有毒、炸、底拖及捕撈熱帶魚等情事，加上海釣開放，岸釣、潛水活動蓬勃發展，若無妥善管理，勢必對海水魚類多少會有負面影響。

台灣海水魚類資源所遭受之危害

了解海水魚類可能遭受的危害，才可以對症下藥，合理制定保育的方法。以下乃就台灣地區可能發生或已發生之情形分別簡述於下（邵，1988）：

A. 天然災害方面

(1)颱風--所引起之狂濤巨浪會直接破壞沿岸魚類棲息之海底之生態環境，特別是摧毀質地脆弱之珊瑚叢。

(2)寒流--不正常之冷水團入侵，使魚類不及躲避而凍斃，過去南灣及澎湖地區均曾發生過。

(3)淤沙--雨季時大雨會將陸地上水土保持不良之泥沙沖入海水，使海水混濁，珊瑚之成長受到抑制，間接影響魚類。

其他像破壞珊瑚之棘冠海星的大量繁生或因雙鞭藻所引起的赤潮等，所幸此二者均尚未在台灣造成明顯的災害。最近El Nino現象所引起全球海水溫度之升高是否會影響魚類群聚結構之變化也已受到大家普遍的關心與重視。台灣目前正進行雙溪水域生態體系之監測即屬配合全球變遷中海陸交互作用（LOICZ）之一項研究計畫。

B. 人爲災害方面

(1)沈積--沿岸因建港、築堤、闢魚塭、填海、挖泥、疏浚、抽沙等工事， 引起的混濁、漂沙沉積會使珊瑚窒息，破壞魚類的棲地。

(2)廢水--來自下水道之家庭廢水、 港澳船隻排放之廢水廢油、工廠或農業之廢水、農藥或肥料之污染均經由各地河川滙流入海，直接威脅魚類之生存。

(3)過度撈捕--漁民之過漁， 年漁獲量與漁民漁獲幾乎相當之海釣活動，捕撈海水觀賞魚等均會直接威脅海水魚類之資源。 而間接地採珊瑚，採集蝦、蟹、貝類也會因影響魚類棲所與餌料生物而有負面影響。

(4)非法採捕--非法之毒魚、 炸魚（含軍事演習）、潛水獵魚、以及底拖網漁船入侵三海浬之沿岸，包括珊瑚礁海域等等爲害最烈。 此外如魩鱙漁業及飛魚卵之採捕有如殺雞取卵， 焚寄網之强光可能使仔稚魚失明等等，均會對仔稚魚造成很大的傷害。

(5)遊憩活動--隨著海防管制漸鬆， 海洋遊憩活動帶來之人潮，在缺乏保育之觀念下， 任意拋錨，丢棄垃圾，踐踏珊瑚（海底步道），採集海洋生物等等，都會對魚類造成衝擊。特別是潮間帶地區破壞最大。

(6)溫排水--沿岸電廠利用海水冷卻反應爐所造成魚類之汲取、撞擊； 與排放溫排水所引起出水口附近底棲生物群聚之改變等， 也會影響漁業資源並造成局部漁場改變。

(7)油污染--來自油輪觸礁之洩油事件（如布拉格、東方佳人號等）， 對沿岸潮間帶之破壞最烈。

(8) 引進外來種 -- 過去大家均認爲養殖或觀賞用外來種之引進只會對淡水魚類造成衝擊， 而對分佈廣、環境變化較小的海洋應不致造成影響，但國外愈來愈多的証據已顯示海水魚引進， 特別是島嶼國家，有可能造成當地沿岸海域魚相之改變（ Randall ， 1980 ）。

台灣稀有海水魚類之保育策略

上述天然災害部份多係人力無法抗拒，故不易防範，但所有人爲因素的危害則可以透過各種教育宣導，監測評估，與保育管理的手段來加以防止控制。茲分

述如下：

1.加强調查研究：此項基礎工作包括了解本省海水魚類之魚種組成、地理分佈、數量與季節變化，群聚變遷及生態習性等現況。如此方能認定那些是固有、稀有、或瀕臨絶滅的魚種，進而制定正確有效的保育措施；或是進一步研究人工繁殖，利用種苗放流，劃定保護區等方式來加以復育（邵， 1991 ）。特別海水經濟或觀賞魚類之繁殖研究，目前成功率不及百分之一，遠不及淡水魚類之成就，對稀有物種之種源保存及滿足社會大衆飼養海水觀賞魚之喜好均難以達成。國內近年來成立之「台灣特有種生物保育中心」亦盼其未來能將海水魚類納入其工作範圍。此外調查研究所獲之基礎資料也可提供解説教育之所需。

2.推展宣傳教育：使民衆藉認識了解稀有海水魚類來支持並參與海水魚類的保育行動。因此除在各種宣傳媒體上廣爲報導介紹本省之海水稀有魚類現況外，並宣導正確的保育觀念，包括不抓、不養、不吃（包括供作中藥材之海龍、海馬等）海水稀有魚種；推廣實地下海潛水去認魚、賞魚、餵魚、水底攝影等的户外活動等。國內目前正籌設中的國立海洋科技博物館、國立海洋生物博物館、澎湖水族館與民間企業計畫投資設立之大型國際水族館等均應能充份發揮教育宣導之功效。

3.積極復育魚源：劃定沿海保護區，禁止任何人員或人爲干擾仍是最簡易有效的保育措施。 Randall (1980) 亦認爲設定海洋保育區 (marine sanctuaries) 是提供海水魚類庇護與繁殖最重要的手段。本省南灣核三廠入水口因爲禁止人員進入，已逐漸形成一處獨特的珊瑚礁魚類群聚，並成爲附近稀有海水魚類的伊甸園，此可作爲最佳例証。此外在適當海域投放人工魚礁，藉增加人工棲所來改善本省沿岸因岩礁數量不足而無法增加海水魚類數量及分佈的限制因子。此兩項工作台灣亦已行之有年，後者已具有相當成效，而前者之取締工作則相當困難。

4.立法保護嚴格執行：應在野生動物保育法中考慮增列海水稀有魚類，以作爲取締捕撈販售之依據；加强海水稀有魚類之進出口管理，以導正目前熱衷飼養海水觀賞魚之不良風氣（人工繁殖成功之海水魚類則不在此限）。Wood (1990) 曾提出五類應限制水族貿易的魚類：(1)蓄養存活率低；(2)採集該魚種會造成當地生態之破壞（如關鍵種'key species'）；(3)採集技術本身會引起棲所或其他生物之破壞（如氰化物）； (4)採集會使目標種之族群量減少或分佈範圍變窄；(5)與當地之管理或立法相矛盾。 此部份之工作由於目前IUCN尚未將海水稀有魚類列入瀕臨絶滅的保護名單之中，除了腔棘魚(<u>Latineria</u> <u>chalumnae</u>

）及加州犬型黃花魚（Cynoscion macdonaldi）兩種之外，均無法有效展開保育工作。美國魚類及野生動物管理局(US Fish and Wildlife Service) 所列的52種瀕臨絕滅的魚類中，也只有一種是海水魚類(McAllister, 1989, 1991)。所幸近年來IUCN中之SSC組織（species Survival Commission of the International Union for Conservation of Nature and Natural Resources）已開始將保育全球珊瑚礁魚類列入未來重點工作，現正透過國際海洋生物之友協會（IMA, International Marinelife Alliance）調查規劃推動此項保育工作（McAllister, pers. comm.）。許多經濟魚類資源之保護措施，如漁期、漁法、漁具或漁獲量、體長大小之限制與禁止等均應確實執行。特別應嚴格取締在保護區內從事非法活動，或任何毒魚、炸魚、獵魚或排放污染物之行爲。

5.調整漁業政策：國人喜食海鮮的飲食習慣，促使台灣的漁船與漁民人數居高不下，爲競爭有限的魚類資源，若干漁民只好無所不用其極地發展更高效率的漁具漁法，或以密集或非法漁撈的手段來捕撈魚類。的確過去一味地追求漁業年產量之成長的確已造成對資源難以彌補的損害。所幸近年來政府之漁業政策已調整爲高品質、零成長，以「放牧型」代替「獵捕型」，並全面進行全省各沿海縣市漁業權規劃，漁船限建（蒐購老舊漁船）等等措施均應對海水魚類之保育有正面的作用。

結　論

台灣的海水魚類資源不論在種類或數量上均已每況愈下，也因此稀有海水魚類的種類每年也有增無減。造成此一現象的原因雖有許多不同的自然或人爲的因素在內，但人們過去根本忽略海水魚類生存的權利，存在價值與重要性乃是根本的癥結所在。許多原本數量不多的珍稀魚種，特別是珊瑚礁區之魚類能夠分佈到台灣海域，實在是值得慶幸並應善加珍惜。海水魚類畢竟也是野生動物之一員，雖然目前調查研究資料不足，但絕不應因此而予忽視，反之更應積極進行調查研究，加强教育宣導，制定各項保護措施，才能使我國保育工作眞正全面落實，並藉以扭轉國際間對我不良的保育形象。

表一：主要海水觀賞魚類之種數及其在台灣附近海域現存數量之概況

科　　名	全世界之總種數	台灣產之種數	現存種數 豐富	常見	偶見	罕見	主要觀賞種類
*Acanthuridae 粗皮鯛	50	35	3	16	5	11	Zebrassoma或 Acanthurus屬
Apogonidae 天竺鯛	>200	70	2	12	16	40	Sphaeramia屬
Balistidae 皮剝魨	125	35	0	9	12	14	全科
Chaetodontidae 蝶魚	120	43	3	0	10	22	全科
Cirrhitidae 絲鰭鷹斑鯛	35	10	2	1	3	4	全科
*Holocentridae 金鱗魚	61	26	0	6	9	11	全科
Labridae 隆頭魚	>500	112	14	28	39	31	全科
*Muraenidae 鯙	200	45	0	3	9	33	全科
Ostraciidae 箱魨	37	9	0	3	4	2	全科
Pomacanthidae 棘蝶魚	80	24	0	2	7	15	全科
Pomacentridae 雀鯛	>300	86	10	23	20	33	Amphiprion, Dasyllus，及 Chromis等屬
Pseudochromidae 准雀鯛	60	10	1	1	6	2	全科
*Scaridae 鸚哥魚	68	26	0	8	16	2	全科
*Serranidae 鮨	320	85	2	5	21	57	Pseudanthinae亞科
*Siganidae 臭都魚	27	8	0	1	6	1	全科
Solenostomidae 剃刀魚	3	2	0	0	0	2	全科
Syngnathidae 海龍	256	25	0	0	3	22	全科
Tetraodontidae 四齒魨	120	29	0	3	14	12	全科
合　　計 (所佔比例)	>2572	680	37 (5%)	129 (19%)	200 (30%)	314 (46%)	

*亦可為經濟性食用魚類

表二、近十餘年來若干根據台灣地區標本所命名之新種海水魚類

科　　名	學　　名	文　　獻
Aploactinidae 絨鮋科	*Erisphex simplex* 平滑絨鮋	Chen (1981)
	Ocosia spinosa 棘裸絨鮋	Chen (1981)
Apogonidae 天竺鯛科	*Apogon cheni* 陳氏天竺鯛	Hayashi (1990)
	Archamia goni 龔氏天竺鯛	Chen & Shao (1993)
Berycidae 金眼鯛科	*Centroberyx rubricaudus* 紅尾棘金眼鯛	Liu & Shen (1985)
Congridae 糯鰻科	*Gorgasia taiwanensis* 台灣園鰻	Shao (1990)
Creedidae 沙鱚科	*Limnichthys* sp.	尚未發表
Hexatrygonidae 六鰓魟科	*Hexatrygon yangi* 楊氏六鰓魟	Shen & Liu (1984)
	H. taiwanensis 台灣六鰓魟	Shen (1986a)
	H. brevirostra 短吻六鰓魟	Shen (1986b)
Holocentridae 金鱗魚科	*Ostichthys sheni* 沈氏骨鱗魚	Chen et al (1990)
Labridae 隆頭魚科	*Pseudocoris* sp.	尚未發表
Myxinidae 盲鰻科	*Paramyxine* spp.（共六種）	尚未發表
Percophidae 鱸騰科	*Osopsaron formosensis* 台灣掛帆鱚	Kao & Shen (1985)
Platycephalidae 牛尾魚科	*Suygrundus longirostris* 長吻牛尾魚	Shao & Chen (1987)
Haemulidae 石鱸科	*Pomadasys quadrilineatus* 四線雞魚	Shen & Lin (1984)
Cynoglossidae 舌鰨科	*Symphurus novemfasciatus* 九線無線鰨	Shen & Lin (1984)
Scorpaenidae 鮋科	*Neomerinthe procurva* 曲背新棘鮋	Chen (1981)
	N. rotunda 鈍吻新棘鮋	Chen (1981)
Serranidae 鮨科	*Plectranthias chungchowensis* 中州花鱸	Shen & Lin (1984)
Sillaginidae 沙鮻科	*Sillago microps* 小眼沙鮻	McKay (1985)
Tripterygiidae 三鰭鳚科	*Enneatterygius* sp.	尚未發表

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FRESHWATER FISH CONSERVATION IN JAPAN

Hiroya kawanabe
Centre Ecological Research and Department of Zoology,
Kyoto university, kyoto, 606-01 Japan

and

Eizo Kimura
Freshwater Fish Protection Association, Dojima, Osaka, 530
Japan

ABSTRACT

Freshwater fishes are " generalists " in ecological sense. Unfortunately, however, its broadness is not enough tolerant to serious environmental change at present caused by human activity.

On the Red Data Book of Japanese freshwater fishes recognized by Environmental Agency of Japanese Government, are there 2 extinct subspecies, 16 endangered species, subspecies or forms, 6 emergent species, subspecies and forms, and 17 rare species and subspecies in Japanese Archipelago (Kawanabe, 1991).

General situation of freshwater fish conservation in Japan especially in relation to physical environment and importance of intraspecific diversity was read in the First International Symposium on Wildlife Conservation at Taipei in 1991 by the senior author. So, in this article, we would like to present some typical situations of conservation program in endangered freshwater fishes in Japan.

CONSERVATION OF FRESHWATER FISHES IN THE UNITED STATES

Robert J. Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

ABSTRACT

As of 1992, about 100 species, subspecies, and populations of freshwater and anadromous fishes were listed under the National Endangered Species Act for the United States. In addition, 180 fishes were under review for listing. The American Fisheries Society's list of fishes endangered, threatened, or of special concern contains 364 species, subspecies, and unnamed taxa for the U.S., Canada, and Mexico. Three genera, 27 species, and 13 subspecies are known to have become extinct during the past 100 years in North America. The Endangered Species Act has had mixed results in relation to achieving its goal of preservation of biodiversity. Other countries can learn from the mistakes and failures of fish conservation in the United States.

INTRODUCTION

Public perceptions of environmental issues influences public policy and law, and gradually have influenced the management of fish and wildlife. During the past 40 years conflicts between consumptive or recreational uses of fisheries and the preservation of native species have become apparent. The Miller Lake lamprey, *Lampetra minima*, was deliberately exterminated in its sole habitat in the 1950's in order to make a more efficient sport fishery based on hatchery-stocked rainbow trout (Miller, et al. 1989). IN 1962, about 500 miles of the Green River and its tributaries were treated with a toxicant to eliminate all fishes so that the newly created Flaming Gorge Reservoir could be more effectively used to grow stocked rainbow trout, a non-native species. The fisheries agencies of Utah and Wyoming issued a brochure at the 1962 meeting of the American Fisheries Society detailing the need for such a massive poisoning operation--to get rid of "trash" fish such as squawfish and bonytail. The poisoning of the Green River eliminated four now endangered species, Colorado squawfish, bonytail, humpback chub, and razorback sucker from a large part of their range in the upper Colorado River basin (Holden 1991). Such actions caused the U.S. Congress to pass an Endangered Species Conservation Act in 1964 which influenced some change in emphasis for natural resource management in regards to at least an awareness of native species preservation. The Endangered Species Act of 1973 and subsequent amendments gave much stronger enforcement powers for preventing extinctions. By 1992, about 100 species, subspecies, and forms of freshwater and anadromous fishes were protected under this act and 180 fishes are under review for listing. The American Fisheries Society has listed 364 species, subspecies, and unnamed taxa of fishes as endangered, threatened, or of special concern in the U.S., Canada, and Mexico (Williams, et al. 1989). During the past 100 years, two genera, 27 species, and 13 subspecies of freshwater fishes have become extinct (Miller, et al. 1989).

Most of the endangered and extinct fishes are of the families Cyprinidae, Percidae (darters), Cyprinodontidae, and Poecillidae. The most common causes of endangerment are environmental alteration and introductions of non-native fish species. The American Southwest is the most severely impacted region in regards to loss of native fishes. This is due to its arid climate resulting in intensive development of water storage and water distribution projects and a depauperate native fish fauna not well adapted to coexist with non-native species in modified environments.

THE ENDANGERED SPECIES ACT

The definition of a species in the Endangered Species Act includes subspecies and their parts (to population level). Such an all encompassing definition is necessary if the goal of preservation of biodiversity is to be achieved. Since 1991, three races (populations) of Chinook salmon, *Oncorhynchus tshawytscha*, and one race of sockeye salmon, *O. nerka*, have been listed as threatened or endangered under ESA. The ramifications of enormous economic consequences concerning instream flow in the Columbia and Sacramento rivers to preserve these races of salmon have led to a concerted effort to modify (weaken) the Endangered Species Act, especially the definition of "species". Because of economic and political considerations, strict enforcement of ESA has often been lax. This has led to criticism regarding the effectiveness of ESA to "preserve and protect". Williams, et al (1989), comparing the 1979 and 1989 American Fisheries Society lists, mention that "not a single species warranted removal from the list because of successful recovery efforts". To date, the only way fish species have been removed from either the federal ESA list or the AFS list is to become extinct. It is obvious that the noble intentions of the Endangered Species Act are far from fulfilling its goal of the preservation of biodiversity. For successful programs to preserve biodiversity, other countries can learn from American mistakes and failures.

CONSERVATION STRATEGIES

Two major issues are basic for a goal of preserving biodiversity. The fist concerns the reasons, the rationale--why should we prevent extinctions? The second issue concerns the definition and identification of units of biodiversity--the Significant Evolutionary Unit (SEU).

Reasons for preventing extinctions can be grouped into two categories: 1. Morals and ethics--a rationale of stewardship or duty to nature to preserve for posterity, and 2. a more applied argument concerning benefits to humans derived from maintaining biodiversity. No single reason or argument will be persuasive to all people. My advice is to be eclectic, pleuralistic, and opportunistic--what strategy might work best in a particular situation.

In a recent paper (Behnke 1993), I addressed the question: what is a species and its implications for conservation programs. Because species concepts and definitions vary and because formally described taxa are not valid guidelines for characterizing biodiversity, other criteria are necessary to define units of diversity. Many attributes of diversity must be considered to characterize a Significant Evolutionary Unit. Quantitative methods for measuring genetic divergence should not be the sole or dominant determinant for the SEU. This is because of problems of sample size (what is actually measured compared to what is in the total genome) and the fact that what is measured bears no relationship to what the organism does (the diversity of niche filling).

In another work (Behnke 1992), I made recommendations for selection and characterization of SEU's based on the concept of "irreplacability"--if a particular unit of diversity becomes extinct, can it be replaced?

We are still in the trial and error stage of learning how to best preserve biodiversity. The American experience can be instructive concerning what to do and what not to do.

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THE TRENDS OF HERPETOLOGICAL RESEARCHES AND CONSERVATION IN TAIWAN

K.Y.Lue
Department of Biology National Taiwan Normal University

ABSTRACT

Currently, scientists are very concerned about the declines on amphibian populations and herpetological conservation. Researchers suspect that global changes are the major culprits including acid rain, U.V., environmental pollutions and habitat fragmentation.

Amphibians possess characteristics that would make them good biological indicators. These includes : complex life cycle, rapid growth rate in tadpoles, intense intra- and inter-specific competition, permeable eggs, gills and/or skin, poikilothermy, being unable to response properly to environmental change during hibernation.

There are quite a few scientific reports on toxicity studies of reptiles and amphibians. Scientists urged that more research efforts should be taken on ecotoxicological and synergistic aspects. Besides, a standardized method should be followed. A series of experiments from laboratory, semienclosure to open fields need to be conducted.

Research activities relating to herpetology were reviewed in Taiwan. Scientific reports includes systematics, zoogeography, reproductive biology, ethology, karyotypes and database. Works on ecotoxicological aspects are missing. In addition to follow the recommendations provided by the Society for the Study of Amphibians and Reptiles, we have to do the inventory survey immediately on the whole island. Meanwhile, we also need to evaluate the impacts on herpetological fauna from habitat fragmentation.

臺灣兩棲類，爬蟲類動物保育及研究之趨勢

呂光洋

師大生物系

摘要：

兩棲及爬蟲動物族羣數量的減少和保育，是科學家們非常關心的主題，造成牠們族羣數量減少的原因，與地球環境的變遷(globale changes)有密切的關係，主要禍首包括了棲地面積的縮小，酸雨、紫外線照射量的增加，以及環境中各種有毒的污染物等等。

兩棲類在生活史中有水棲與陸棲兩個階段，種內及種間對於資源的競爭相當明顯，兩棲類在一些生態系的物質循環中也扮演著決定性角色，牠們的卵、鰓以及皮膚，對於各種化學物質的通透性甚大，也對環境中各種污染物的反應相當敏感，最後，在休眠階段的調適能力力差，這些都使得牠們能忠實地反應出環境的變遷。

文獻上有些有關於污染物對於兩棲爬蟲動物耐毒性強度研究及影響方面的報告，爲了日後兩棲爬蟲動物的保育，科學家建議加強有關生態毒物學，環境酸化在自然環境中毒物加成作用的影響，與經營管理方面的研究，另外，必須有系統地進一系列由實驗室到半野外，至完全自然環境方面的監測實驗。

國內相關的機構，在過去進行之有關兩棲及爬蟲動物方面的研究，其涵蓋有分類，系統分類，動物地理，生殖生物學，生殖行爲，生態需求，核型研究與資料庫等，但缺乏對兩棲爬蟲動物進行生態毒物學方面的研究以及資源清查的工作，未來的保育研究工作，除了參考及採用國外的研究取向外，我們必須加強資源清查之進行，資料庫的建檔，與棲息地零碎島嶼化對於兩棲爬蟲動物族羣數量的影響之研究。

一、引言：

近幾年，世界各地的生物學家和一般的民衆都發現到，兩棲類的族羣有逐漸減少(amphibian population declines)的趨勢，(Baringa, 1990, Philips, 1990, Wyman, 1990, Wake, 1991)，而兩棲爬蟲和保育學家也正試圖找出造成牠們族羣量減少的原因，以便進一步可以抑制族羣減少之趨勢。

目前科學家們經過初步的探討與收集資料，懷疑是地球環境的變遷(globale changes)造成兩棲類族羣數量的減少，其中，森林的破壞(deforestration)，空氣污染所造成自然水域及陸域的酸化，紫外線照射量的增加，以及各種有毒污染物的出現是其主要因素。

二、兩棲類適合做爲環境變化監測之生物
(biological indicators)

兩棲類族羣的減少爲何在近年來較受重視呢？與其牠較高等動物相比，兩棲類對環境的變化較爲敏感，牠們較能忠實地反應出環境的變遷，因此適合做爲環境指標生物，生物學家從生活史及生理上的特點，歸納出兩棲類適合做爲指標生物的原因(Dunson, et. al. 1992)

1. 絕大多數的兩棲類都有複雜的生活史(life cycle)，在牠們的一生中，分別有水棲及陸棲的階段，因此，任何環境的變境都會對兩棲類造成影響。

2. 水棲的蝌蚪在暫時性或永久性水域中，在水尙未乾枯前，往往有很快的生長速率(growth rate)，以便在水乾前完成變態(metamorphosis)，有利於在短時間內看出環境的變化。

3. 和其牠生物相比，兩棲類對於資源的利用，種內及種間的競爭(intra and interspecific competition)非常強烈，而在對於毒性(toxicity)反應方面的實驗中，在很短的時間內，就可以測出不同種(species)間對於不同污染物(pollutants)之忍受程度(tolerance)的差異。

4. 兩棲類的卵(egg)、鰓(gill)、及皮膚(skin)等，對於環境中之任何化學因子（包括污染物等）之通透性(permeability)甚強，因此容易受到這污染物的影響。

5. 在某些生態系(ecosystem)中，尤其是溫帶的落葉林及暫時性的水域，兩棲類在物質環境中扮演著決定性的角色。

6. 由於是變溫動物(poiklothermy)，兩棲類在遭遇環境的極端變異(extreme environmental fluctuation)時，很容易受到傷害。

7. 不管在水域或陸域之冬眠(hibernation)或夏眠(estiration)的階段，牠們的新陳代謝都無法維持在正常的水平，因此，對於環境的異常無法進行正常的調適與反應。

8. 兩棲類動物和其牠動物相比，活動及移動能力都不強，易於追蹤(tractability)，因此有利於實驗室內及室外試驗工作之進行。

三、國外有關兩棲類保育(amphibian conservation)方面之研究之趨勢

在前面已提到過，兩棲類族羣的減少與地球環境的變遷有關，因此，在保育相關的研究中，不少研究就專注於探討環境變遷與兩棲類族羣數量，生理，生殖及生活史變動的關係，例如環境中pH值的改變與Rana temporaria的生殖(Beattie and Taylor-Jones, 1992)，酸雨和山區兩棲類族羣危機的評估(Corn and Vertucci, 1992)，蠑螈族羣變動是人爲或自然因素造成(Wissinger and Whiteman, 1992)，陸域環境酸化的程度和兩棲類族羣之關係(Wyman and Jancola, 1992)，酸化淡水沼澤和兩棲類生殖(Karns, 1992)，低酸鹼度的暫時沼澤內對於兩棲類關係之多層面研究(Sadinski and Dunson, 1992)，從遺傳上的變異來探討低酸鹼度對於兩棲類忍受程度之影響(Pierce and Wooten, 1992)，從行爲上來探討兩棲類幼體對低酸鹼度變化之關係(Freda and Tayler, 1992)，土壤化學性質對於Red back salmander之鈉離子平衡方面的影響(Frisbie and Wyman, 1992)，無尾類蝌蚪對於酸忍受程度之探討(Grant and Licht, 1993)，另外，在Michale's Fry之有關Amphibians and Pollutants Bibliography上也可以找到很多相關的資料，而U.S. Fish and Wildlife Service之Acid Precipitation Section在1989年出版之Acid Rain Publications by the U.S. Fish and Wildlife Service 1979-1989，也可以找到有關環境變遷對兩棲類變遷的關係。

有關兩棲類及爬蟲類方面之經營管理目前尙在起步的階段，然而，美國農業部之森林署，於1988年在亞利桑那州舉行了一個有關兩棲爬蟲及小型哺乳動物之經營管理研討會(Management of Amphibians, Reptiles, and Small Animals in North America)。

這一兩年來，由於聯合國及IUCN，在地球高峯會議(Earth Summit)中，特別強調生物歧異度(biodiversity)及資源永續利用(sustainable use)，因此，有部分的兩棲及爬蟲專家也投入這方面的研究。

四、國內目前有關兩棲爬蟲動物學方面的研究現況

自從臺灣光復之後，有關基礎生物學方面的研究很少，包括兩棲及爬蟲動物學方面的研究也是如此，筆者在閱覽過相關的報告之後，將國內各學術機構所進行有關的研究，概略介紹如下：

1. 國立臺灣大學動物系：兩棲類之分類，蜥蜴類之分類，兩棲類（臺北樹蛙、白頷樹蛙、面天樹蛙）之生殖生物學，行爲學，生態需求，生理生態及核型之研究。

2. 國立臺灣省師範大學生物系：兩棲類之分類，蜥蜴類之分類，兩棲類（翡翠樹蛙、艾氏樹蛙、盤古蟾蜍）之生殖生物學，行爲學，生態學（共棲樹蛙之資源分配利用），兩棲爬蟲動物之資料庫，臺灣地區不同耕作系統之兩棲類現況，特有種兩棲類之核型，臺灣產山椒魚之基礎生態學研究，兩棲類之生物地理，兩棲類之食性調查，系統分類。

3. 私立東海大學生物系：兩棲類（盤古蟾蜍、澤蛙、拉都希氏蛙）之生殖研究，蜥蜴之生殖，行爲，生殖生理，分類等。

4. 私立文化大學生物系：蜥蜴類之生殖生物學研究。

5.國立中山大學海洋生物研究所：海蛇之生態學研究。

6.國立自然科學博物館：兩棲爬蟲之分類和蝌蚪之分類。

7.臺灣省立博物館：兩棲及爬蟲動物之分類。

8.臺灣省特有種生物保育研究中心：兩棲及爬蟲動物之分布及相關基礎調查。

9.國防醫學院：兩棲類胚胎發育：蛇類之形態之蛇毒之防治。

10.國立臺灣大學醫學院：臺灣產毒蛇之蛇毒生化及分子生物方面研究。

五、兩棲類保育之研究趨勢

在有關兩棲類族羣減少和棲地酸化研討會(Dunson, et. al., 1992)報告中，特別提別以往缺乏有系統及統一方法的調查，因此很難評估出來環境變遷對於兩棲類族羣長期的影響，因此，建議科學家們能有一個統一之標準研究方法，大家都能採用，如此日後才足以評估變遷和影響之關係，當今在文獻上已有探討一些污染物對於兩棲爬蟲動物的各類影響，此外仍應該加強amphibian ecotoxicology方面的研究，尤其以須注意到multiple level方面的研究，另外，須注意環境中各種因子共同作用(synergistic effects) 所造成對兩棲類之影響，加強各種因子對兩棲類渡冬存活率(overwinter survival)之研究，進一步有關的研究必須有計劃，而且有系統地進行一系列的研究，由實驗室內的實驗，進一步到半圈養(semifield enclosure)，野外環境因子的控制(in field manipulation)，與野外的監測(Field monitoring)等，在設計野外監測兩棲類族羣變化的實驗時，必須注意到可重複性之設計(replicated design)，以符合基礎科學的研究，想辦法來釐清兩棲類野外族羣數量的變動，是自然因素或人為干擾所造成的後果？

在本島，有關兩棲爬蟲類方面的保育研究，除了可以參考國外有關保育研究的趨勢外，首先，我們必須加速進行一些基礎調查(inventory survey)和資料庫(data base)之建立，歐美國家的研究，早已超越了基礎調查的階段，他們對於相關的基本資料也早已收集到相當的程度，因此，他們在科學上可以察覺出兩棲類減少的情形，反觀我們，不僅不知道我們有多少資源，有些新種仍陸續在發現呢！保育的第一步，就是必須先瞭解我們有什麼資源！與國外的環境比起來，臺灣的兩棲爬蟲動物所面臨殺蟲劑(pesticides)方面的壓力要來的大，這也是我們必須加強研究之處，此外，臺灣的人口壓力越來越大，各種野生動物，包括兩棲爬蟲動物在內，除面臨族羣島嶼化(population fragmentation)的壓力越來越嚴重之外，從經營管理的觀點來看，我們如何讓本島的兩棲爬蟲動物，可以生存在人為干擾的環境中，也是一個重要的課題。

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GLOBAL AMPHIBIAN DECLINES; CRISIS OR CONUNDRUM?

James L. Vial, Ph.D.*
Center for Analysis of Environmental Change, 200 South West 35th Street, Corvallis, OR 97333, USA

During the past several years there has been increasing public concern for the habitat destruction and species extinctions being measured on a global scale. One facet of these universal phenomena is exemplified by reports from biologists of a widespread decline in amphibian populations.

In response to the expressed concerns of the scientific community, the International Union for the Conservation of Nature (IUCN) has activated the Declining Amphibians Task Force. The focus of this program is to provide a global coordinating center for invetigators and agencies concerned with documentation and determination of causes of these declines.

Overseeing the activities of the Task Force is a Board of Directors, having international representation. This directorate is responsible for establishing policies, determining priorities and raising funds. A Coordinating Council serves as the operational unit for the program, which includes researchers, liaison officers of societies and agencies and others. Among its functions are the collating of all available information and establishing a computerized data base.

Managed by a coordinator, Council headquarters are situated with the Center for Analysis of Environmental Change in Corvallis, Oregon. The coordinator works with the directorate to establish working groups of independent scientists and technical personnel.

There is little doubt that many of these amphibian declines are the result of human activities. Habitat fragmentation and destruction, pollution, as well as introduced exotics, are among the known factors that impact upon native species. However, similar observations are reported from many well-protected areas or biological preserves. That these events are so cosmopolitan and coincident in their occurrence, and in many cases of catastrophic proportions, is an enigma. It is the goal of the Task Force to identify the causative agents and make recommendations for remediation.

Recent Studies on Endangered Species of Wildlife in Taiwan

Ming-Lung Jan

Taiwan Endemic Species Research Institute

No.1 Ming Shan E. Road, Chi-Chi, Nantou,

Taiwan, R.O.C.

Summary

Taiwan, an island located on the western Pacific rim, is bisected by the Tropic of Cancer. With great altitudinal differences, rich and complex environments have produced rich animal resources(Lin,1985). However serious side effects of recent economic development have pushed many species towards extinction. In response,the R.O.C. Government passed the Wildlife Conservation Law and founded the Taiwan Endemic Species Research Institute to practice wildlife preservation.

As announced by the Government, about 19 Taiwan animals are currently endangered, including four mammal, nine bird, one reptile, two fish, and three insect species. Beginning in 1970, eight published accounts of endangered species have included the Taiwan black bear, Swinhoe's pheasant, Mikado pheasant, Lanyu scops owl, Taiwan ku-fish, Taiwan trout, borad-tailed swallow tail butterfly, and bird-winged butterfly. The remaining 11 species urgently need study; these include the Formosan flying fox, Chinese river otter, clouded leopard, Hodgson's hawk eagle, black eagle, Tawny fish owl, brown wood owl, Tawny wood owl,

maroon oriole, hundred-pace snake, and large purple fritillary. The previous and recent studies show that we have no enough information on the endangered species of wildlife in Taiwan; thus, carrying out the following four research stages is of the utmost importance: (1) basic population information collection and protection area settlement sudies. (2) biological and ecological studies. (3) in situ and ex situ preservation (4) follow- up studies.

(Key words: endangered species, wildlife, Taiwan.)

Introduction

Geographically, the island of Taiwan with an area of 36,000 km^2 is located on the western Pacific rim. Bisected by the Tropic of Cancer, the weahter in Taiwan is influenced not only by its tropical and subtropical climates, but also by both continental and Pacific Ocean forces. Due to extreme differences in elevation,the complex geography produces various habitats inclouding alpine forest, low-land jungle, mangrove etc. About ten thousand years ago Taiwan was attached to mainland China; consequently, much wildlife was introduced into Taiwan from subtropical Asia. With the introduction of Homo sapiens, competition with wildlife increased. Currently, Taiwan has one of the world's highest human population densities; as a result, habitats for wild animals have shrunk drastically. Overhunting is one of the primary causes of endangered species in Taiwan. In response, ecologists and other biologists have used the mass media to explain the importance of a balanced ecosystem and species preservation; in addition, they have initiated many research projects concerning species preservation. The Government has lately supported such research and has passed the "Wildlife Conservation Law" on June 23, 1989, as well . Official lists of endangered species, rare animals, and other animals to be protacted were issued on August 4, 1989. Currently, lists of indigenous wild animals and plants are being systematically built up. The Government also founded the Taiwain Endemic Species Reserch Institution July 1, 1992. these efforts are all in an attempt at wildlife preservation.

Endangered species of wildlife in Taiwan

The term "endangered species "is defined as" those species whose population size is at or below a critical level, so that their survival is in jeopardy" (Wildlife Conservation Law). There are a total of 19 terrestrial animals on the endangered species list, including four mammal, nine bird, two fishe, one reptile, and three insect species. The name list was announced by the Council of Agriculture on August 31, 1990. Brief information on the above species is listed below. The possible distribution of these species is presented from Figure 1 to Figure 8.

(1)Mammals

A. Formosan flying fox (Pteropus dasymallus formosus P.L. Sciater)

The animal is the member of family Chiroptera, order Chiroptera, and is the largest bat in Taiwan, eating mainly fruit. It's distribution is mainly in Lutao, with occasional sightings in Lanyu, Hualien, Kaohsiung, Taitang, etc.. The total wild population is unknown.(Severinghaus and Liu,1990; Yu,1990).

B. Formosan black bear (Selenarctos thibetanus formosanus Swinhoe)

The omnivorous animal is an endemic subspecies of Taiwan, belonging to family Ursidae, order Carnivora. This is the biggest terrestrial animal of Taiwan. The animal usually appears in forests at altitudes of between 1000 to 3500 m. The total wild population is unknown.(Severinghaus and Liu, 1990; Wang, 1990;

Wang and Chen,1991)

C. Chinese river otter (<u>Lutra</u> <u>lutra</u> <u>chinensis</u> Gray)

This carnivorous animal belongs to family Mustelidae, order Carnivora. It was distributed near rivers from sea level to an altitude of about 1500 m. originally; however, in recent years, it has been extremely rare. the last recorded sighting was in September 1989 near the upper reaches of the Liwu river. The total wild population is unknown.(Severinghaus and Liu,1990; Yu, 1990)

D. Clounded leopard (<u>Neofelis</u> <u>nebulosa</u> Griffith)

The animal is an endemic subspecies of Taiwan, belonging to family Felidae, order Carnivora. Originally distributed in forests at an altitude of about 1000 m., but has not been spotted in a long time. The total wild population is unknown and it is very rare now. Possible survival sites include Yu Shan and Tawu Shan areas.(Rabinowitz, 1988; Severinghaus and Liu,1990;)

(2) Birds

A. Hodgson's hawk eagle (<u>Spizaetus</u> <u>nipalensis</u> <u>fokiensis</u> Hodgson)

The carnivorous bird belongs to family Accipitridae, order Falconiformes. They are mainly distributed in forests of altitudes between 1100 to 2500 m. The total wild population is unknown. It is very rare now.(Severinghaus and Liu,1990; Lin, 1992)

B. Black eagle (<u>Ictinaetus</u> <u>malayensis</u> Temminck)

The carnivorous Black eagle belongs to the same family and order as Hodgson's hawk eagle. Its distribution is in forests of altitudes between 1100 to 2500 m. The total wild population is unknown. It is very rare now.(Severinghaus and Liu,1990; Lin, 1992)

C. Swinhoe's Pheasant (<u>Lophura</u> <u>swinhoii</u> Gould).

The bird is an endemic species of Taiwan. The bird belongs to family Phasianidae, order Galliformes. It eats berry, leaf and insects. Its distribution is in broadleafed-coniferous mixed forest at altitudes of 300 to 2300 m, The total wild population is unknown.(Alexander,1988; Severinghaus and Liu, 1990)

D. Mikado pheasant (Syrmaticus mikado Ogilvie-Grant)

The bird is an endemic species of Taiwan. It belongs to the same family and order as Swinhoe's pheasant and has the same diet. Its distribution is at the bottom of forests at altitudes from 2000 to 3500 m.(Severinghaus and Liu,1990; Alexander etc., 1990)

E. Lanyu scops owl (Otus elegans botelensis Kuroda)

The bird is an endemic subspecies of Taiwan. It belongs to family Strigidae, order Strigeformes. Its diet inciudes insects and other invertebrate animals. Its distribution is only on Lanyu Island. The total wild population number is about 200. (Severinghaus, 1986; Severinghaus and Liu,1990)

F. Tawny fish owl (Ketupa ketupa flavipes Hodgson)

This carnivorous bird belongs to the same family and order as the Lanyu scops owl. Its distribution is in broadleafed and coniferous mixed forests. The total wild population is unknown. The animal is extremely rare. (Severinghaus and Liu,1990; Wang etc., 1991)

G. Brown wood owl (Strix leptogrammica Swhihoe)

This carnivorous bird belongs to the same family and order as the Lanyu scops owl. It is distributed in broadleafed and coniferous mixed forests. The total wild population is unknown. The animal is very rare.(Severinghaus and Liu, 1990; Wang etc., 1991)

H. Tawny wood owl (Strix aluco yamadae Yamashina)

This carnivorous bird is an endemic subspecies of Taiwan, distributed maily in broadleafed and coniferous mixed forests at medium and high altitudes. It belongs to the same family and order as the Lanyu scops owl. The animal is very rare.(Severinghaus and Liu, 1990; Wang etc., 1991)

I. Maroon oriole (Oriolus trailliiardens Swinhoe)

The animal is an endemic subspecies of Taiwan. It belongs to family Oriolidae, order Passereaformes. It eats mainly insects and is distributed in broadleafed forests at low altitudes. The wild population is unkmown.(Severinghaus and Liu, 1990; Wang etc., 1991)

(3) Reptiles

A. Hundred-pace snake (Agkistrdon acutus Gunther)

This carnivorous animal belongs to family Viperidae, order Rhynchocephilis. It is distributed at the bottom stratum of forests. The total wild population is unknown. It is very rare. (Severinghaus and Liu,1990)

(4) Fishes

A. Taiwan Ku-fish (Varicorhinus alticorpus Oshima).

The fish is an endemic species of Taiwan and belongs to family Cyprinidae, order Cypriniformes. It is distributed in the upper parts of rivers in eastern and central-southern Taiwan. The wild population is unknown, and is very rare.(Tzeng, 1986; Severinghaus and Liu,1990)

B. Taiwan trout (Oncorhynchus masou Brevoort)

The fish is an endemic subspecies of Taiwan and belongs to family Salmonidae, order Salmaniformes. It eats mainly acquatic insects. It only distrbut in the upper reaches of the Tachia river--- Chi-Ja-Wann and Hsueh Shan rivers. The Taiwan trout is at the southernmost limit of global trout distribution. The wild populatoin number is about 1000 now.(Severinghaus and Liu,1990; Lin etc., 1992)

(5) Insects

A. Broad-tailed swalllowtail butterfly (<u>Agehana</u> <u>maraho</u> Shiraki and Sonan)

This butterfly is an endemic species of Taiwan belongs to family Paplionidae, order Lepidoptera. The larvae eat leaves of Lauraceae. The butterfly appears between the end of spring and the beginning of summer. Its distribution is in mountainous areas of central and southern Taiwan at altitudes between 1000 and 2000 m. The wild population is very rare.(Severinghaus and Liu, 1990; Yang and tzeng, 1992)

B. Bird-winged butterfly (<u>Troides</u> <u>magellanus</u> C. and R. Felder)

This butterfly belongs to the same family and order as Broad-tailed swallowtail butterfly, and the larvae eat the leaves of Aristolochia foveolata Merr.. Its ditribution is only on Lanyu Island. The population size is very small now. The buttrtfly appears between March and April and between September and October. (Severinghaus and Liu,1990; Chen, 1987,1988)

C. Large purple fritillary (<u>Sasakia</u> <u>charonda</u> <u>formosana</u> Chen). This butterfly belongs to family Nymphalidae, order Lepidoprera. The larvae eat the leaves of Sassafras randaiense. The butterfly can be found between May and July. It is rare,mainly distributed in mountainous areas of central and northern Taiwain. (Severinghaus and Liu,1990; Eiji, 1987)

Recent research on endangered terrestrial animal species

Due to the rare appearance of the above animal species little is known about them. Before 1945, research on those animals was conducted mainly by Westerners and Japanese. After World War II, there was little local research done until the 1970s, when returning native scientists from the U.S., Japan, and European countries spearheaded the conservation movement and consciousness raising. Still, a paucity of trained specialists and often inadequate support limit the research being done. Published papers are often the result of summary or literature review. The research work on endangered species of wildlife in Taiwan is shown in table 1.

Prospects for further research on endangered species of wildlife in Taiwain

There are many reasons to force an animal to the brink of extinction. Two main reasons, however, are overhunting and shrinking habitat due to ever-growing popularion pressure from mankind. Endangered wild animal species usually have the following three characteristics: (1) the wild population is rare and small in number, (2) the original widespread habitat has now been divided into small isolated areas, and (3) they may not survive without human intervention in the form of setting off reserved areas for them. Two methods available to us to preserve this priceless biological heritage are to reserve and protect known habitats (in-situ), or set up new ones (ex-situ) reserved for the endangered species exclusive use. The will to conserve our nature treasures cannot, howerer, do the job alone; massive support in the form of well-endowed budgets, great effort and time, and advanced technology, to mention a few commitments, is urgently needed. As mention before, at the moment we do not have even basic information about many of the endangered species; thus, carrying out the following four research stages is of the utmost importance.

I. First stage

(1) Intitiating basic information gathering: to understand the existant population, distribution, and habitat of the endangered species.

(2) Pinpoint the factors causing the species to disappear:

A. Disappearance of habitat.

B. Hunting pressure.

C. Diseases.

D. Natural predators.

E. Foreign competitors.

F. Pollution of environment.

G. Other reasons.

(3) Allocating land for protected areas.

A. Locating current population habitats.

B. Estimating required protected area for conservation of species.

C. Recommending good management system of protected areas.

II. Second stage

(1) To study the biology and ecology of the species.

A. To understand the population structure.

B. To understand reproductive behavior.

C. To understand the home range.

D. To understand the life cycle.

(2) To design the training curriculum of specialist and technicians.

(3) To select habitats.

III. Third stage

The research we need to follow up at this stage depends on which preservation method (in-situ, ex-situ, or both) we select. If in-situ is selected, then we need to concentrate our studies on:

1. Studing how to improve the quantity of population by improving the quality of the habitat, e.g., to supply food. additional nesting places, and shelter areas.
2. Studing the Methods which can reduce mortality, e.g., how to reduce hunting, control disease, avoid hybridization with foreign species , avoid natural predation.

If we select preservation ex-situ, then we need to concentrate our studies on:

1. Studying how to improve reproductive performance by artificial methods.
2. Finding a good new location to conserve the species.

IV. Fourth stage

The most important aspects of this follow-up stage are to ensure survival by helping the endangered species reproduce and adapt to its environment.

Conserving a species is a kind of crisis management. We may need to go through each stage as fast as possible. In practice, however, these stages may be modified according to the exigencies of each case, such that research could go with stage (2) and (3) after stage (1) directly, meanwhile, a successful conservation program cannot be done just by few people, it needs to integrate efforts from researchers, Government, and the public.

Conolusion

Previously, little reseach into wild animals in Taiwan was done. Recntly, however, the Goverment has put a lot of

effort into encouraging this kind of research as well as into conservation. The Government has lately improved the "hardware" of conservation, i.e., passing the"Cultural Heritage Preservation Law" and the "Wildlife Conservation Law " and has also improved the conservation "software," i.e., direct support of research into conservation. Several important achievements in wildlife research include work with the Lanyu scops owl, Taiwan trout, and the sika deer which had disappeared from wilderness areas since 1969. Still, however, we face a shortage of trained specialists in conservation. This has resulted in a lack of hard information not only on endangered species but also on the general wildlife of Taiwan. Thus, we need trained specialists and more knowledge of our natural history of Taiwan urgently. The situation is critical not only for the above-mentioned 19 species, but also for other species in the future, such as many unnamed insects and other invertebrate.
"Extinction is forever" should remind us of the moral and scientific importance of this work; another motto may well be "One species (mankind) is a lonely species." In the past few years Taiwan has taken a good step, but only a small step, in the right direction. Much more needs to be done, and needs to be done immediately.

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臺灣瀕臨絕種野生動物之研究概況

簡明龍

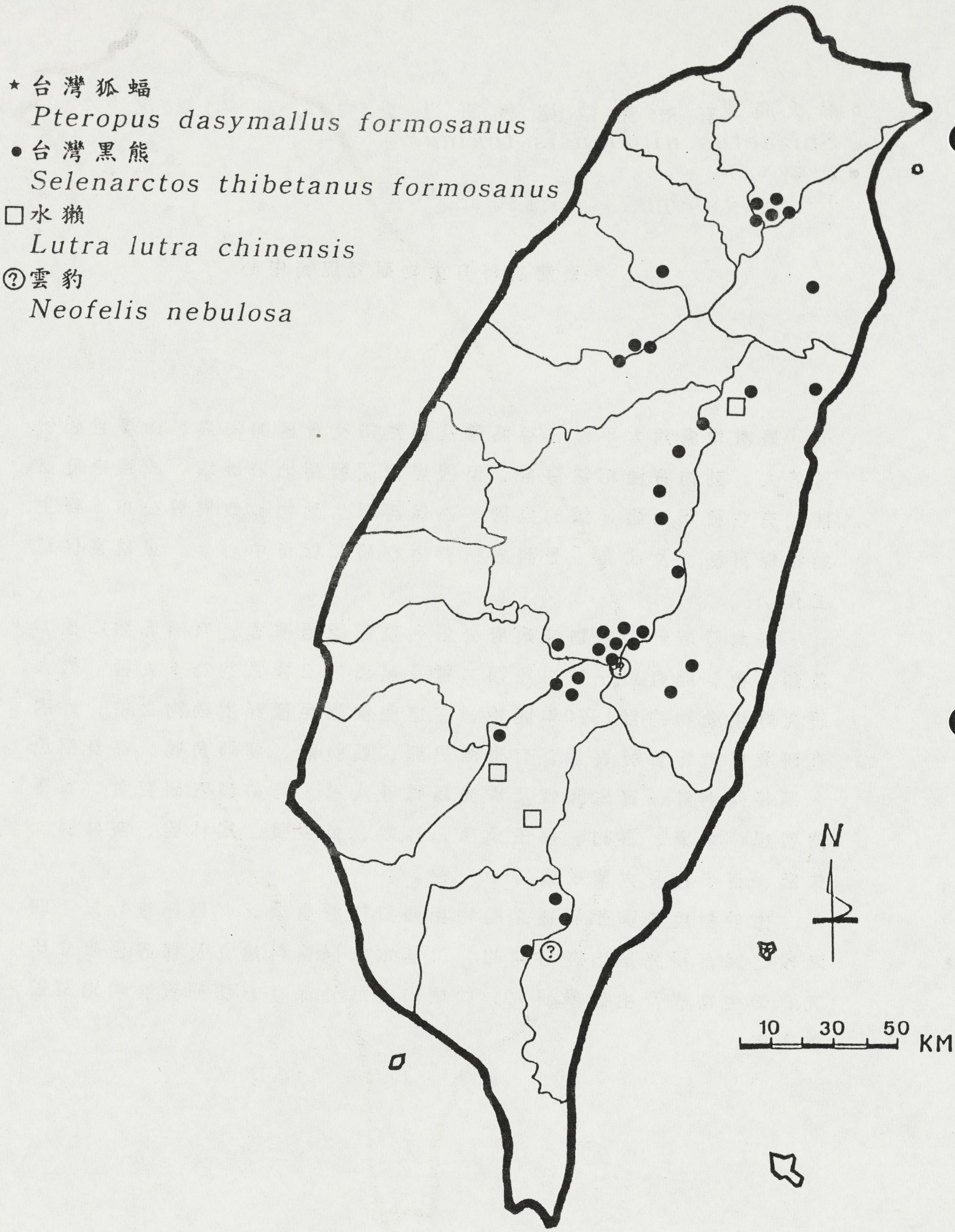
臺灣省特有生物研究保育中心

摘要

臺灣位處西太平洋，為熱帶及亞熱帶交會區的海島，山多且起伏落差大，動物資源相當豐富，但因經濟開發棲地被破壞，或遭過度獵捕，有些種類面臨延續的危機。為保護野生動物，政府曾公布「野生動物保育法」及成立「臺灣省特有生物研究保育中心」，以落實保育工作。

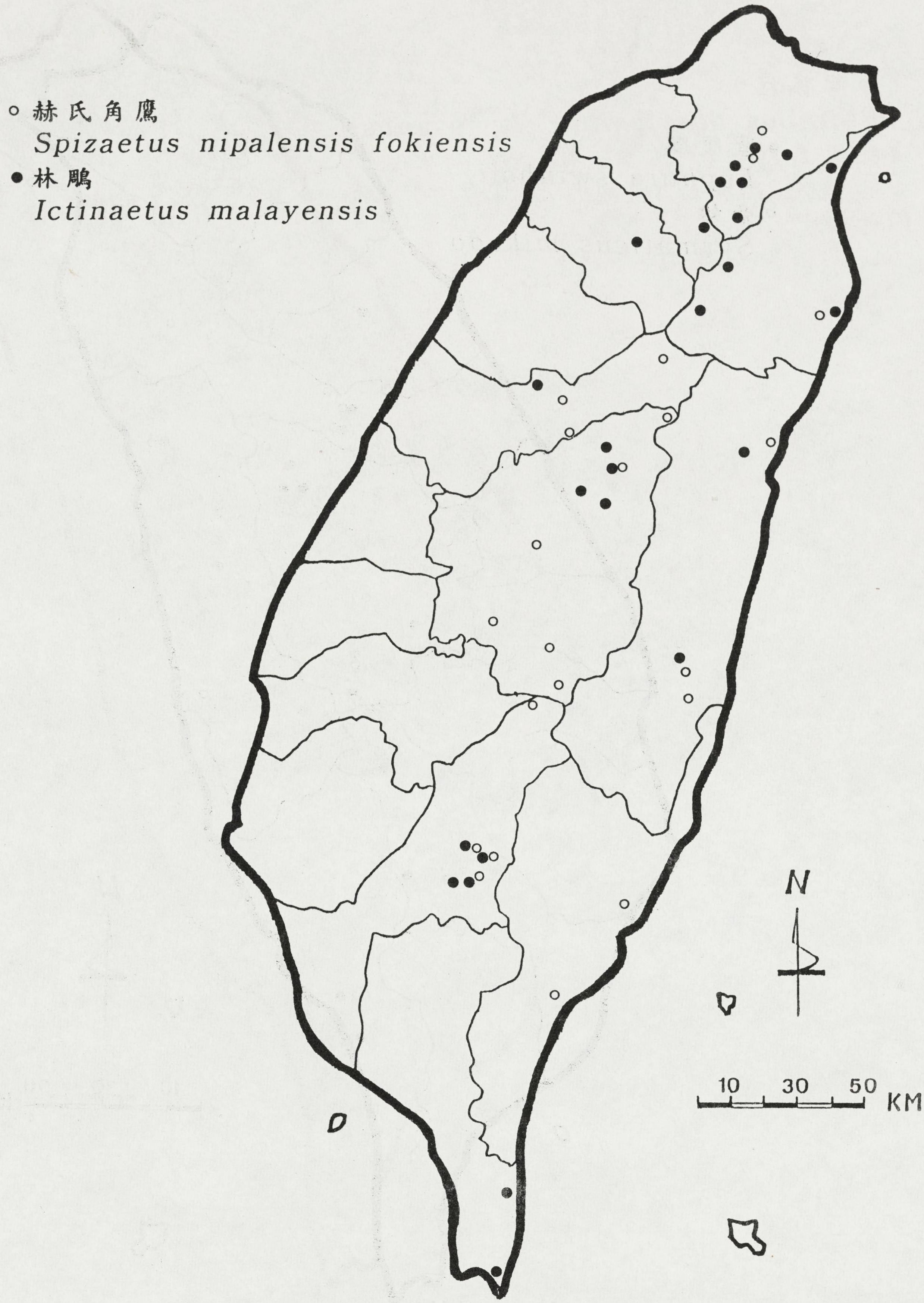
臺灣陸域野生動物經政府公告列為瀕臨絕種者，有哺乳類四種、鳥類九種、爬蟲類一種、魚類二種及昆蟲類三種，共為十九種。國人研究野生動物約自1970年開始，在這些瀕臨絕種野生動物之中，經調查研究已有報告發表者，有臺灣黑熊、藍腹鷴、蘭嶼角鴞、高身鯝魚、櫻花鉤吻鮭、寬尾鳳蝶及珠光鳳蝶等八種。尚待調查研究者，有臺灣狐蝠、水獺、雲豹、赫氏角鷹、林鵰、黃魚鴞、褐林鴞、灰林鴞、朱鸝、百步蛇及大紫蛺蝶等十一種。

由於對這些瀕臨絕種之動物相關資料嚴重缺乏，積極進行以下四階段之保育研究是迫在眉睫的，⑴基本族群資料建立及保護區設立研究，⑵生物學及生態學研究，⑶域內或域外保存方法研究，⑷追蹤監控研究。

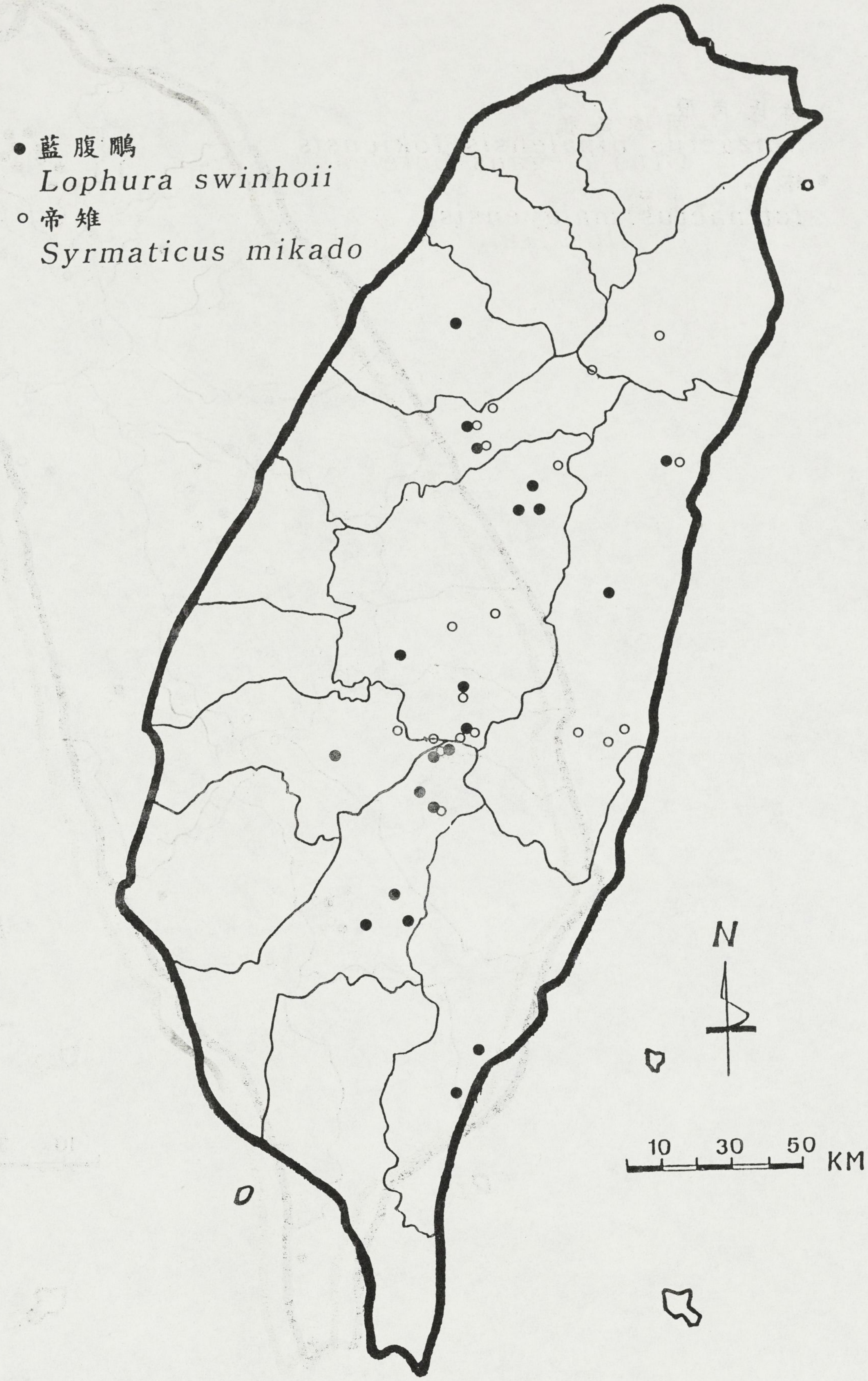


圖一：台灣瀕臨絕種哺乳類之分佈圖

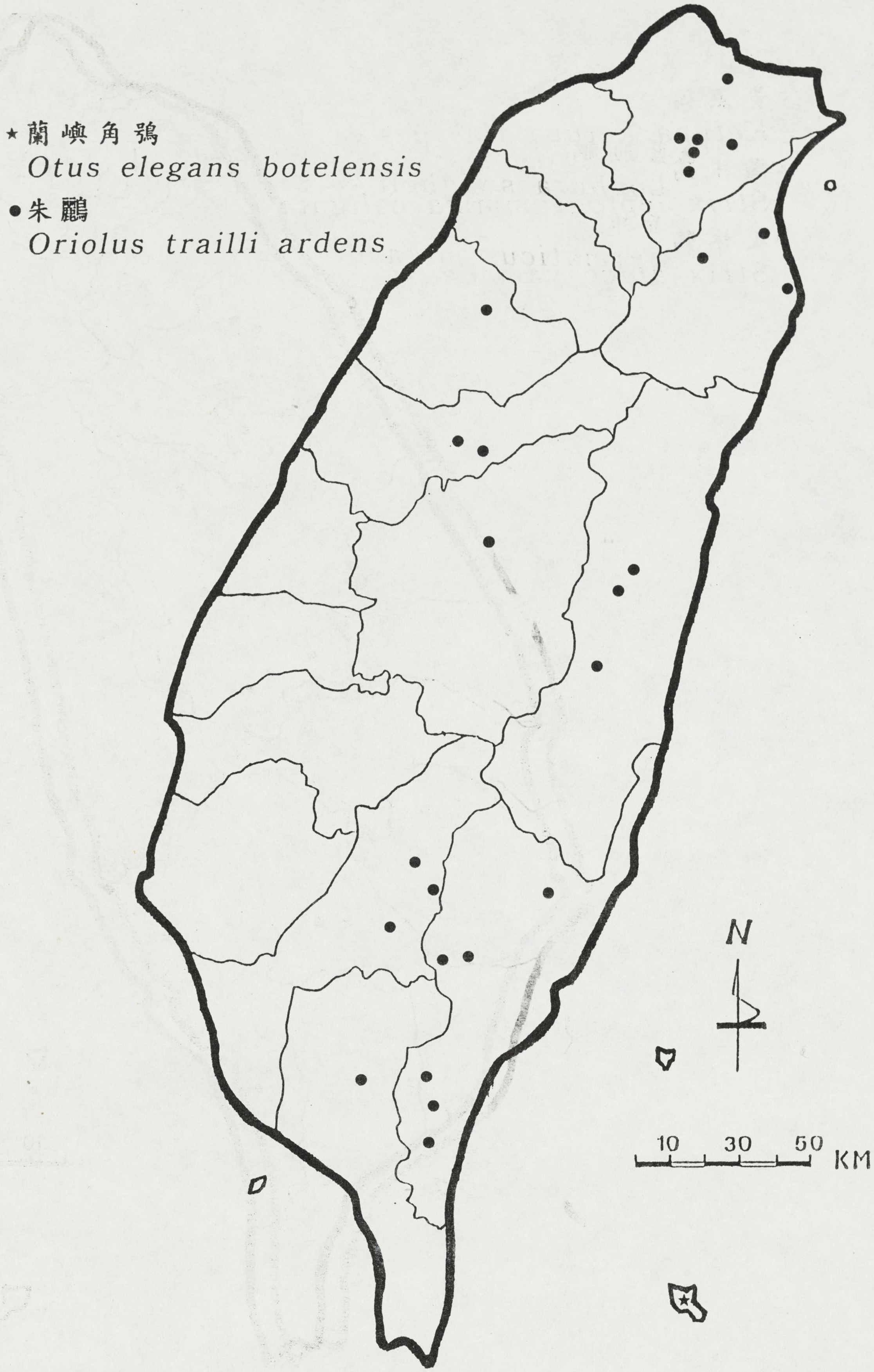
Fig.1. The distribution of endangered species of mammals in Taiwan.



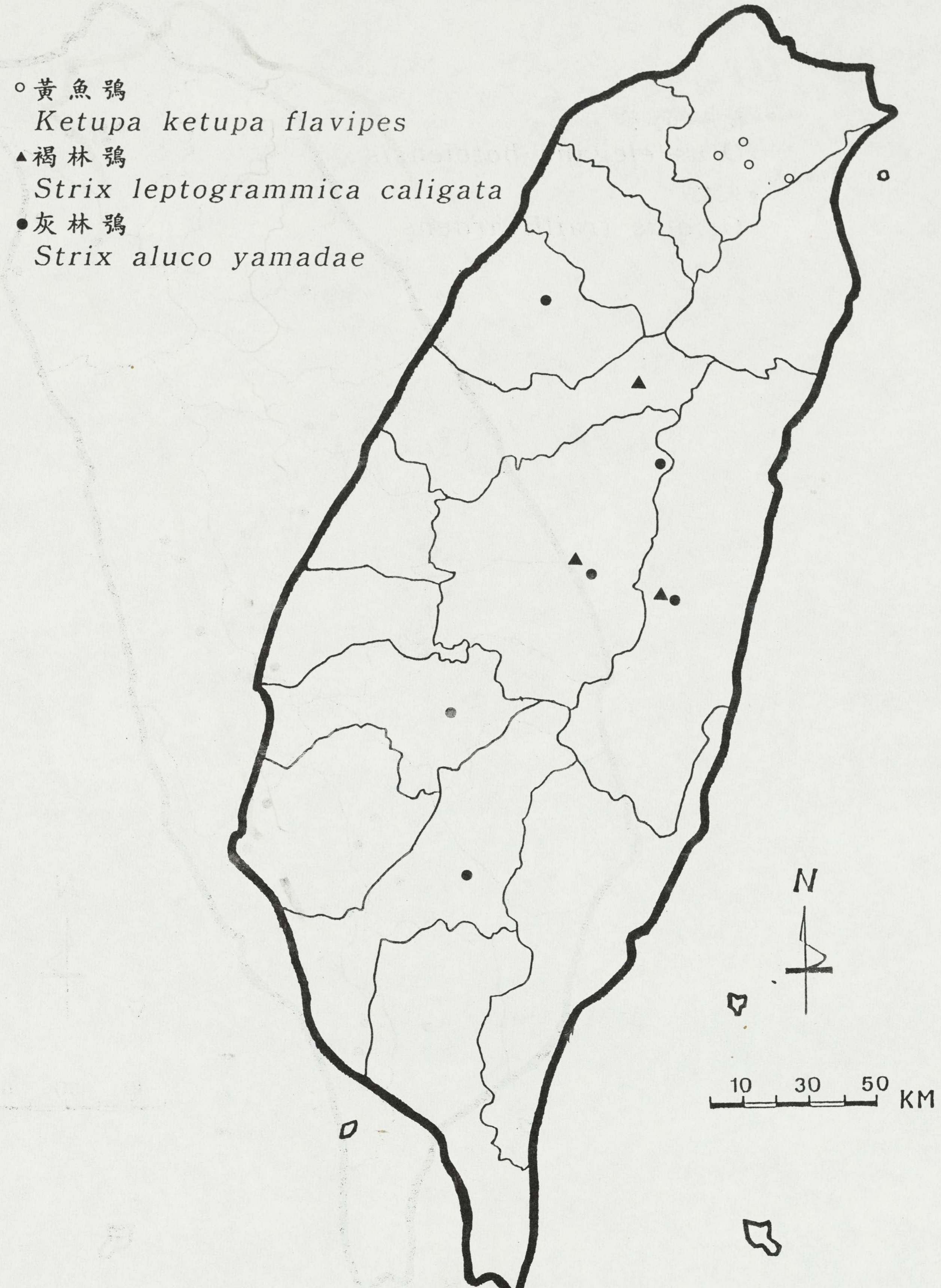
圖二：台灣瀕臨絕種鳥類之分佈圖(1)
Fig.2. The distribution of endangered species of birds in Taiwan(1).



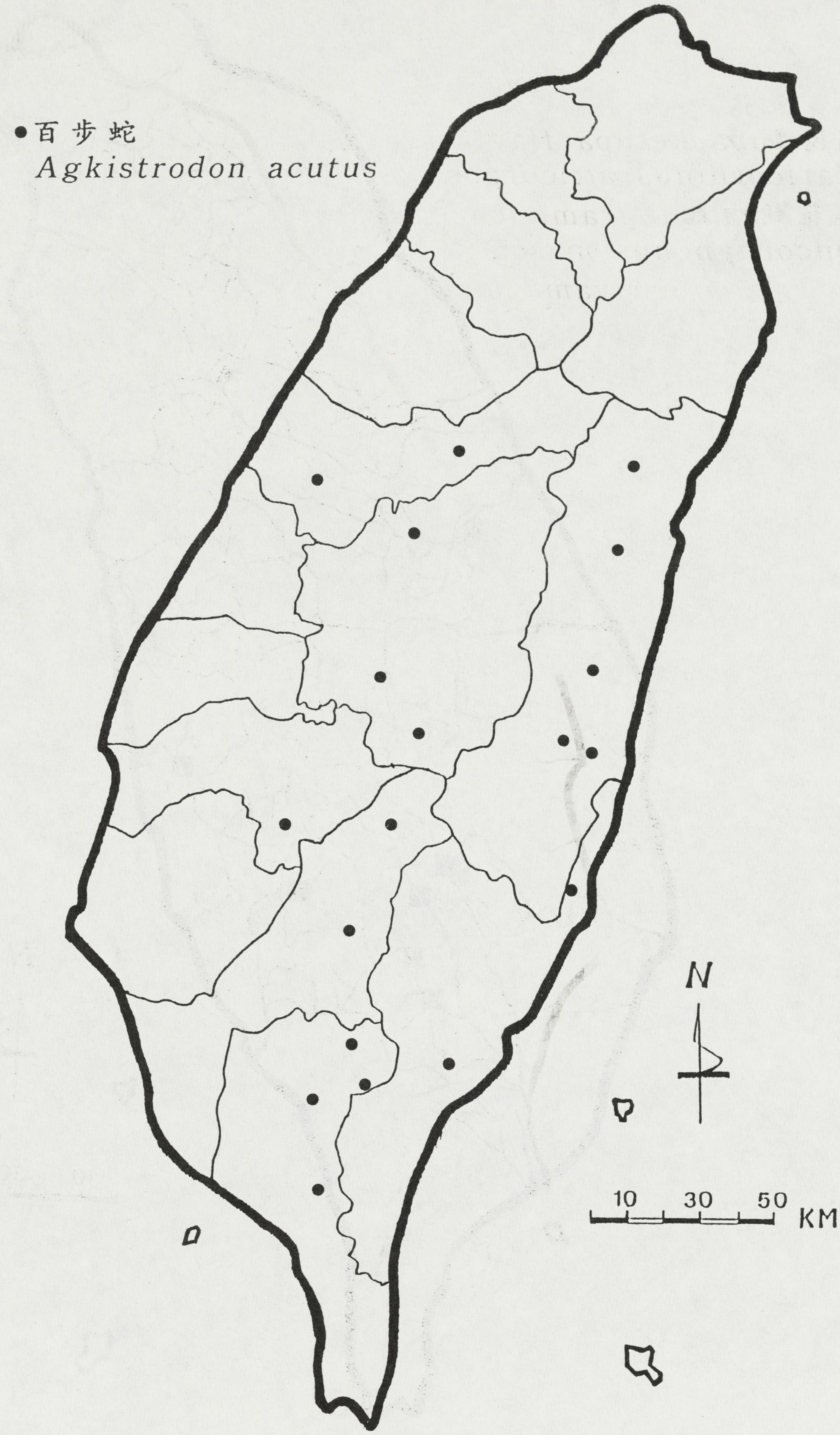
圖三：台灣瀕臨絕種鳥類之分佈圖(2)
Fig.3. The distribution of endangered species of birds in Taiwan(2).



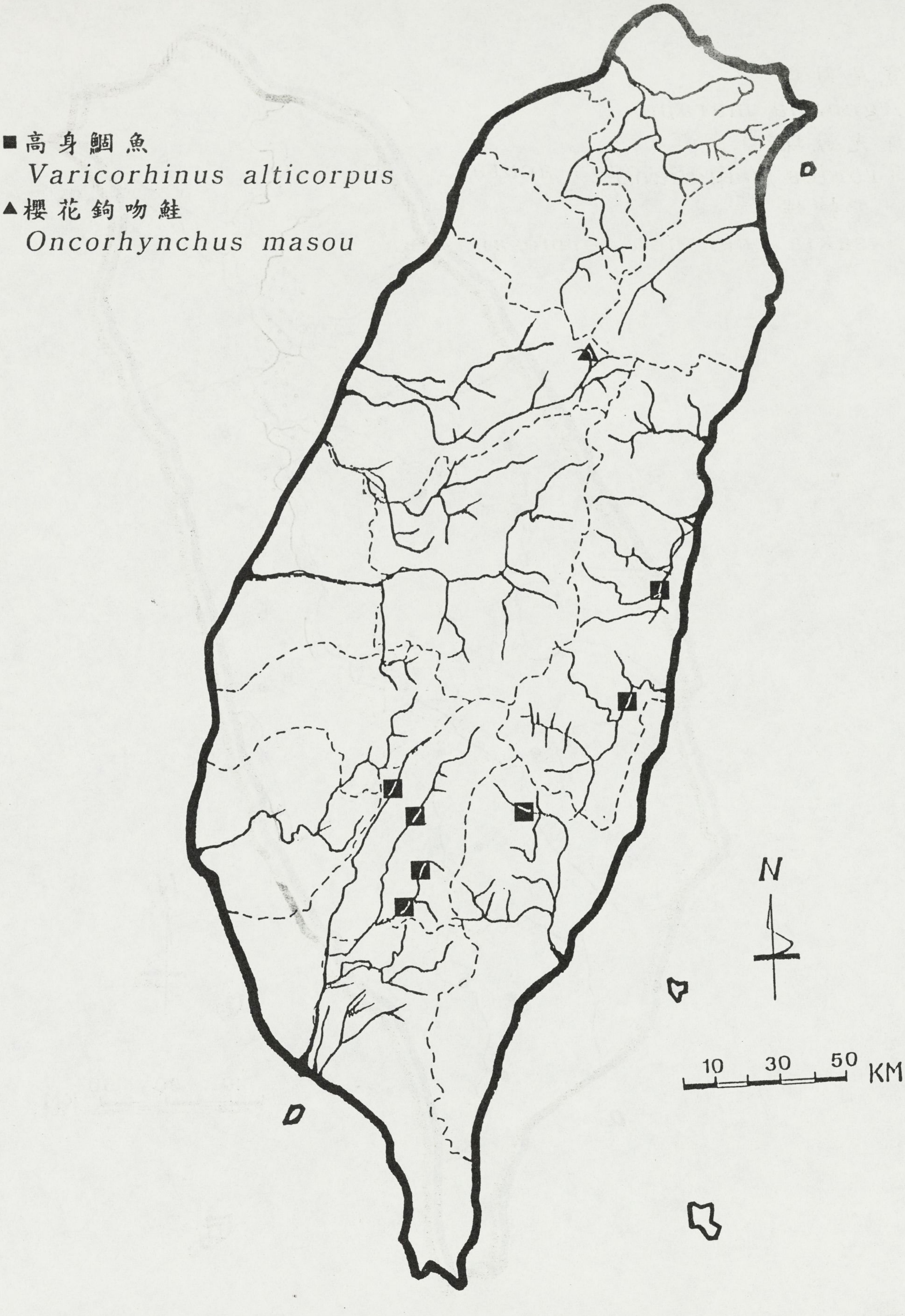
圖四：台灣瀕臨絕種鳥類之分佈圖(3)
Fig.4. The distribution of endangered species of birds in Taiwan(3).



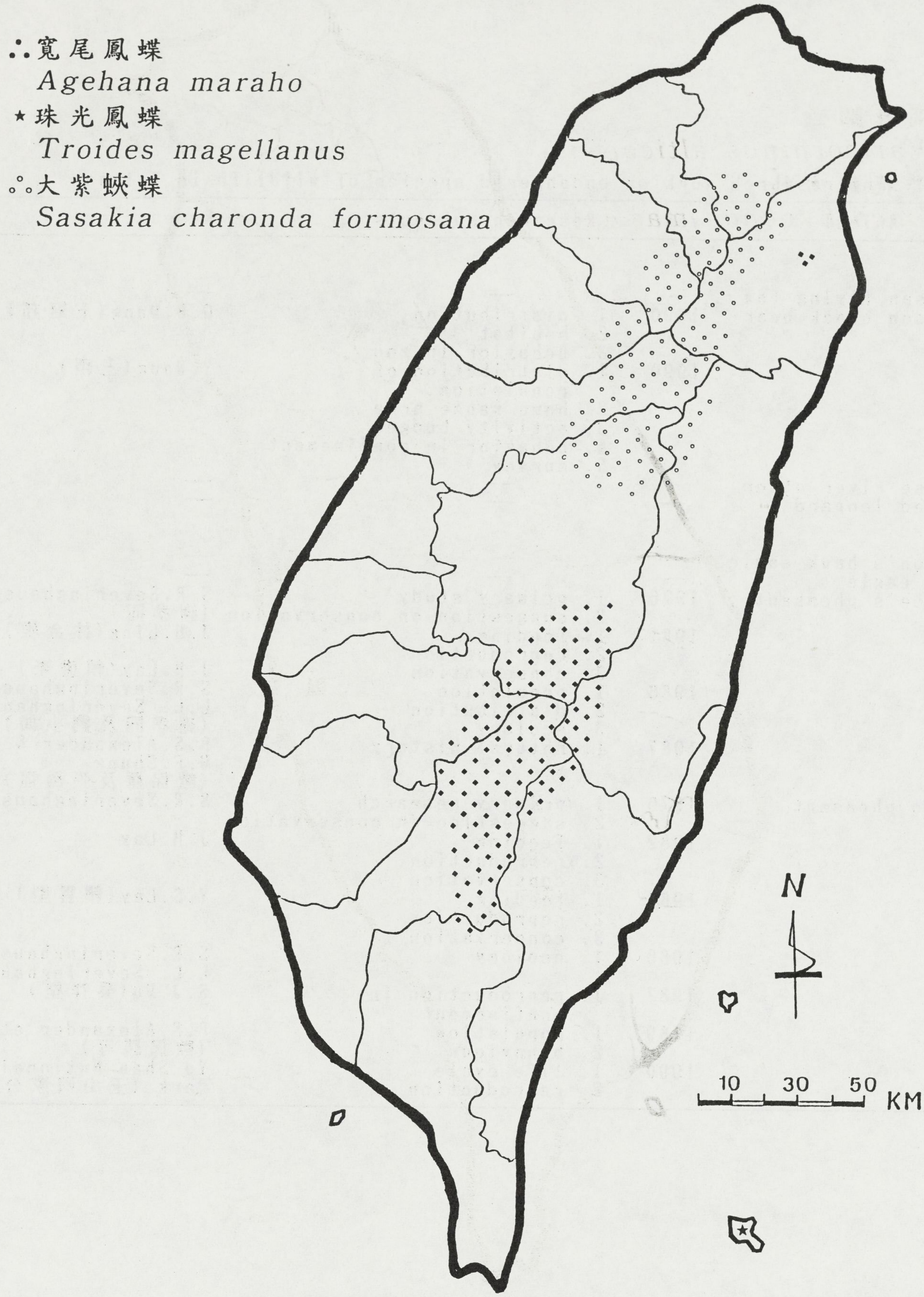
圖五：台灣瀕臨絕種鳥類之分佈圖(4)
Fig.5. The distribution of endangered species of birds in Taiwan(4).



圖六：台灣瀕臨絕種爬虫類之分佈圖
Fig.6. The distribution of endangered species of reptiles in Taiwan.



圖七：台灣瀕臨絕種淡水魚類之分佈圖
Fig.7. The distribution of endangered species of freshwater fishes in Taiwan.



圖八：台灣瀕臨絕種昆蟲類之分佈圖
Fig.8. The distribution of endangered species of insects in Taiwan.

Table 1. The research work on endangered species of wildlife in Taiwan

Animal	year	Research subjects	Researcher
Mammal			
Formosan flying fox	—	—	—
Formosan black bear	1990	1. distribution	G.B.Wang(王冠邦)
		2. habitat	
		3. behavior in zoo	
	1990	1. distribution of population	Y.Wang(王穎)
		2. home range area	
		3. activity budget	
		4. behavior in confinement	
		5. survey	
Chinese river otter	—	—	—
Clouded leopard	—	—	—
Bird			
Hodgson's hawk eagle	—	—	—
Black eagle	—	—	—
Swinhoe's pheasant	1976	1. primary study	S.R.Severinghaus
		2. suggestion on conservation	(謝孝同)
	1981	1. feeding	J.H.Ling(林金雄)
		2. reproduction	
		3. conservation	J.H.Lay(賴俊豪)
	1986	1. population	S.R.Severinghaus &
		2. distribution	L.L. Severinghause
		3. ecology	(謝孝同及劉小如)
	1987	1. natural history	P.S.Alexander & W.F.Chung (歐保羅及張萬福)
Mikado pheasant	1976	1. primary research	S.R.Severinghaus
		2. suggestion on conservation	
	1982	1. feeding	J.H.Lay
		2. reproduction	
		3. conservation	
	1984	1. feeding	Y.S.Lay(賴雲型)
		2. reproduction	
		3. conservation	
	1986	1. ecology	S.R.Severinghaus & L.L. Severinghause
	1987	1. reproduction in confinement	S.J.Wu(吳祥堅)
	1989	1. population	P.S.Alexander etc.
		2. behaviour	(歐保羅等)
	1990	1. life cycle	Yu Shan National
		2. reproduction	Park (玉山國家公園)

Table 1. (Continued)

Animal	year	Research subjects	Researcher
	1992	1. biology 2. habitat	Taiwan Endemic Species Res. Institute (特有生物研究保育中心)
Lanyu scops owl	1987 | 1991	1. population estimation 2. habitat 3. home range 4. life cycle	L.L. Severinghause
Tawny fish owl	—	—	—
Brown wood owl	—	—	—
Tawny wood owl	—	—	—
Maroon oriole	—	—	—
Reptile			
Hundred pace snake	—	—	—
Fish			
Taiwan Ku-fish	1986	1. distribution	C.S.Tzeng(曾晴賢)
	1992	1. habitat	Y.T.Day(戴永禮)
Taiwan trout	1958	1. morphology 2. ecology	H.T.Deng(鄧火土)
	1986 |	1. habitat 2. population change 3. reproduction 4. behavior	Y.S.Lin etc. (林曜松等)
Insects			
Broad-tailed swallowtail butterfly	1987	1. life cycle 2. feeding	Y.L.Liaw & Y.S.Yang (廖有麟及楊義賢)
	1991	1. ecology 2. biology 3. morphology	P.S.Yang & J.H.Tzeng (楊平世及曾兆祥)
Bird-winged butterfly	1985 | 1987	1. population distribution 2. morphology 3. life cycle 4. activity budget 5. climate 6. conservation	W.S.So(陳維壽)
Large purple fritillary	—	—	—

Keeping Pangolins in Captivity

Jung-Tai Chao

Division of Forest Protection, Taiwan Forestry Research Institute,
53 Nanhai Road, Taipei, Taiwan, R.O.C.

Abstract

The order Pholidota includes the single family Manidae, with seven species from tropical Africa and Asia. All seven species of pangolins are now listed on appendices of the CITES. In addition to onsite maintenance of pangolins, worldwide efforts were spent to preserve pangolins in captivity. Pangolins specialize in feeding on ants and termites. Since their natural history were poorly known and their natural diet hardly to find suitable subsitute, pangolins have been regarded as most difficult to keep in captivity. This paper reviews the development of rearing techniques for different species of pangolins. The survival of captive pangolins is affected by factors such as food quantity and quality, temperature, shelter and hygienic conditions, and these factors are discussed in detail.

Key words: Pangolin, captivity, artificial diet.

穿山甲的人工飼育

趙榮台

林業試驗所森林保護系

摘要

穿山甲屬於鱗甲目（Pholidota)，全世界僅一科七種，分佈於亞、非兩洲。七種穿山甲目前全部名列華盛頓公約（CITES）附錄，面臨存亡絕續的威脅。除了區內保存之外，區外保存穿山甲也日益重要。由於我們對穿山甲的自然史瞭解不足，以及難以找到其天然食物的代用品，使得穿山甲的人工飼育相當困難。本文綜論各種穿山甲人工飼育的技術、經驗，供各界參考。本文亦討論穿山甲人工飼料的質、量、配料應該注意考慮的事項、飼育溫度、衛生條件、穿山甲本身的健康狀況等問題。

關鍵詞：穿山甲、飼育、人工飼料。

穿山甲（pangolins）又稱鯪鯉，因為全身被有表皮層衍生的（epidermally derived）角質甲片（horny scales）並有掘土穴的習性而得名。穿山甲的頭部上方、背部、四肢的外側及尾部都覆蓋了甲片，這些甲片呈縱向、橫向櫛比鱗次地排列；穿山甲是寡食的（oligophagous）動物，主要取食螞蟻和白蟻；此外，牠的頭骨奇特、無齒等等特殊形態，均使之別於其他的哺乳類動物，因此穿山甲被列為單獨的一目（order）— 鱗甲目（Pholidota）。

全世界有七種穿山甲，其中四種分佈在非洲，三種分佈在亞洲（Pocock, 1924)。然而由於穿山甲的肉可食用、甲片可葯用、皮可製革，使得牠們在亞、非兩洲遭到大量捕殺，數量急遽減少（詳趙榮台，1991)。目前七種穿山甲全部名列華盛頓公約的附錄（Appendices Ⅰ,Ⅱ and Ⅲ）中（Honacki <u>et</u> <u>al</u>., 1982)，其中南非穿山甲（Cape pangolin, <u>Manis</u> <u>temminckii</u>）更列名華盛頓公約附錄一，瀕臨滅絕。假如不能有效控制獵殺穿山甲的行徑，則無論其族群密度或是分佈範圍勢將益趨萎縮，導致滅絕。

穿山甲的奇特形狀以及對特定食物的適應，一直是許多動物園（zoological parks, zoos）亟欲收集的對象（Menzies, 1963)。過去，動物園飼育野生動物或許只是為了展示，供人參觀。今天，由於動物園做為遊樂中心代名詞的時代已將結束（Turner, 1984)，動物園以人工設施飼育、繁殖野生動物，不但有展示、教育、研究的功能，而且對於物種存活（species survival）具有正面、直接的貢獻。就穿山甲而言，由於全世界一屬七種都面臨存亡絕續的威脅，除了區內保存（<u>in</u> <u>situ</u>, onsite maintenance）之外，以人為方式飼育、繁殖的區外保存（<u>ex</u> <u>situ</u>, offsite maintenance）也日益重要。因此，本文回顧過去各種穿山甲的人工飼育經驗，並加以討論，做為保育單位的參考。

過去有許多人認為穿山甲幾乎無法人工飼育（例如 Cansdale, 1947)，這是因為如果用穿山甲的天然食物（natural diet）— 螞蟻和白蟻 — 來飼養穿山甲的話，必須不斷地採集大量的螞蟻和白蟻，這樣的飼育法非常耗費人力，既困難又不經濟。Menzies (1963)、Rahm (1956) 及作者的研究室在飼養穿山甲時，都有過這種四處採集螞蟻而不勝負荷的經驗。在白蟻、螞蟻還不能以人工方式大量生產之前，以其他代用品取代穿山甲的天然食物成了當務之急。然而，有關穿山甲自然史的資料十分缺乏，難以根據穿山甲的取食習性找到適當的人工飼料來

取代穿山甲的天然食物 (Menzies, 1963)。人工飼料的配方實際上都是從試誤中逐漸發展出來的。本文附錄中羅列的各種穿山甲人工飼料 (顧文儀等, 1983；增井, 1966；Anonymous,1963； Masui, 1967; Menzies, 1963, 1966；Ogilvie and Bridgwater, 1967; Rahm, 1960; van Ee, 1966), 都曾經被不同種類的穿山甲接受取食, 並且讓取食人工飼料的穿山甲生命延續了相當長的一段時間。在人工飼育下存活的穿山甲超過二、三年者不乏其例 (Menzies, 1963, van Ee, 1966), 就連斷奶的仔穿山甲也可能適應人工飼料, 生長良好 (Masui, 1967；Menzies, 1967), 而印度穿山甲的人工飼育紀錄更高達 13 年 (Nowak and Paradiso, 1983)。顧文儀等 (1983) 認為飼育穿山甲失敗的原因主要有拒食、不適應人工飼料、腸胃疾病及受涼得肺炎死亡。實際上, 在穿山甲的人工飼育上要考慮的細節很多, 茲概略分述如下：

一、飲食

表一列出全世界七種穿山甲的體重, 其中顯示穿山甲的體重有很大的變異, 例如非洲的大穿山甲 (<u>M</u>. <u>gigantea</u>) 體重超過 30 kg, 而長尾穿山甲 (<u>M</u>. <u>tetradactyla</u>) 及白腹穿山甲 (<u>M</u>. <u>tricuspus</u>) 都不到 2 kg, 亞洲的穿山甲體重介於非洲大型穿山甲 (大穿山甲、南非穿山甲) 與小型穿山甲 (長尾、白腹穿山甲) 之間 (表一)。顯然, 不同種類穿山甲的食量因體型大小不同而有相當大的差別。譬如 Büttikofer (in Bequaert, 1922) 報告在大穿山甲前胃發現 6 l 白蟻, 後胃發現等量的軍蟻 (driver ant)。這個說法或許有些誇大 (Bequaert, 1922), 但另有報告指出大穿山甲的胃容量有 2 l, 一夜會捕食 700 g (相當於 20 萬隻) 螞蟻 (Dickman, 1989)。體形最小的白腹穿山甲一夜要吃掉 140～200 g(5～7 oz) 的螞蟻 (Rahm, 1960)。以此估計, 體重在 4～5 kg 的臺灣穿山甲 (<u>M. pentadactyla</u> <u>pentadactyla</u>, 表一) 一夜應可取食 300～400 g 左右的螞蟻。

根據 Rahm (1960) 及 Anonymous (1963) 發展出來的人工飼料配方 (詳附錄), 每天提供大穿山甲的食物量乾重不到 400 g, 而 Menzies (1963, 1966) 每日僅餵飼白腹穿山甲 40 g 人工飼料。由此可見穿山甲野外的取食量與上述圈養時的食量實有相當差距。只有增井 (1966) 提到她所飼養的中國穿山甲 (該穿

表一 全世界七種穿山甲（*Manis* spp.）的體重

種名[1]（中文名[2]）	體重（kg）	參考文獻
亞洲的穿山甲	6.8～18.2	Hayman(1954)
M. crassicaudata（印度穿山甲）	9.1～13.3	Blandford(1888)
	4.6	Hutton(1949)
	9.5	Allen(1938)
M. javanica（爪哇穿山甲）	5～7	Lekagal & McNeely(1988)
M. pentadactyla（中國穿山甲）	6.8～7.7	Blandford(1888)
M. p. pentadactyla（台灣穿山甲）	最常見約 4	趙榮台(1989)
	最高達 12	
M. p. pusilla（海南穿山甲）	4.3 (N=5)	徐龍輝等(1980)
非洲的穿山甲		
M. gigantea（大穿山甲）	25～33	Dickman(1989)
M. temminckii（南非穿山甲）	7.9 (N=30)	Coulson(1989)
	最高達 27	Sweeney(1956)
M. tetradactyla（長尾穿山甲）	1.4 (N=2)	Rahm(1956)
M. tricuspus（白腹穿山甲）	1.2 (N=13)	Rahm(1956)
	1.6	Menzies(1966)

1) 依 Honacki *et al*. (1982)
2) 依賴景陽 (1986)

山甲運自臺灣，故可能為臺灣穿山甲）在產後每日取食 300～400 g，其取食量與估計的野外取食量相當。

野外取食量與圈養時取食量的差異至少反映了幾種可能：1）穿山甲不喜歡人工飼料；2）人工飼料提供的營養、能量均高於穿山甲的天然食物；3）人工飼養的穿山甲活動量較低或不健康，其進食量不像野外的穿山甲那麼高。根據作者研究室的飼育紀錄，圈養的台灣穿山甲並非每日取食，有時候整天都在休息，根本不出來活動，這種現象據說也發生於野外。這樣看來，間隔多少時間、提供多少量的飼料給穿山甲，是一個可以不斷嘗試改進的工作。

至於人工飼料在“質”上是否比得上天然食物則是另一個值得探討的問題。穿山甲的天然食物是昆蟲，而各種人工飼料配方（詳附錄）除了中國穿山甲人工飼料的蠶蛹（顧文儀等，1983）以及白腹穿山甲人工飼料的 Stimulite (Menzies, 1963, 1966) 以外，大多是以畜產品（肉、蛋）做為主成份。我很同意顧文儀等(1983) 的看法：“脊椎動物體蛋白質與昆蟲體蛋白質性質不同，....以脊椎動物的肉類代替無脊椎的昆蟲做飼料是不適當的”。我的研究室也曾嘗試以蜂蛹、蠶蛹餵飼臺灣穿山甲，但是經過冷凍後的蛹很容易黑化，難以維持新鮮。此外，臺灣穿山甲對蠶蛹粉的接受度並不高，換言之，蠶蛹粉並不適宜做為臺灣穿山甲人工飼料的主要成份。

在印度穿山甲、中國穿山甲、大穿山甲及南非穿山甲的人工飼料配方中均加有牛奶（詳附錄），但是據陳寶忠（個人聯繫）告知，牛奶可能使腸鈣化，引起穿山甲便血。因此作者研究室在飼育臺灣穿山甲時，均不採用牛奶。

臺灣穿山甲能夠接受新鮮冷凍的舉尾蟻（<u>Crematogaster</u> sp.)，而且取食後之糞便外觀正常。在不可能餐餐供應螞蟻給穿山甲的狀況下，間歇地提供螞蟻給穿山甲，或可達到讓穿山甲充分消化，營養均衡的需求。Menzies (1966) 曾以凍僵的螞蟻（<u>Oecophylla</u> sp.）餵飼白腹穿山甲，然後逐漸在飼料中減少螞蟻的比例，增加人工飼料的份量。這種以漸進的方式使穿山甲適應人工飼料是公認的飼養步驟（詳附錄)。

Menzies (1967) 認為活螞蟻能誘發斷奶的白腹穿山甲仔獸取食。顧文儀等 (1983) 曾用蚯蚓誘導拒食的穿山甲取食。由於穿山甲取食螞蟻，所以也有人在人工飼料中加入蟻酸（formic acid)(例如 Rahm, 1960)。加入蟻酸的做法可能是基於蟻酸能誘導穿山甲取食的假設，不過，Menzies (1966) 卻建議在白腹穿山甲的人工飼料中加入二己烯醛（hex-2-enal) 以代替傳統的蟻酸。顧文儀等 (1983) 稱穿山甲舌上的粘液 pH 值高達 9～10，可能有中和酸性食物的作用。這麼看來，人工飼料似應為酸性，但卻不一定要加蟻酸。酸性物質在飼料中的功能仍有待釐清。

此外，本文附錄中的各種人工飼料配方都考慮到經常在飼料中加入維他命或使用含有多種維他命的食物。充足的飲水更是不可或缺。顧文儀等（1983）提到在人工飼料中加入少量土壤和植物纖維對穿山甲的消化吸收過程有一定作用，這

是相當好的建議。

二、溫度

一隻臺灣穿山甲的體溫為 30～32℃（楚南，1922）。穿山甲雖是恆溫動物，卻沒有很好的禦寒能力，在冬天低溫時常有顫抖的現象，將溫度提高，穿山甲的顫抖就會減少，甚至消失。顧文儀等（1983）認為穿山甲對地面溫差適應力差，容易受涼並引起肺炎。作者研究室的做法是在飼育室為穿山甲設置木箱，做為穿山甲的臥榻。將臥榻墊布、墊草、或是加暖墊（heat pad）都可以充分保暖。不過溫度提高時，穿山甲的飲水量會增加，水分的供應必須充足。

三、衛生條件

人工飼育的穿山甲最常死亡的原因之一是牠們不適應人工飼料，以至於穿山甲不是營養不良就是消化不良，導致死亡（Menzies，1963）。事實上，人工飼料中的配料（例如肉、蛋、牛奶、麥片等）都是非常好的細菌培養基，稍有不潔或是擱置時間過長，很容易孳生細菌造成飼料腐敗（個人觀察）。腐肉曾有引起穿山甲腹膜炎進而死亡的案例（Menzies，1966），因此，人工飼料必須保持衛生，隔夜的食物必須丟棄。

在自然狀況下，穿山甲穴土而居，因此飼育室內應有相當的空間安置土壤。穿山甲習慣在土壤上排泄，並以土掩蓋其排泄物。有了土壤穿山甲便不致於在臥榻排泄，影響清潔（顧文儀等，1983）。

另一個威脅穿山甲生命的就是農藥。穿山甲對農藥非常敏感：以微量的 DDT 去除穿山甲身上的寄生蟲、以微量 BHC 消毒穿山甲居住的籠子所留下的殘毒，都曾造成南非穿山甲死亡（van Ee，1966，1978），所以毒藥殘毒在穿山甲的人工飼育環境中應儘量避免。

四、穿山甲本身的健康狀況

許多穿山甲在開始人工飼育前就餓了很久，基本上已經衰弱不堪。Menzies (1963) 發現健康狀況良好的穿山甲比較更能適應人工飼育的狀況。剛開始飼養的穿山甲有拒食的現象，而穿山甲的頭形，也使得強迫進食十分困難（Cansdale

，1947)。不過顧文儀等（1983）、Masui（1967）卻列舉了數種灌食方法，顧文儀等（1983）並認為灌食是過渡飼養的有效措施。在臺灣，穿山甲多半是用獸夾捕到的，有些傷口不容易看出來，在營養失衡與緊迫（stress）的狀況下，更使得穿山甲不易存活。因此，在飼養期間應對穿山甲施行檢查，治療可能的傷口或疾病，以免病情惡化。

穿山甲的人工飼育方式在摸索中已經建立了一些模式，雖然人工繁殖成功的案例鳳毛鱗角，但能夠先求圈養中的穿山甲存活，確已屬不易。在人工飼育成功之前，討論發展進一步的區外繁殖、保育科技或許只是一種奢想。如果有更多的營養、生理學家參與穿山甲的研究，相信對穿山甲的人工飼育、繁殖以至於區外保育，將會有更大的突破。

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附錄：各種穿山甲的人工飼料配方

印度穿山甲（*M. crassicaudata*）(Ogilvie and Bridgwater, 1967)

0.4 g　乾狗食

0.2 g　絞馬肉

1/2 罐　濃縮奶水（evaporated milk）

2 個　生蛋

5 滴　維他命 ABCDE

將上述配料餵飼一對穿山甲，結果雄體取食不良，一個月後死亡；雌體產一仔後存活一年以上。

中國穿山甲（*M. pentadactyla*）

(1) 據 Masui (1967)

150 g　絞馬肉

180 cc　牛奶

1 個　生蛋黃

5 g　未煮過的麥片

5 g　Esbilac (Borden Dairy Co., New York, 生產的商品化奶粉)

1 g　鈣

0.2 cc　多種維他命

雌性穿山甲人工飼養後順利產一仔獸。仔獸自第 89日起改食人工飼料，母子食用人工飼料生長狀況良好。Masui 的日文報告中（增井，1966）人工飼料成份與上相同，唯用量稍有變化。

(2) 據顧文儀等 (1983)

50%　蠶蛹粉

5%　熟蛋

5%　奶粉

10%　乾酵母

25%　種植作物的表層土壤

5% 乾槐葉粉

0.02% 多種維他命

0.05% 生長素

將上述配料研磨成粉狀後充分攪拌，餵食加水 40-50%。

大穿山甲 (M. gigantea)

(1) 據 Rahm (1960)

25 g 玉米片 (corn flakes)

100 g 無糖煉乳

100 g 溫開水

150 g 碎肉

15 g 乾燥螞蟻卵

1/2 茶匙 麥胚油

1 滴 蟻酸

將上述配料在果汁機內充分攪拌，大穿山甲會接受這種食物。

(2) 據 Anonymous (1963)

25 g 玉米片

100 g 溫開水

150 g 碎肉

1/2 茶匙 麥胚油

1 滴 蟻酸

將上述配料以果汁機攪拌，每天餵飼 2 次，混合物應維持在 25～26℃。

南非穿山甲 (M. temminckii) (van Ee, 1966)

1/2 磅 碎肉

1/2 磅 煮開的玉米糊 (mealie meal)

2 個 生雞蛋

1 茶匙 Embelex (一種補葯，為 Maybaker Ltd., Port Elizabeth, South Africa 的產品)

2 品脫　鮮奶

上述配料以果汁機攪拌 15 分鐘。每天早上 11 時以 2 lb 白蟻餵飼穿山甲，晚上 8 時則以上述人工配料餵穿山甲。

穿山甲接受人工配料，生長良好。

白腹穿山甲（<u>M</u>. <u>tricuspus</u>） (Menzies, 1963, 1966)

2 份　冷凍的螞蟻（<u>Oecophylla</u> sp.）

2 份　Stimulite （一種食蟲鳥類的上市飼料，P. H. Hastings, Portsmoth, England 的產品）

1 份　碎肉

將上述配料充分攪拌，不加水，成為濕潤粉末狀，每天餵飼 40 g。水由他處供應，並不時加入數滴多種維他命“Abidec”。人工飼料中的螞蟻逐漸減少，直至完全以 Stimulite 取代。白腹穿山甲以此為食活了一年多。

梅花鹿之復育

王 穎

師大生研所

摘 要

台灣梅花鹿因受到棲地分割及人為的獵捕的影響，野外的族羣已經滅絕，所幸民間及動物園尚保存部份族羣，為保育固有之品系並使其回歸山林，墾丁國家公園管理處於1984年開始執行梅花鹿復育計劃，由國內動、植物、獸醫、畜牧等各類專家人士組成復育小組進行規劃及研究，將復育過程分為準備、放養及追蹤三期。1986年11月22日頭鹿由台北動物園運送到墾丁社頂復育區，正式展開了梅花鹿的復育工作，至1993年3月已增至一百頭以上，在復育區內部份地區密度已超過每公頃2隻以上，棲地明顯可見鹿隻活動的蹤跡。其在野外生活情形由無線電追蹤資料顯示，鹿隻一日24小時的活動，以晨昏以午夜為高峯，其棲所遮蔽程度較一般地區高，區內植物遭其啃食者至少有73種，繁殖季由9月底至來年1月，以11月為高峯。以形態特徵而言，雄鹿各項特性皆大於雌鹿，隨年齡改變而有相當之差異，雌鹿約3歲定型，雄鹿則在4歲。22頭鹿目前仍有12頭存活，年齡至少在8至11歲以上，已知死亡的成體中以雄性較雌性所佔的比例為高。由4-8隻梅花鹿粒線體色素b基因'3及'5端所獲得之鹽基序列顯示，各個體的粒線體基因型皆不相同，表示復育羣的基因庫內有很大的變異度。目前除持續對區內鹿隻進行監測外，已展開對國內其他地區及國外地區鹿隻野放可行性之評估。

緣 起

梅花鹿分布於亞洲東南部，共有13個亞種，而台灣梅花鹿(Cervusnippon taiouanus)是台灣特有亞種，是其中體型較大者，在三、四百年前，於台灣中低海拔的平原及丘陵地為其主要活動範圍，在早期之開發史上，梅花鹿亦曾為先民及當地原住民之重要經濟活動資源之一。然近年來因經濟利益使梅花鹿大量被捕捉，而其棲息環境亦因農業開發而遭分割，致使野外族羣數量銳減，據馬卡拉博士(Dr. Dale R. McCullough)於1973年調查報告指出，野生梅花鹿可能已於1969年在台灣絕跡。

台灣梅花鹿在野外絕跡，為台灣自然生態環境破壞警訊之一，而野生動物保育工作近年來受到國內及世界各國之重視。有鑑於此，墾丁國家公園乃在內政部營建署的支持下，展開梅花鹿之復育工作，希望藉由復育計畫之推行，能保有台灣梅花鹿之固有品系並使其回歸原野生活。

參與成員

復育計畫爲國內首次進行之大型野生物動物復育計畫，涉及行政，研究及管理等各層面，是以在復育初期即成立復育研究小組綜合畜牧、獸醫、行爲、生理、植物及歷史等各方面之研究者，進行各項與復育有關之研究工作，並成立復育諮詢委員會包括上述各研究者及其他從事與復育工作相關的專家或學者組成，提供研究成果或專業知識指導復育工作的方針及解決工作進行所遭遇的困難。此外，行政及管理方面則由中華民國自然生態保育協會、內政部營建署國家公園組、及墾丁國家管理處保育課及工務課有關工作人員等分別負責行政協調、研究支援、現場管理、及復育設施建設等工作。

工作規畫

在參酌國內現有之人、物力及主客觀環境後，梅花鹿復育小組在「使鹿隻回歸自然」之前提下，將復育過程規畫爲三個階段，依序爲準備期、放養期、及追蹤期。隨著各期之推展，人爲飼養管理之程度將逐漸降低，鹿隻生存之空間將逐漸擴大且由人工圈養逐漸走向自然野放，依此逐步訓練鹿隻回復野外自立生活的能力。茲將各分期構想介紹如下：

(一)準備期：

以往梅花鹿基本生活資料極爲缺乏，故此方面資料之收集爲準備期之工作重點之一。主要工作內容包括鹿隻行爲生態、年齡及品系鑑定、鹿隻與植物之關係、基礎生理、疾病保健、養殖現況及歷史研究等項目。其次，復育核心鹿羣之遴選及復育地點之勘定、規畫與建設乃復育研究工作執行之基礎，亦爲本期之工作重點。

(二)放養期：

本期之工作重點乃在於將鹿隻選人復育環境後，訓練，協助其逐步回復野性，並對其適應性進行各類相關評估及研究。鹿隻迁入現場後，初期仍以人工方式圈養，此後則逐漸減低爲飼養管理之程度，並日漸擴大其生活空間，在詳細的計畫與觀察評估下，以分段漸進方式達成鹿隻完全野放之目的。本期工作內容主要針對遷入復育現場之核心鹿羣繼續追蹤進行各項適應性試驗及相關後續研究，並對野放區域內之植被及生物環境做適當之管理研究，漸次實現鹿隻行野性生活自給自足的目標。

(三)追蹤期：

最終階段之目標在於將已完全野性化之鹿隻，釋放於其原來可能生長之環境。因此本期之工作重點在於選擇社頂復育區以外的適宜地點來釋放回復野性之梅花鹿，並對釋放鹿羣繼續加以追蹤監視，記錄研究其野放情況並對其與新環境間之互動關係進行探討分析，並建立野放鹿隻經營管理之法則。

執行現況

台灣梅花鹿復育研究計畫爲一長期綜合性計畫，自民國73年開始正式執行，目前正進行第九個年度之工作（表1）。前3年已完成準備期之各項工作，包括基本資料之收集、復育核心鹿羣之選取及遷移、復育環境之勘定規畫及現場主要工程設施之建立等。第四年至今已完成大部分放養期之工作，包括對鹿隻遷入復育環境後之適應性各項相關之研究及評估。

基本資料之收集，包括鹿隻行爲生態、生理、遺傳學、年齡鑑定、飼育保健、養殖現況、天然生育植羣分析、及梅花鹿與台灣歷史淵源等各項研究。關於復育核心鹿羣之選取及遷移乃依據復育小組成員對台北市動物園梅花鹿羣進行兩年行爲生態觀察研究結果，根據鹿隻個體繁殖狀況及社會地位，從其中挑選較理想性別及年齡配比之22頭鹿隻爲核心鹿羣，並已於75年底遷入社頂臨時鹿舍中。在復育地點之勘選、規畫方面，曾實地探訪屏東縣牛角灣，墾丁國家公園仁山生態保護區、及社頂自然公園等處，在審愼考慮後擇定社頂公園北側之沿海丘陵地帶爲復育地點。經多次勘測及研議後，於75年間完成復育區之區設施規畫及部分之工程設計，且於同年發包施工，並於其後三年中陸續完成現場作業區的研究設施工程及其他多項相關復育設施（圖1）。

這幾年來之執行過程中，除了研究工作及現場建設工作之進行外，並曾邀請國外相關專家來台指導，交換學識技術經驗，美國動物學專Dr. Richard D. Taber, Dale R. McCullough，英國學者Michael Green及紐西蘭圍籬技術專家Bruce Hamblyn等；此外亦曾辦理中、大型綜合性研討會，彙集各界相關學者專家及業務人員與會，藉有關知識及研究工作心得之交流，促進復育目標早日圓滿完成及社會大衆對台灣梅花鹿復育研究工作之認知與認同。

由第四年至今放養期階段則針對鹿隻遷入復育環境後適應性及其與新環境間之互動關係進行評估及研究。初期研究重點包括對鹿羣繼續追蹤觀察，探討鹿羣在新環境中對時間、空間、食物之利用及個體間相互關係；同時對遷入新環境的核心鹿羣進行生理性狀之調查，建立基本資料；觀察當地植羣演替。

以明瞭鹿羣對當地植物之影響；從事復育地內主要寄生性動物及蟎類進行生態調查。

建立梅花鹿疾病防台追蹤及人畜保健之資料。此外，爲配合復育計畫野生動物保育教育之目標，並進行台灣梅花鹿之馴育計畫，訓練一批較能承受人爲干擾之台灣梅花鹿族羣，提供研究及解說教育之對象。

78年12月部份鹿隻野放植生試驗區後，即對其在野外生活之情形進行觀察。80年1月23日研究及管理人員將29頭鹿分別釋放於復育區內各處，正式開始野外之放養工作。至今部份區域內鹿隻密度達每公頃2隻以上，其活動所留痕跡處處可見，顯示鹿雙對情地之利用已達飽和階段。現已完成放養期之工作階段，目前正進行對其它地點野放可行性之評估，即將於近期內展開正式之野放，邁入追蹤期之工作階段。

復育鹿羣現況

自民國75年11月將22頭(5雄、17雌)核心鹿羣從圓山動物園遷入社頂梅花鹿復育區後，至民國77年底，核心鹿羣已增加至41頭，並於77年12月28日將6頭核心鹿羣(2雄、4雌)移入植生試驗區，以為野放先驅之實驗，另有5頭馴育用雌幼鹿於78年併入核心鹿羣。民國79年年底為止，復育區核心鹿羣增加至58頭(9雄、23雌、4雄幼、5雌幼、8雄仔、9雌仔)，民國80年元月23日，正式將29頭(不包括馴育鹿羣)，核心鹿隻放入野放一至三區，連同植生區6頭梅花鹿及其所生產至少3雌鹿，1頭雄鹿，野放區共有39頭核心鹿羣。

除核心鹿羣外，早期復育研究計畫生理研究用的東海鹿羣自78年3月1日運至社頂臨時鹿舍後，至79年7月，其數量已從原來17頭(8雄、9雌)增加到23頭(8雄、9雌、5雄幼、1雌仔)。79年12月6日將16頭東海鹿羣移入遠眺區中，12月中再移入2頭雄鹿。

至民國82年3月止，圓山動物園22頭核心鹿羣中有10被發現死亡，12頭存活，存活者其年齡估計至少皆在8-11歲以上。野放區於80年、81年共發現10頭新生仔鹿及1雄幼鹿，除第三區因密度低外，各區都有發現新生仔鹿之蹤跡，此外，自80年初至82年3月，目前復育區鹿隻至少87隻以上（圖２），由於野放地區植被遮蔽程度高，隱密性大，故鹿隻不易被發現，此一族羣數量估算可能偏低。

研究人員於1990年秋取得51個樣，以探討梅花鹿復育族羣之遺傳結構，利用其粒線體基因羣的三個片段，將聚合鏈反應放大並分析其序列，顯示所有被取樣之台灣梅花鹿均屬於單一起源之羣體，但其個體間粒線體基因型並不相同，表示在復育鹿羣內基因庫有很大之遺傳變異度。

此外，研究者亦對鹿隻年齡、體重、身長、肩高進行測量（表２），其結果顯示，復育鹿羣雌、雄隨年齡之改變而有相當之差異，以年齡來看，雄鹿體型生長較快，至４歲左右成長速度就趨緩，體型固定下來，而雌鹿體型之成長，速度較雄鹿稍緩，約在３歲才定型，而從體重、身長、肩高３種體型測量值相關係數來看，雄鹿之相關度極高，顯示雄鹿成長朝向體長、高度同時生長，而雌鹿之成長則偏向體長之方向生長（表３）。

野外習性

在梅花鹿野放後藉由無線電追蹤，研究者得以觀察並記錄其野外習性及活動狀況。結果顯示一日24個階段皆有鹿隻在活動（圖３），其中以17-18時，5-6時，23-24時活動高峯，而以9-10時為最低潮。

其在野外的活動以覓食為主，覓食植物種類據初步觀察至少有24科46屬51種（表４）。以覓食部位來分，只有葉被食用的有18種，莖、葉被食用的有36種，莖、葉、果被吃的只有１種，莖、葉、籽皆吃的只有２種；再以生活型來分，喬木17種，灌木４種、攀藤13種、闊葉草９種、禾草有８種，進食所佔時間比例在10％以上者，包括羊角藤、台灣海桐、扛香藤、兩耳草、金腰箭等。

至於梅花鹿野放後對棲地利用之特性，於1989年於植生試驗區調查11處鹿隻棲息場所特性來看，其棲所遮蔽程度較一般棲地為高，附近5公尺方圓內樹高1.4公尺以上者較其他地區為多，此外棲息場所與溪流、礁石、主要步道及圍籬之距離跟非棲息場所不同，棲息處距溪流礁石較接近，而與主要步道、圍籬較遠。

另在1990年2-7月間，於植生區逢機選取387個樣區，測量區內環境特性及記錄鹿隻活動之痕跡，包括休息處、打架、磨角、排遺等地，所得結果顯示，具有磨角痕跡之樣區有27處、打架10處、休息26處、排遺70處，其中鹿隻休息處平均坡度較全體樣區平均坡度為低，顯示鹿隻有選擇較平坦處休息之趨勢，且地表裸露度較高，草生覆蓋度亦較高，而灌叢覆蓋度則較低，再就磨角、打架所發現之痕跡，多見於乾季，可能與鹿隻發情繁殖活動有關，而此兩處樣區與全體樣區相較，其禾草覆蓋度小，但樹木多，土壤裸露程度較大。

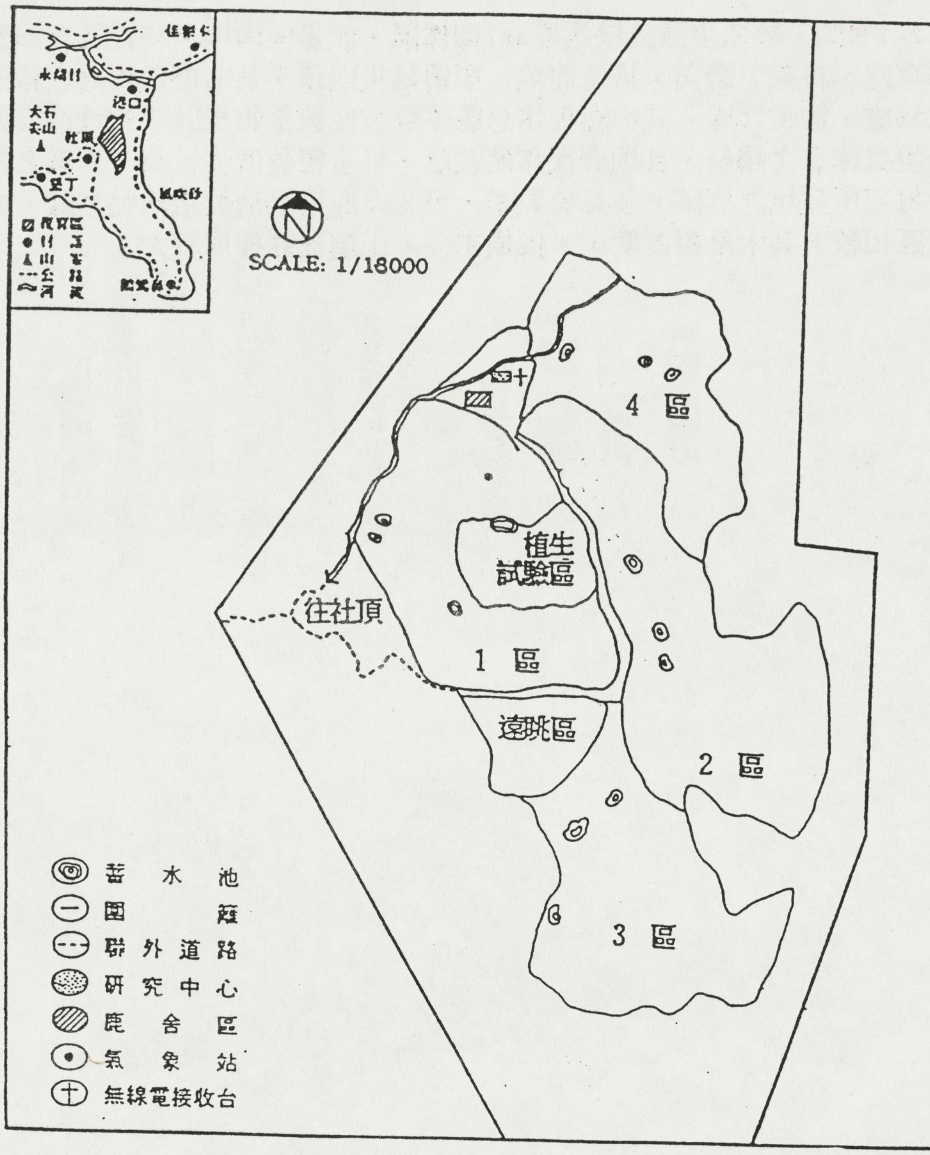

圖１．社頂梅花鹿復育區之設施及各分區之相關位置

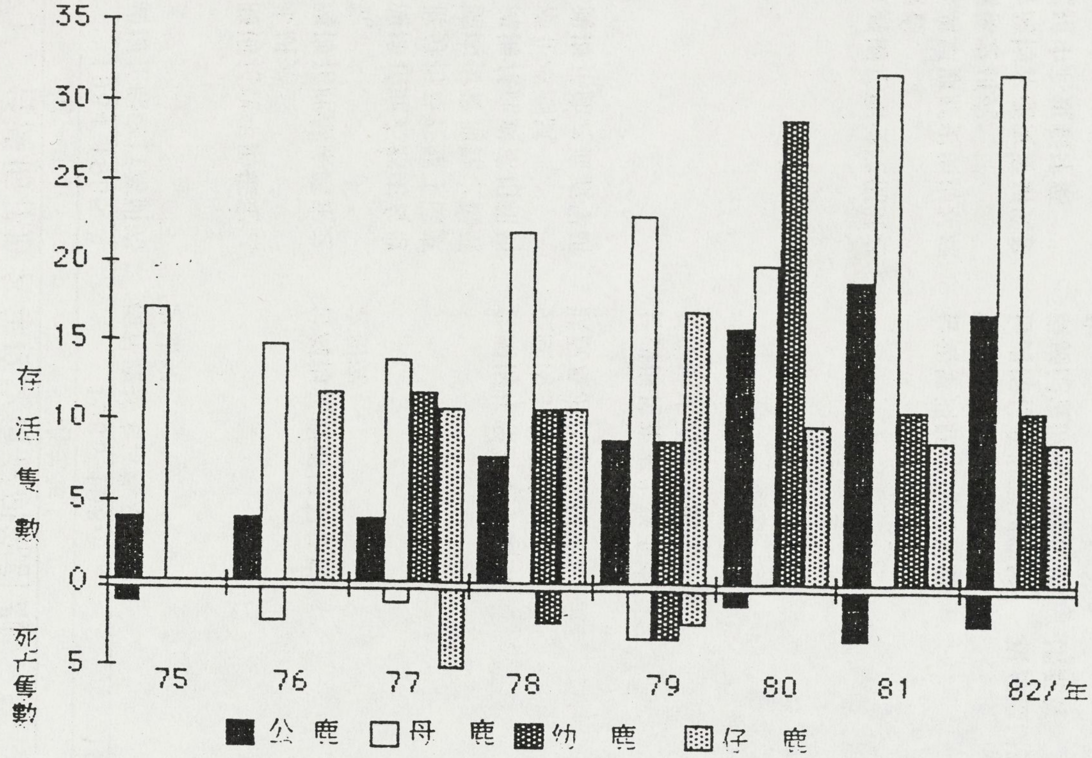

圖2. 核心鹿群族群各年性別與年齡組成之變化

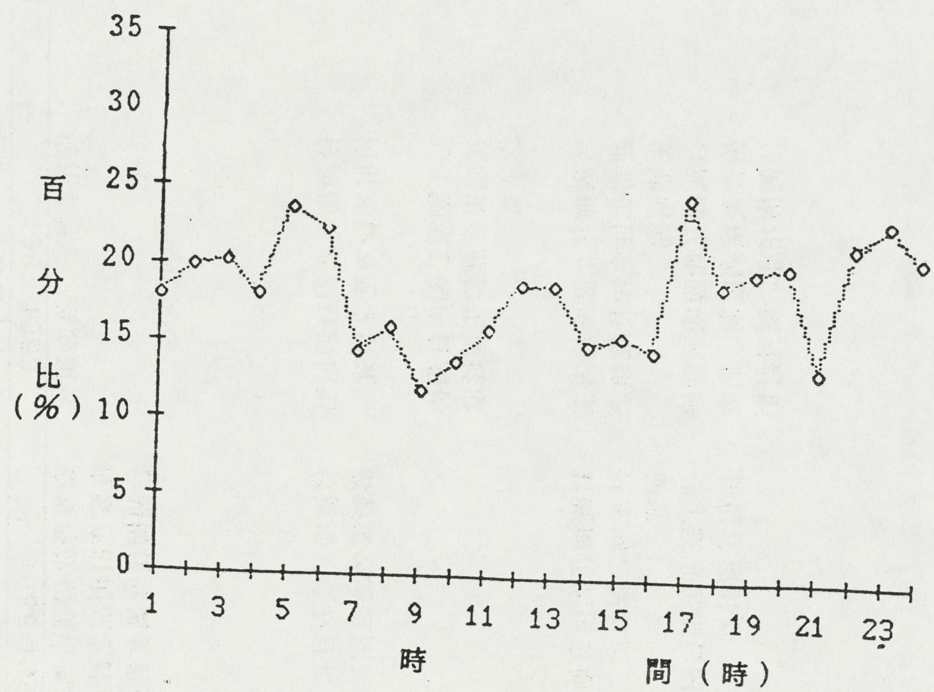

圖3. 梅花鹿之活動模式

表1．台灣梅花鹿各年度之復育研究計劃

研究工作範圍	第一年 1984-1985	第二年 1985-1986	第三年 1986-1987	第四年 1987-1988	第五年 1988-1989
行為生態	台灣梅花鹿之行為研究	梅花鹿基本行為及生態之研究		梅花鹿社會行為之研究	鹿隻野放初期行為之觀察及復育鹿群現況之評估 台灣梅花鹿攝食喜好性試驗
年齡鑑定	台灣梅花鹿年齡鑑定之初步研究				
遺傳學	台灣梅花鹿品系鑑定之研究	台灣梅花鹿遺傳學特徵之研究			
植群	台灣梅花鹿天然生育地植群分析及在墾丁國家公園內復育地點之勘選			台灣梅花鹿對社頂地區植群影響效應之研究	台灣梅花鹿對社頂地區植群影響效應之探討(Ⅱ)
生理	台灣梅花鹿對常用粗料之消化率測試 台灣梅花鹿之血液學研究	台灣梅花鹿對墾丁國家公園內主要食物之嗜食狀況及消化率之研究		墾丁國家公園內台灣梅花鹿復育鹿群生理性狀之調查	
疾病及保健		台灣梅花鹿寄生蟲調查及疾病病因之研究		台灣梅花鹿復育地內主要寄生性生物及螺類之生態研究 台灣梅花鹿臨床病理學檢查及疾病控制之研究	台灣梅花鹿復育地區寄生性生物之保蟲宿主之生態研究 墾丁國家公園台灣梅花鹿保健診療計劃
馴育				台灣梅花鹿之馴育計劃	
養殖現況	台灣梅花鹿養殖現況之調查				
歷史	台灣早期歷史與梅花鹿關係之研究	台灣早期歷史與梅花鹿關係之研究(續)			
復育區規劃建設	台灣梅花鹿復育研究及繁殖中心規劃建築	台灣梅花鹿復育研究區設施配置原則及管理構想	復育區研究站之建設植栽及圍籬等	完成復育區之各項主要硬體建設	梅花鹿復育研討會
學術技術提供	國外顧問專家邀請研究 梅花鹿復育研討會	台灣梅花鹿復育研究計劃協調及審議	台灣梅花鹿復育諮詢委員會		
其他					

續表 1．台灣梅花鹿各年度之復育研究計劃

研究工作範圍	第六年 1989-1990	第七年 1990-1991	第八年 1991-1992	第九年 1992-1993
行為生態	復育鹿群概況及其棲地利用之特性	台灣梅花鹿行為及棲地利用之研究		
年齡鑑定				
遺傳學		台灣梅花鹿品系之分析		
植群				
生理				
疾病及保健	台灣梅花鹿保健診療計劃	台灣梅花鹿保健診療計劃	台灣梅花鹿保健診療計劃	
馴育 養殖現況				
歷史				
復育區規劃建設				
學術技術提供				
其他			台灣梅花鹿拍攝計劃	梅花鹿野放可行性之評估

表 2 . 社頂梅花鹿復育鹿群年齡與形態測量值

性別	年齡	數量	體重(kg)±SD	身長(cm)±SD	肩高(cm)±SD
雄	1	8	16.4±3.7	111.6± 9.9	64.8±4.9
雄	2	4	37.4±3.1	143.9± 7.9	83.5±2.3
雄	3	3	53.8±4.2	145.0± 5.0	90.2±5.1
雄	4	3	67.5±2.2	154.7± 3.1	97.2±0.3
雄	8	3	68.3±6.4	162.3± 7.6	95.0±1.7
雌	1	10	16.0±3.3	108.8±10.5	63.8±8.5
雌	2	5	30.9±2.4	134.2±11.3	76.6±3.1
雌	3	7	39.0±2.2	141.4± 6.4	81.0±3.2
雌	4	5	42.5±3.5	148.5± 5.1	78.9±6.8
雌	8	12	42.3±5.6	147.1± 8.0	80.3±3.2

表 3 . 復育鹿群雌、雄體型各項測量值之相關係數 (r^2)

	雌 (n=39)			雄 (n=21)		
	體重	身長	肩高	體重	身長	肩高
體重	1.0	0.9	0.6	1.0	0.8	0.9
身長	0.9	1.0	0.5	0.8	1.0	0.9
肩高	0.6	0.5	1.0	0.9	0.9	1.0

表 4. 海花鹿野外食物種類

名稱		覓食部位 莖	葉	果	籽	觀察地點 1區	3區	生活型[1] A	B	C	D	E
海金沙科	Schizeaceae											
海金沙	*Lygodium japonicum*	✓	✓			✓	✓			✓		
榆科	Ulmaceae											
山黃麻	*Trema orientalis*		✓			✓		✓				
桑科	Moraceae											
構樹	*Broussonetia papyrifera*		✓			✓		✓				
白榕	*Ficus benjamina*		✓			✓		✓				
海桐科	Pittosporaceae											
臺灣海桐	*Pittosporum pentandrum*		✓			✓		✓				
薔薇科	Rosaceae											
山枇杷	*Eriobotrya deflexa*		✓			✓		✓				
豆科	Leguminosae											
銀合歡	*Leucaena glauca*	✓	✓			✓	✓	✓				
含羞草	*Mimosa pudica*	✓	✓			✓	✓				✓	
濱豇豆	*Vigna marina*	✓	✓			✓				✓		
豇豆屬	*Vigna* spp.	✓	✓				✓			✓		
酢醬草科	Oxalidaceae											
酢醬草	*Oxalis corniculata*	✓	✓				✓				✓	
大戟科	Euphorbiaceae											
紅仔珠	*Breynia officinalis*	✓	✓			✓			✓			
土密樹	*Bridelia tomentosa*	✓	✓			✓		✓				
鐵色	*Drypetes littoralis*		✓			✓		✓				
血桐	*Macaranga tanarius*		✓			✓		✓				
扛香藤	*Mallotus repandus*	✓	✓			✓				✓		
蟲屎	*Melanolepis multiglandulosa*		✓				✓	✓				
芸香科	Rutaceae											
月橘	*Murraya paniculata*		✓			✓	✓	✓				
食茱萸	*Zanthoxylum ailanthoides*	✓	✓			✓		✓				
楝科	Meliaceae											
紅柴	*Aglaia formosana*		✓				✓	✓				
葡萄科	Vitaceae											
三葉崖爬藤	*Tetrastigma formosanum*	✓	✓			✓				✓		
漢氏山葡萄	*Ampelopsis brevipedunculata*	✓	✓			✓				✓		
錦葵科	Malvaceae											
賽葵	*Malvastrum coromandelianum*	✓	✓				✓		✓			
細葉金午時花	*Sida acuta*	✓	✓				✓				✓	
金午時花	*Sida rhombifolia*	✓	✓			✓					✓	
野棉花	*Urena lobata*	✓	✓			✓			✓			

續表：

西番蓮科	Passifloraceae										
三角葉西番蓮	*Passiflora suberosa*	✓	✓		✓	✓			✓		
千屈菜科	Pythraceae										
九芎	*Lagerstroemia subcostata*		✓		✓		✓				
桃金孃科	Myrtaceae										
芭樂	*Psidium guajava*		✓		✓		✓				
山欖科	Sapotaceae										
大葉山欖	*Palaquium formosanum*		✓		✓		✓				
蘿藦科	Asclepiadaceae										
羊角藤	*Gymnema alternifolium*	✓	✓		✓				✓		
茜草科	Rubiaceae										
紅珠藤	*Morinda parvifolia*	✓	✓		✓				✓		
毛玉葉金花	*Mussaenda pubescens*	✓	✓		✓			✓			
旋花科	Convolvulaceae										
野牽牛	*Ipomoea obscura*	✓	✓		✓	✓			✓		
紅花野牽牛	*Ipomoea triloba*	✓	✓		✓	✓			✓		
菜欒藤	*Merremia gemella*	✓	✓	✓	✓	✓			✓		
紫草科	Boraginaceae										
恒春厚殼樹	*Ehretia resinosa*		✓		✓		✓				
馬鞭草科	Verbenaceae										
馬櫻丹	*Lantana camara*		✓		✓	✓				✓	
長穗木	*Stachytarpheta jamaicensis*		✓		✓	✓				✓	
菊科	Compositae										
生毛將軍	*Blumea lacera*	✓	✓			✓				✓	
野茼蒿	*Erigeron sumatrensis*	✓	✓			✓				✓	
金腰箭	*Synedrella nodiflora*	✓	✓		✓					✓	
禾本科	Gramineae										
弓果黍	*Cyrtococcum patens*	✓	✓		✓						✓
龍爪茅	*Dactyloctenium aegyptium*	✓	✓	✓		✓					✓
亨利馬唐	*Digitaria henryi*	✓	✓	✓		✓					✓
小馬唐	*Digitaria radicosa*	✓	✓			✓					✓
竹葉草	*Opilsmenus compositus*	✓	✓		✓						✓
兩耳草	*Paspalum conjugatum*	✓	✓		✓	✓					✓
雀稗屬	*Paspalum* spp.	✓	✓	✓		✓					✓
蘆葦	*Phragmites communis*		✓		✓						✓
天南星科	Araceae										
拎樹藤	*Epipremnum pinnatum*		✓		✓				✓		

註(1)：A-喬木，B-灌木，C-藤本，D-闊葉草，E-禾草。

Oct. 87
23-25
S. Schumm
Fluvial Geomorphol.

89 Sept. 13-24
60
Typhoon 1989
100-150 cm

Population of the Formosan Landlocked Salmon (*Oncorhynchus masou formosanus*) in Chichiawan Stream

Yao-Sung Lin, Eric Hsien-Shao Tsao, Yeong Tyi Day,
Ling-Chuang Jaung, and Kun-Hsiung Chang

Department of Zoology, National Taiwan University
Taipei, Taiwan, 10765, R.O.C.

ABSTRACT

Population dynamics of the Formosan landlocked salmon (*Oncorhynchus masou formosanus*) was estimated by underwater observations in a 4.2 km stretch of the Chichiawan Stream from September 1987 to January 1991. The salmon population is declining due to the deterioration of its natural habitats. Yearly fluctuation in salmon abundance in the young fish was greater than that of the adults. The stream has become wider but shallower, and current velocity become slower during the study. Decrease in water depth is considered as the primary factor that diminish the suitable salmon habitats, especially for the adult fish. Natural disturbances interacting with anthropogenic factors contributed to the spatial as well as temporal variability of salmon habitats, and depressed its population by habitat degradation.

INTRODUCTION

The Formosan landlocked salmon (*Oncorhynchus masou formosanus*) was listed as endangered species in Taiwan. Half a century ago, the salmon was widely distributed in six upper tributaries of the Tachia River (Kano, 1940). Unfortunately, habitat degradation associated with agricultural development, as well as over harvest caused serious declines in the salmon populations. This unique salmon population can only be found in the Chichiawan Stream recently (Lin and Chang 1989). Therefore, protection of the remaining population and its natural habitats is an urgent task for us to save this glacial relict from extinction.

Since 1984, the Council of Agriculture has funded many research projects concerning the endangered salmon population. A diverse of information was also collected to improve our knowledge on this landlocked salmon. In this paper, we present our observations on the abundance of the Formosan landlocked salmon between September 1987 and January 1993 in Chichiawan Stream.

STUDY AREA

Chichiawan Stream, an upper tributary of the Tachia River, is located at east Taichung Hsien in Taiwan. Most of the drainage areas to the west bank of Chichiawan Stream have been converted into orchards or vegetable farms since the 1970's. Fertilizers are used intensively in croplands during the growing season from March to October.

The watershed receives an annual precipitation of 1000 to 1500 mm. In general, the rainy season starts in May and extends through September with fairly predictable typhoon and flood occurred in the summer or fall. These floods combined with mass soil movement typically scoured the channel system and removed riparian vegetation.

From 1973 to 1978, series sediment-retention dams were established along the Chichiawan Stream and its upper tributaries where the Formosan landlocked salmon inhabited. All these dams are over 4 m in height, which thus divide the salmon population into small groups and prevent its upstream migration. Three sediment-retention dams were observed within our study area (Fig. 1). The dam located at the upstream end was denoted as Dam 1 (0 m) and that at the downstream end Dam 3 (4.2 km). Dam 2 is located mid-way at 1.5 km downstream from Dam 1. Mean width and depth of the study section is about 9 m and 50 cm, respectively. The Formosan landlocked salmon *Oncorhynchus masou formosanus* is the dominant fish in the study area, and the kooye minnow (*Varicorhinus barbatulus*) coexists (Lin et. al. 1990; Wang 1989).

FIELD SURVEY METHOD

Two total demographic counts by underwater observation were made between Dam 1 and Dam 3 each year. The study stretch of the Chichiawan Stream was equally divided into 14 contiguous sections. A team of two divers entered the stream from the downstream boundary and move slowly upstream in case not to interrupt the fish. The number of fish in each section was recorded as adult fish (longer than 20 cm) and young fish (5-20 cm), separately. Fry which is usually less than 5-cm-long and difficult to be spot is ignored in these counts. It took about 20 working hours to complete the whole 4.2 km census sections. Counts of two trained divers agreed quite well. A total of 12 such censuses were made during the period September 1987 till January 1993. Data from all seven years were combined to present the dynamics for the salmon population. According to the climates in Taiwan, every year is divided into four seasons. For example, March to May have been considered as the first season, the spring , for each year, followed by the summer (June to August), the fall (September to November), and the winter (December this year to February next year). So, March to May 1987 would be denominated as the spring 1987, but January and February 1987 would be still the winter 1986.

RESULTS

Estimated abundance of the Formosan landlocked salmon in the 4.2 km stream stretch of the Chichiwan Stream has been declining during the last seven years. The number of fish was around 646 in the summer of 1986, reached a highest of 1798 in the summer of 1987, since then a trend of decrease in fish population was observed through the winter 1992 (Fig. 2).

Yearly fluctuation in abundance of the young salmon was greater than that of the adult fish. Change in population of the adults was relatively slight from the summer 1987 to the summer 1992. The number of adults fluctuated between 498 and 295 during this period of time, with a variation of less than 109 fish between two consecutive seasons. However, the adult population dropped dramatically from 331 in the summer 1992 to a low of 116 in the winter 1992. It is evident that natural impacts such as frequent floods and landslides combining with tremendous sediment transportation downstream during the typhoon seasons will cause this disaster. Two huge floods occurred during the typhoon Paoly and Ted are responsible for the decline of the fish population. Without hiding place, fish were washed downstream and would never come back to their natural habitats due to the barriers of sediment-retention dams. Similar damage was recorded on the young population which dropped from 435 to 135 (69%), either.

Annual fluctuations on salmon young were quite different from the adults. A maximum of 1370 in the summer 1987 and a minimum of 198 in the winter 1988, with a larger variation in two consecutive seasons were measured from the summer 1987 to the summer 1992. Every summer, a significant recruitment of salmon young can be observed, except the summer 1992. Floods during the 1991 associated with the construction of a sediment-retention dam during the salmon spawning season all contributed to the loss of surplus young in the coming year. Total number of salmon population again, showed how Typhoon Ted impact this endangered fish and how serious it is going to be extinct without more attention from us.

DISCUSSION

About half a century ago, the Formosan landlocked salmon was distributed in at least six headwater streams of the upper Tachia River System, including Chichiawan, Hsuehshan, Yousheng, Nanhu, Hohuan and Sukairan Streams (Kano, 1940). Today its distribution is probably limited to a 7-km reach of the Chichiawan Stream.

Between 1950 and 1980, considerable modification and destruction of natural environments occurred due to rapid development in Taiwan. Habitat degradation associated with agricultural development caused serious declines in the salmon populations. Frequent floods, combined with man-made hydrological changes, resulted in downstream transport of fish away from their original habitats. Sediment retention dams built along headwater streams, divide the dwindling salmon population into smaller groups and prevent recolonization of upstream habitats.

Typhoon intrude Taiwan frequently. During the last seven year of our study, there were three destructive typhoons, Typhoon Lynn , Sarah, and Ted in 1987, 1989 and 1992, respectively, strike the Chichiwan Stream. All three typhoons caused direct mortality and downstream transport of the salmon. In addition, the subsequently serious floods always caused landslides and habitat degradation in the streams. The degradation of habitat was very obvious from the comparisons of the number of pool, sedimentation and water depth. In general, the decrease of channel depth for the last seven years was the major factor affecting the old salmon in term of its habitat quantity. Sedimentation, in the other hands, has greatly diminished the available spawning habitats.

Typhoon Lynn struck the upper Tachia River drainage areas in October 23-25, 1987 which was in the middle of the early October till late November spawning season of the Formosan landlocked salmon. Flood destroyed the spawning ground and the eggs already embedded under the stream bottom. It almost eliminated the 1987 year class. Adult salmon were less severely affected by floods than younger ones. Elwood and Waters (1969) observed that flooding seemed to have relatively little effect on native brook trout of one year old or older. However, they found that flood nearly eliminated two year classes of trout by destroying eggs and/or fry. Allen (1949) estimated that 80-90% of the ova produced by brown trout were destroyed by a serious of floods that destroyed redds.

Serious floods in non-spawing season also have great effect on the fish populations. In September 13-14, 1989 the upper Tachia watershed received a further precipitation of more than 1500 mm during the strike of Typhoon Sarah. The water level was elevated for more than 3 m in certain sections of the Chichiawan Stream. In 1992, the Typhoon Ted brought the serious flood which was the largest flood in the last fifty years. Physically, the effects of this typhoon and flood were severe in the extreme: large trees were uprooted, a small dam was destroyed, bottom materials were scoured and disturbed, many aquatic invertebrates were eliminated, and large deposit of sands and gravels were left above the dams. Pool areas were also filled with sand that decreased available space for the fish. Therefore, the degradation of suitable habitats for both young and adult caused the declines of the salmon population.

To reduce sedimentation in downstream Techi Reservoir, many sediment-rentention dams 4-10 m in height were built in the 1970's. Three dams in our study section of the Chichiawan Stream were built in 1973. Prior to the construction of these dams, environmental conditions of the stream downstream and upstream of these dams were similar, if not identical. The presence of sediment-rentention dams impacted natural hydraulic processes. It hastened transport of sediment downstream above the dam. Thus the upper reaches of the dams previously suitable for the salmon gradually became a monotonous, slate- and sandstone-bottomed shallow run devoid of fish life. That may be the reason why more fish were observed in the reaches below the dams than above them. Lack of adequate spawning and rearing grounds in reaches both above and below the dams has contributed to the decline of the Formosan landlocked salmon in the past. This situation became even worse when floods occurred.

CONSERVATION STRATEGIES

Due to unpredictable weather events in concert with heavy human activity in its range, this unique salmon population is at high risk of extinction. Any long-term recovery plan for the Formosan landlocked salmon become impractical either. More pressing to their survival is the need to identify the limiting factors, enhancing salmon reproduction in the wild, and establish salmon refuge.

Several research has been sponsored by the Council of Agriculture since 1985, but most work was conducted in parts of the Chichiawan, Hsueshan, and Yousheng streams. Before 1991, no work was done on the other three Tachia River tributaries. These tributaries were also in the original range of the Formosan landlocked salmon. Research effort should focus on all of the original habitats as well as streams outside this range in order to extend necessary protection and restore salmon in suitable habitat. This situation is especially true when habitat improvement project was reported as difficult according to the frequent summer floods. In the near future, artificial propagation program will remain a top priority because our studies showed a shortage of spawning ground for masu salmon. It could be the reason why there is no satisfactory number of surplus young to replenish the salmon population.

How to protect the riparian areas along salmon's historical range from further agricultural development is another challenge. Fortunately, part of the riparian areas is now under the protection of National Park Department. Protection of high-quality habitat is essential for the continued existence of the Formosan landlocked salmon population in the upper Tachia River. In order to maintain and enhance wild landlocked salmon populations, management strategies have been focused on protection of the existing habitat and expansion of their living habitat. In the future, restoration of degraded habitat should be emphasized. With the care and effort from all of us, a self-sustaining Formonsan landlocked salmon population is highly anticipated.

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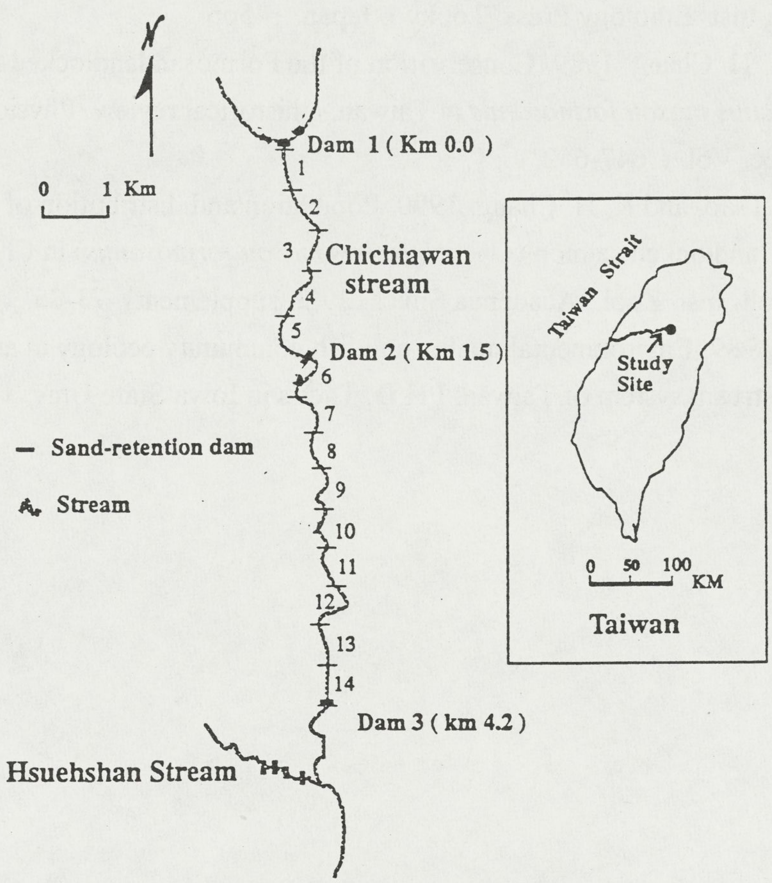

Fig.1. Locations of the dams and sampling sections(1-14) in Chichiawan Stream.

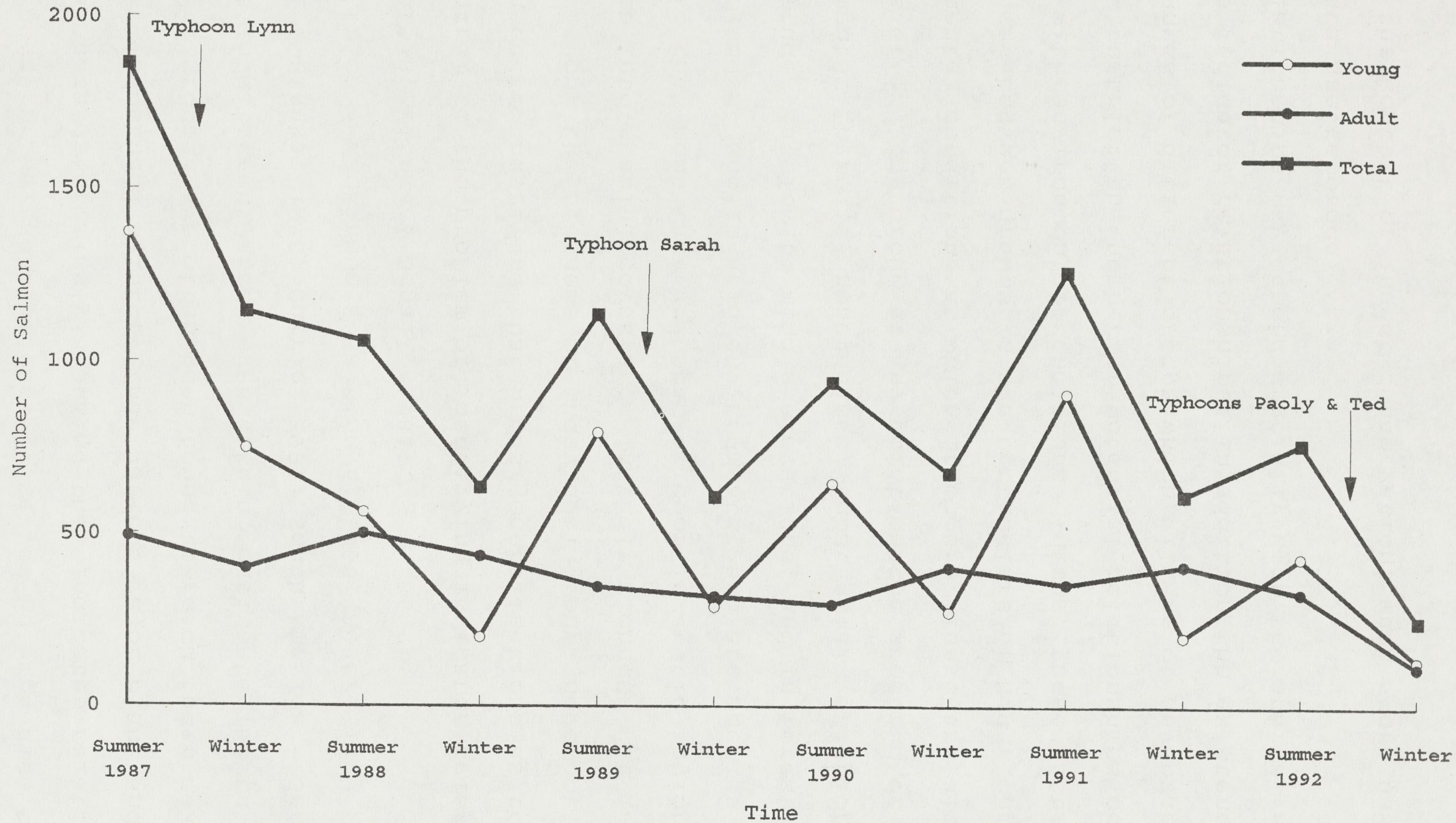

Fig. 2 Population dynamics of the Formosan landlocked salmon.

Current Researches on the Conservation of Rare and Endangered Insects of Taiwan

Ping-Shih Yang

Professor and Head of Department of Plant Pathology
and Entomology, National Taiwan University

Insects play a crucial role in the ecosystem. They are closely interrelated to other fauna and flora in the food chain. The survival of insects is now seriously endangered because of inappropriate land development, massive use of pesticides, lost of forests, water pollution, overcollecting and inapt introductions of foreign species. As a result, some insect populations have significantly declined and some are even endangered.

Researches on Taiwanese insects can be traced back to 150 years ago. This article reviews previous researches on insect resources and elaborates on the development of insect conservation during the past decade. Furthermore, this article presents the biology of the 18 threatened species and explores the future development of insect conservation in Taiwan.

台灣珍稀及瀕臨絶種昆蟲之保育及研究趨勢

國立台灣大學植物病蟲害學系

楊　平　世

中　文　摘　要

昆蟲乃生態系中之重要成員，在食物網中，昆蟲和其他動、植物關係均相當密切。然而，長期以來，由於土地不當利用、農藥大量使用、林相變更、水污染、過度採集及不當引入外來種動物，已對某些昆蟲族群造成不利影響，甚致引起某些種類族群式微或瀕臨絶種。

台灣產昆蟲之科學性研究已有150 餘年歷史，本文就日人據台前、後及台灣光復以迄今天之昆蟲資源研究作一綜述，同時詳述近十年來昆蟲保育研究之發展過程。另外，本文並介紹１８種台灣保育類昆蟲之習性、特徵、分佈及研究現況，同時探討未來台灣昆蟲保育研究之趨勢。

一、緒言：

在生態系中，昆蟲爲食物網中之重要成員，其不但是食蟲性動物之食物，有些昆蟲亦爲顯花植物不可或缺之授粉媒介。另外，腐食性昆蟲乃自然界中之分解者，能分解動物糞便、屍體或枯枝敗葉，使營養能在生態系中繼續循環。然而由於昆蟲種類多、數量大，因此在維持整個生態平衡上，的確扮演舉足輕重之角色。

據Wilson(1970)、Beer(1971)、Brown(1973)、Covell(1977)、Opler及Williams(1978)、Pyle等(1981)、Nilsson(1983)、New(1984)、Feltwell(1986)、浜等(1989) 、今泉(1992)及楊(1989,1991) 之報告，許多人類活動，包括不當的土地開發利用、農藥大量使用、林相變更、河流污染、過度採集及不當引入外來動物，均會對某些昆蟲族群造成不良影響，甚至導致族群式微或瀕臨絶種。Strong(1978)之報告指出，在歐洲人侵入美洲之後，由於土地不當之開發利用，至少已造成33種昆蟲絶種。台灣爲一海島，面臨此類衝擊更大，尤其近三十年來之土地過度開發利用，林相變更、森林砍伐及觀賞性昆蟲大量利用，亦已使珠光鳳蝶(*Troides magellanus* C.& R. Felder)等昆蟲瀕臨絶種；有關此類人爲不利因子對台灣產昆蟲所造成之衝擊，可參閱楊(1989,1991a)之報告。

另一方面，在1945年－1960年代期間，台灣曾因過度利用觀賞性昆蟲而引起國際野生動物保育界人士之詬病(Marshall,1982; Morton and Collins,1984; 楊,1989,1990,1991a)；因此在1985年時，關懷台灣野生動物保育之專家、學者乃建議政府將4種蝶類及39種其他珍稀動物列爲台灣亟待保護之野生動物(未具名,1985)；1989年8月4 日行政院農業委員會及文化建設委員會則將3種蝴蝶公告爲瀕臨

絕種動物，15種其他昆蟲則列爲珍稀動物名錄中(行政院農委會,1989)，並依「野生動物保育法」及「文化資產保存法」保護。本文將就台灣昆蟲保育研究發展過程，保育類昆蟲及其研究現況和未來台灣昆蟲保育研究之趨勢進行討論。

二、台灣昆蟲保育研究之發展

台灣產昆蟲之文獻記載始自西元1684年金鋐之「福建通志」，但科學性之描述則自1837年有關象鼻蟲之研究(Roelofs,1837)，是故有關昆蟲學之研究在台灣至少已有150餘年之歷史。

在1840年代至1894年間，台灣昆蟲資源之研究以歐、美人士爲主，其中較著名者例如英人R.Swinhoe, H.E.Hobson及加拿大籍醫生兼傳教士G.L.Mackay；研究係以昆蟲分佈調查及分類學爲主。而在1895年日人據台，至1945年台灣光復期間，除了少數西方昆蟲學家仍繼續在台灣各地採集、調查昆蟲外，從事昆蟲研究之日籍研究之學者更多，其中對台灣昆蟲資源研究有具體貢獻者，例如三宅恆方、松村松年、三輪勇士郎、佐佐木忠次郎、新渡戶稻雄、素木得一、江崎悌三、加藤正世及鹿野忠雄等。有關此時期之昆蟲學研究，可參閱江崎(1935a,1935b)、高橋(1934)及朱(1973,1974)之報告。儘管此時期之研究仍以分類學及昆蟲調查爲主，但這些學者之研究成果已爲台灣基礎昆蟲學奠定良好之基石。在此期間，和昆蟲保育有關者乃1935年日人將寬尾鳳蝶 (Agehana maraho Shiraki and Sonan) 列爲天然紀念物(朱,1973) 。

西元1945年台灣光復至1970年間，政府爲解決所面臨之農林作物病蟲害及公共衛生害蟲問題，台灣之昆蟲研究一直偏向應用昆蟲學方面發展；有關此方面之研究報告甚多，可參閱邱(1958,1965)及台灣

農業文獻索引(1956,1966,1974,1983,1987)。在此時期，尤其是1960-1970年期間，台灣昆蟲之商業性利用甚爲鼎盛，以1960年代爲例，蝶類之外銷總值每年約在3000萬美元左右(New,1984)，故蝶類之過度利用現象，亦迭遭致國內、外保育界人士之責難；有關此期間昆蟲之商業性利用概況，可參閱楊(1989,1990,1991a,1991b)之報告。至於此時期，則鮮有昆蟲保育研究報告；至於和昆蟲保育有間接相關之昆蟲分類及分佈調查，據周(1991)之報告，在1945－1990年間共有300篇，計發表1185種新種。

1970年代末期，台灣經濟發展十分蓬勃，此時儘管蝶類加工業在東南亞及中南美洲昆蟲加工業者之競爭下，已漸走下坡，惟此時期森林砍伐，栽種單一林木及山坡地大肆開發，已使某些昆蟲族群逐漸式微，；因此，有識之士有感於台灣土地過度開發利用，乃有設置自然保留區(Nature Reserve)及成立國家公園(National Park)之芻議。故1977年時，行政院首有成立國家公園之共識，但一直到1984年才成立我國首座國家公園－墾丁國家公園，自此開始野生動植物之保育才漸受重視，而有關台灣野生動植物－包括昆蟲之保育研究，也因而逐漸發展。如今，在台灣已陸續成立墾丁、陽明山、玉山、太魯閣及雪霸國家公園，現尚有蘭嶼及金門兩處國家公園正規劃籌設中。至於行政院農業委員會所公告的自然保留區，已有15個；而國有林自然保護區則共有20個(湯等,1989;呂等,1992)。因此這十年來在內政部營建署各國家公園管理處及行政院農委之支持下，許多野生動物保育研究－包括昆蟲保育研究，亦皆已積極進行；而有關昆蟲保育研究在近十年中之發展，亦可參閱楊(1991a,1991b)之報告。

值得一提者乃1989年6月23日「野生動物保法」在立法院三讀通過，由總統明令公佈後，同年8月4日行政院農委會依法公告，並同時公告23種台灣瀕臨動物及各類稀有動物名錄（行政院農委會，1989)

；其中有３種蝴蝶被列爲瀕臨絕種動物，15種其他昆蟲被列爲珍貴稀有動物；此法不但把昆蟲視爲野生動物，並有具體之法令保護所列名之保育類昆蟲。

其實，在此法未公佈之前，國內關心野生動物保育之學者、專家在1985年即已草擬43種台灣亟待保護之動物，其中即包括４種珍稀的蝶類(未具名，1985)。近十年來有關昆蟲資源及保育之研究，包括報告和專書已有40餘篇，其中以國家公園及自然保留區之昆蟲相調查爲多，此例如朱等(1986,1987)、楊等(1986a, 1986b, 1987a, 1987b, 1988a,1988b,1988c,,1989a,1989b,1990,1991a,1991b,1992a,1992b ,1992c,1992d)、趙(1989,1990)、陳(1985,1987,1988)及張(1989)等人之報告；其中楊之報告並對各國家公園及自然保留區昆蟲之特色提出討論，同時建議保育類昆蟲名錄。然而，對於已列名保育類昆蟲之研究，除早期之分佈記錄外，僅陳(1987,1988)、楊及曾(1992)之報告；其實，除瀕危種及珍稀種之保育研究猶待積極進行之外，特殊昆蟲棲地之研究亦頗重要。以日本爲例，除立法保護33種昆蟲「天然紀念物」外，該國現有10處螢火蟲、４處蟬類棲地亦以立法保護(加藤及沼田,1984;浜等,1989),而在台灣據陳(1981)、Ishii and Matsuka (1990)及 Wang & Emmel(1990)及楊(未發表)之調查，亦有多處蝶類特殊棲地亟待保護，但相關之生態研究在未來則亟待展開。

三、台灣保育類昆蟲之及其研究概況

現階段台灣保育類昆蟲共有18種(如表一)，其中３種爲瀕臨絕種種類，另外15種爲珍貴稀有種類；前３種均屬於鱗翅目蝶類，後15種中有２種爲蝶類、２種同翅目昆蟲、１種蜻蛉目昆蟲、８種鞘翅目昆蟲、１種直翅目昆蟲及１種竹節蟲目昆蟲。所謂瀕臨絕種之種類乃「

The National Zoo also houses a number of other threatened species with varying degrees of breeding success, among others the crowned lemur (Lemur coronatus) - endangered; the mongoose lemur (Lemur mongoz) - endangered; the golden lion tamarin (Leontopithecus rosalia) - endangered; the orang-utan (Pongo pygmaeu) - endangered; the gorilla (Gorilla gorilla) - vulnerable; the chimpanzee (Pan troglodytes) - vulnerable; the giant anteater (Myrmecophaga tridactyla) - vulnerable; the bush dog (Speothos venaticus) - rare; the red panda (Ailurus fulgens) - "K"; the brown hyaena (Hyaena brunnea) - vulnerable; the black rhino (Diceros bicornis) - endangered; the banteng (Bos javanicus) - vulnerable; and the lechwe (Kobus leche) - vulnerable.

The National Zoo also has a large number of threatened bird, reptile, fish and amphibian species and good breeding results have been achieved with many of these, among others the northern bald ibis (Geronticus eremita); the ocellated turkey (Agriocharis ocellata); the salmon-crested cockatoo (Cacatua moluccensis); the Nile crocodile (Crocodylus niloticus); the dwarf crocodile

(Osteolaemus tetraspis); the otjikoto tilapia (Tilapia guinasana); the lowveld largemouth (Serranochromis meridianus); and the axolotl (Ambystoma mexicanum).

In Situ involvement

The National Zoological Gardens also contributes to the in situ conservation programme for various vulture species, including the Cape vulture (Gyps coprotheres), which is listed as rare by the IUCN.

Cape vultures were originally dependent for food on the herds of animals that ranged through the country. In time these herds were replaced by open range domestic stock, which were an acceptable substitute for the vultures. The domestic cattle population, however, was virtually wiped out by the rinderpest epizootic in 1896.

Subsequent changes and improvements in farming practices have reduced the number of cattle and also sheep carcasses to be found in the veld and thus also the food supply of the Cape vulture.

With fewer and fewer carnivorous mammals such as lions, leopards, jackals and hyaenas on domestic farmland, Cape vultures have little or no access to the bone fragments which had been discarded by carnivores and scavengers. These bone fragments are essential for the nestlings.

A lack of bone fragments or insufficient calcium in the diet causes osteodystrophy. Osteodystrophy leaves the nestlings incapable of successful flight and they die.

In an attempt to supplemtn their food the National Zoological Gardens operates two so-called vulture restaurants. At these restaurants carcasses are provided for consumption by the vultures, together with supply of bones suitably broken to provide calcium for nestlings. The restaurants attract up to 100 free-flying vultures on a daily basis.

Future programmes

A consignment of very interesting species will soon be arriving at the National Zoo, among them six gaurs (Bos gaurus) and babirusa (Babyrousa babyrussa), both listed as vulnerable by the IUCN.

However, the most exiting project is certainly the possibility of an ex situ and in situ breeding programme for the giant sable antelope (Hippotragus niger variani) from Angola. The status and survival of the giant sable are in the balance and this is aggravated by the ongoing political unrest and conflict in this war-torn country.

Conflicting reports on their status range between 12 animals and a few hundred. The CBSG, in collaboration with the Pan African Association (PAAZAB), had planned to conduct a PHVA in Luanda in October 1992. Unfortunately, this never materialized because of the extremely dangerous situation in this country's capital. A South African company has now offered to sponsor the entire project and high-level discussions are underway with a view to removing at least some of the animals to the National Zoological Gardens.

CONCLUSION

Geographically speaking, South Africa is very isolated from the mainstream of zoological collections. This problem is exacerbated by ever-increasing air transport costs.

More often than not, the cost of importation far outweighs the value of the animal, which naturally results in many transactions being cancelled. This continuously affects the introduction of new genetic material and can result in a high in-breeding co-efficient.

Since the majority of zoos in South Africa are privately owned, they tend to specialise in specific kinds of exhibits such as bird parks, aquariums or reptile collections. Only a few zoos maintain representative collections.

Each one of these institutions has its own saturation point and even collectively they are not really in a poistion to successfully maintain viable gene pools.

The National Zoological Gardens with its two game breeding centres covering an area of some 7 000 hectares addresses this problem very successfully. Thousands of animals roam these areas in wild and semi-wild conditions and constitute invaluable gene pools for captive breeding.

The successful implementation of any breeding programme depends on national and international co-operation. The African Preservation Programme (APP), which functions under the auspices of PAAZAB, aims to co-ordinate breeding programmes throughout the continent. Species co-ordinators have been appointed, and numerous endangered vertebrate species have already been identified for the APP programme.

The National Zoo is a member of ISIS and acts as convenor of the annual animal inventory for PAAZAB.

As far as international co-operation is concerned, the National Zoo and three other zoological institutions are members of the IUDZG. We maintain cordial working relations with every country in the world, and the signing of the sister agreement with the Taipei Zoo earlier this year was a highlight in our dealings with international zoological organisations.

It is my firm belief that the zoological institutions in South Africa will go from strength to strength and will continue to make an invaluable contribution to the conservation of the world's endangered species. Thank you.

CONTRIBUTORS:

* Hoedspruit Cheetah Project - Lente Roode.
* National Zoological Gardens of South Africa
  Willie Labuschagne, Dr Ferdi Schoeman and Mike Penrith.
* Transvaal Snake Park - Rod Patterson.
* Tygerberg Zoological Preservation Trust and Endangered
  Wildlife Breeding Centre - John Spence.
* Umgeni River Bird Park - Dr Alan Abrey.
* World of Birds - Walter Mangold.

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中国産サケ科魚類の地理的分布について

李　思　忠*1（佐藤一彦訳）*

“鮭”（gui）は中国の古書では後漢の王充（27～107年）の著わした“論衡”の‘鮭肝死人’[3]にみられるが，この鮭は河豚（フグ）のことである．杜亜泉等が“動物学大字典”(1923) で Salmonidae を鮭科と称し始めた．サケ科魚類の主要な特徴は，主上顎骨・歯骨・鋤骨・口蓋骨・舌に歯を有すること，鰭に棘条および棘がないこと，2個の背鰭があり後方のは脂鰭であること，腹鰭は軟条7以上で腹位にあり，基底に突起があること，頭部を除き体は円鱗におおわれること，側線を有すること，鰓膜は分離し峡部に連結していないこと，鰓条骨数は7～20で中烏喙骨と補助顎骨を有すること，顱頂骨は額骨と上後頭骨の間（例，*Coregonus*属）または両側（例，*Oncorhynchus* 属）にあり，膜性楔耳骨と上前鰓蓋骨は存在する種としない種があること，幽門垂数が11～210で，鰾に食道に通ずる管があることである．

* Li Sizhong: Discussion on the geographical distribution of the Salmonid Fishes in China

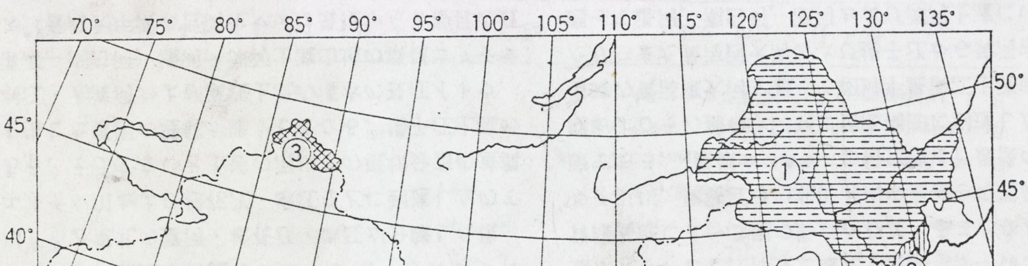


図1．中国産サケ科魚類分布図　　1．黒龍江水系，2．豆満江・綏芬河水系，3．エルチシ川水系，4．鴨緑江水系，5．渭河源流（黄河水系），6．灤河上流・潮白河上流，7．渾河水系，8．揚子江上流，9．秦嶺南麓漢江上流（揚子江水系），10．大甲渓，11．西蔵（ガンジス川水系）

種は遡河産卵習性をもつ河口性回遊魚で２種は１度も降海しない陸封型である．北に種類が多いのは，河口から近いこと，東北アジア沿岸の寒流による影響が大きいことによるのである．次にエルチシ川水系には，北欧のドビナ川からアナジル川までの北極海・ベーリング海北部の流入河川に広く分布する *Stenodus leucichthys nelma* が生息する.[4][5][6] 鴨緑江には３種が分布する.[11] 他の各区にはそれぞれ１種が分布する.[6][7][11]

３．分布図からサケ科魚類は強い冷水性をもつことがわかる．サケ科魚類は北半球の寒帯や温帯北部に広範に分布しているが，Coregoninae でそれが著しい．暖温帯に分布する少数の属・種はすべて標高のある山中に局限されている．これは山間部では気温および水温が比較的低いためである．

４．サケ科魚類はユーラシア大陸寒帯に起源し，第四紀の氷河期に南進し中国に至った.[2][5][6] であるから中国に分布する種は氷河期の残存魚類である.[6] またサケ科魚類は新疆のエルチシ川・ウルングル川[5][6] と東北の遼河・松花江・嫩江が分離した後，エルチシ川および松花江・嫩江などに到達したのである．そうでないと上述の河川での現状分布の差異を生じた原因の理解が難かしくなる.[6] 揚子江上流の岷江・大渡河および漢江上流の湑水の長江イトウ，渭河，潮白河，灤河・渾河上流山地の秦嶺コクチマス,*2 台湾大甲渓の台湾ヤマメは最後から２番目の最寒の氷河期（蘆山氷河期）あるいは最後の大理氷河期に日本海をへて黄海・東シナ海南部に到達した．その後，気候の温暖化により多くは北へ後退または死滅したが，少数は現在の山間部に逃れ残存し，数個の離島状分布区を形成したのである．また，回遊性のサクラマス〔*Oncorhynchus masou masou*〕と陸封型のサクラマス〔*O. masou masous*〕は現在も朝鮮半島東側の水系,[12] 豆満江[8] などに生息するが，これら地域では今も沿岸寒流が強いためである．一方，台湾の周囲は北太平洋暖流にかこまれているため，台湾ヤマメは大甲渓に閉じ込められ陸封型の一亜種となったのである.[6] また豆満江の陸封型サクラマスの体型は小さく，生殖期に雄の性腺が成熟するにすぎず，雌の卵巣はやっとII期段階に達するだけであるが，原因は不明である．

５．渭河・潮白河・灤河・渾河および朝鮮半島の漢江等の上流域の秦嶺コクチマスは幽門垂数(51～75)，

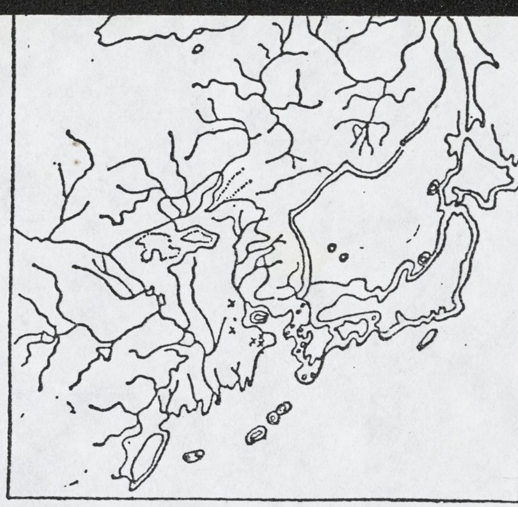


図２．黄海と東シナ海の更新世末期海退時の水系概念図．リンドバーク（1955）による．西村（1967）より引用．著者やや改変．

第１鰓の鰓耙数（18～23）が少ないこと，体部の斑点が大きいこと，体長が短かく成熟年が早いこと，背鰭基底に４～５個の黒点が存在することなど，エルチシ川，黒龍江等の北部河川の亜種との差異が明瞭である．〔秦嶺コクチマスの祖先種は〕最後の氷河期およびその前の氷河期に黄海南部に到達したのち，当時の黄海東大河を通って朝鮮半島漢江上流部にいたり，また黄海西大河および揚子江から黄河古道を遡って渭河，潮白河，灤河および渾河上流にいたったのであろう．当時，渤海はすでに沈降し低地となっていたが，未だ海とはなっていなかったと考えられる．更新世末と完新世初期の氷河期の後，渤海海峡（廟島列島一帯）を通って黄海から海水が渤海に入ったものと思われる.[9] 元来，遼河，渾河などは合流したのち遼河古道の下流を通り西南に流れ灤河，潮白河などと合し，渤海湾南部から泰山西側の東平湖，独山湖一帯へ至り黄河に合流し，南へ流れ,[10] 黄海西大河を通り海へ注いでいた(図２)．であるから，現在これら地域の秦嶺コクチマスは相似しているのである．

６．科学者の中には自然界で新種が形成されるのは遅々としたものであり，最後の氷河期から今迄のわずか２万年の間には新亜種は形成できるが，新種は形成できないというものがいる.[13] もしこの見解が正しいならば，長江イトウ *Hucho bleekeri*，高麗イトウ *H. ishikawai* はアムールイトウ *H. taimen*

種名 ＼ 分布水系	龍江水系	芬河・豆満江	ルチシ川水系	緑江中上流	河上流山麓	白河・濼河上流	河上流	川・青海揚子江上流	嶺南麓漢江上流	湾大甲渓上流	ベット亜東ガンジス川水系
Coregonus ussuriensis Berg	＋										
C. chadary Dybowski	＋										
Stenodus leucichthys nelma Pallas			＋								
Thymallus arcticus arcticus Pallas			＋								
T. a. grubei Dybowski	＋	＋		＋							
Salmo trutla fario Linnaeus 〔ブラウントラウト〕											⊕
Hucho taimen Pallas 〔アムールイトウ〕	＋	＋	＋								
H. ishikawai ※Kimura 〔高麗イトウ〕 ※訳者注：正しくはMori				＋							
H. bleekeri Kimura 〔長江イトウ〕								＋	＋		
**Salvelinus leucomaenis* Pallas 〔イワナ〕	＋	＋									
**S. malma malma* Walbaum 〔オショロコマ〕	ⓐ	＋									
S. malma Walbaum （陸封型）		(＋)									
**Oncorhynchus gorbuscha* Walbaum 〔カラフトマス〕	＋	＋									
**O. keta* Walbaum 〔サケ〕	＋	＋									
**O. masou masou* Brevoort 〔サクラマス〕	ⓐ	＋									
O. masou masous Brevoort （陸封型）〔ヤマメ〕		(＋)									
O. m. formosanus Jordan et Oshima 〔台湾ヤマメ〕										＋	
Brachymystax lenok lenok Pallas 〔コクチマス〕	＋	＋	＋	＋							
B. l. tsinlingensis Li 〔秦嶺コクチマス〕					＋	＋	＋		⊕		
合計 17種・亜種	2ⓐ,8＋	8＋	4＋	3＋	1＋	1＋	1＋	1＋	1＋,1⊕	1＋	1⊕

＋…分布，⊕…人為的移殖，ⓐ…下流河口に分布(下流混同江有分布)，＊…遡河産卵のため河口に回遊するもの．なお現在分類学者の多くは同一環境では亜種は形成されないと考えている．それによると，*Salvelinus malma curilus* Pallasと*Oncorhynchus masou ishikawai* Jordan et McGregor は亜種ではなく種内の陸封型変異である．

化石はヨーロッパで発見された中新世のものが最初である(Berg, 1940)．元来は北半球の冷水域に生息する淡水性あるいは遡河性回遊魚類であるが，すでに数十年前に南半球に移殖されている．現生するのは３亜科９属の約68種である．漁業上，非常に重要な経済的意義をもっている（Nelson, 1976)．中国では王以康教授（1958）が13の種及び亜種がいると以前総括したが，手元の資料によれば，現在８属14種または17の種・亜種が知られている．次にサケ科魚類を地理的分布に重点をおき簡単に分析し，後で詳述してみたい．

中国産サケ科魚類の現状分布の分析

1．表１から中国のサケ科魚類には11の分布区がある(図１)．各区に分布する属，種および亜種数は分布表の通りである．現在までの調査結果によると，チベット南部亜東地区のブラウントラウトは１世紀前イギリスからインドのガンジス川水系に移殖された後，亜東地区にひろがったものである.(6)秦嶺山脈南麓の太白河および湑水（漢江水系）の〔秦嶺コクチマス〕の分布は周至県石珍子鎮の住民宋某が1940年頃，黒河（秦嶺山脈北麓・渭河水系）から南麓に移殖したものである.(4)(6)であるから自然分布は全部で10区である．

2．分布表をみると北部に自然分布の属・種が多い

疼惜新手足
THEY ARE MY BROTHERS

國際瀕臨絶種動物保育研討會

INTERNATIONAL SYMPOSIUM
ON THE CONSERVATION
OF ENDANGERED ANIMALS

1993年4月19日・20日

台北國際會議中心

大會手冊

目次 國際瀕臨絕種動物保育研討會

International Symposium on the Conservation of Endangered Animals

序言1

近二十年來，台灣之生態環境由於都市化、土地過度開發及產業持續發展，導致許多野生動物的棲地因而受到破壞；如今共有23種野生動物已被列為瀕臨絕種動物。

同樣的，在世界上許多地區，野生動物亦由於棲地破壞、過度獵捕，正面臨浩劫的命運！是故，野生動物保育現在已成為世界各國共同關心的問題。而以經濟成就傲視全球的台灣，身為「地球村」的一份子，又豈可自外於世界性的潮流！尤其是最近國際野生動物保育團體曾就我國對於犀牛角的利用問題提出嚴苛批評之際，如何讓世人瞭解我國政府及民間團體多年來在挽救野生動物所做的努力，亦為舉辦此次研討會目的之一。在這一次「國際瀕臨絕種動物保育研討會」中，本會除邀請國內專家學者提出研究心得之外，也同時邀請英國、美國、南非及日本等國際上知名野生動物保育專家提出各類瀕臨絕種動物之保育研究心得。冀盼此次國際性野生動物保育研討會能喚起國人更重視野生動物所面臨之困境，並提昇國人保育知識，也希望藉此能加強國際間野生動物保育研究之交流和合作，同時也向國內外關心野生動物保育人士宣告我國民間團體在這方面之努力和堅持。

這一次「國際瀕臨絕種動物保育研討會」原已邀請中國大陸專家、學者十餘人參加，可惜由於多種因素之影響，大陸專家、學者未能如期組團前來，但仍盼望今後有機會邀請彼岸學者、專家來訪，共為兩岸野生動物保育而努力。

「台北市動物園之友協會」曾舉辦多次保育宣導活動，惟國際性學術研討會乃首度舉辦，如有未盡周到之處，尚祈見諒為盼！最後敬向農委會孫主委明賢博士、林副主委享能先生、台北市黃市長大洲博士及所有參加研討會之專家學者申致由衷之謝忱。

台北市動物園之友協會理事長

洪文棟

Preface

For the past two decades, Taiwan has experienced a rapid economic growth at the cost of a healthy environment Urbanization and industrial development have threatened the survival of many animals It is a real regret that twenty-three animals have been listed as endangered species in Taiwan I belive the same situation has occurred all over the world. Wildlife animals are now facing a disaster caused by hunting and loss of habitats. In fact, wildlife conservation is onw one of most important issues all mankind must work together to deal with Taiwan, as a member of the international society, is also contributing her share. Unfortunately, some environmental groups severely accused Taiwan of killing rhinoceros for their horns with no convincing evidence. Today, we are gathered here not only to clear the misunderstanding but also to reveal to the entire world the efforts that the government and people in Taiwan have made in protecting wildlife animals.

For this symposium, we are very honored to have many leading experts from Japan, South Africa, the United Kingdom, and the United States along with our local researchers to share their experiences in the conservation of endangered wildlife animals. I wish this symposium will be able to elevate the perception of wildlife conservation in Taiwan. Furthemore, this symposium also aims to strengthen the internatioal communication and to display the continuing efforts of conserving wildlife animals by the non-government organizations in Taiwan.

Researchers from Mainland China were scheduled to be present but they are not able to attend due to some unexpected problems. Nevertheless, we look forward to meeting them in the near future.

The Zoological Society of Taipei has devoted itself to the conservation of wildlife animals for. It is our very real hope that this symposium will be a good start of our first step to the international stage. May this Internationally Symposium become a milestone toward the great goal of the global cooperation on the conservation of wiidlife animals.

Lenton Hung

序言2

生態保育是維護人類良好生活環境及永續利用自然資源必須推動的工作。而近年來，全球環境日益惡化、自然資源日益枯竭，許多生物面臨絕種的命運。此乃人類過度利用，棲地被大量破壞，以及各種汙染所造成。

台灣位於亞熱帶地區，由於地形複雜，海拔落差達四千公尺，因而形成複雜的生態環境，並孕育了極為豐富的生物資源。過去數十年來，由於人口快速增加及土地過度開發利用，加上民衆缺乏保育觀念，寶貴的自然資源被恣意獵捕、破壞或採集，許多野生動植物數量銳減，甚且有些棲息地的破壞更使若干珍貴的動植物瀕臨絕滅。

世界上的物種極為複雜，各種生物在生態系中均扮演不同的角色，若人類對自然資源毫無節制的取用，將導致若干物種絕滅，並造成生態系的不平衡。目前，每年地球上有八百種以上的動物面臨絕滅之威脅，全世界保育人士都紛紛為瀕臨絕種動物請命，例如大貓熊、犀牛、藍鯨、老虎等都已成為全球共同努力拯救的物種。

多年來，農委會積極推動自然保育計劃，包括禁止使用流刺網，加強森林資源維護、綠化環境、保護珍稀野生動物及規劃自然保留區等等，此皆為生態保育之基本工作，明賢更希望藉此「國際瀕臨絕種動物保育研討會」，凝聚國人對本土生物資源保育及國內外瀕臨絕種野生動物保育的共識，使台灣的生物資源得以永續保存與利用。我們也要呼籲全民了解保育瀕臨絕種動物乃國際趨勢，大家必須加強維護我們賴以生存的地球環境，才有共同的未來。更希望國際人士了解我國對生態保育的重視與成效，給予正面的評估與支持。

行政院農業委員會主任委員

孫明賢

議程

第一天：1993年4月19日（星期一）

09:00—09:10　主席致詞(洪理事長文楝)

09:10—09:20　台北市長致詞
(黃市長大洲先生)

09:20—09:30　貴賓致詞
(行政院農業委員會孫主委明賢教授)

09:30—09:50　當前野生動物保育之國際觀
(行政院農委會林副主委享能先生)

主持人：吳金洌教授(中央研究院動物研究所所長)

09:50—10:15　台灣野生動物保育研究現況與趨勢
李三畏副處長(行政院農業委員會林業處)

09:25—09:50　台灣瀕臨絕種鳥類之保育研究(蘭嶼角鴞)
(劉小如教授　中央研究院動物研究所)

10:40—11:00　茶敘時間

主持人：李健全處長(行政院農業委員會漁業處處長)

11:00—11:25　台灣魚類保育研究之趨勢
(張崑雄教授　中央研究院動物學研究所)

11:25—11:50　台灣稀有海水魚類之保育
(邵廣昭教授　中央研究院動物學研究所)

11:50—13:00　午餐

主持人：張崑雄教授(中央研究院動物學研究所)

13:00—13:40　日本稀有魚類之保育
(Prof.H.Kawanabe, Dept.of Zoology,Kyoto Univ.Japan)

13:40—14:20　美國溪流魚類之保育
(Prof.R.Behnke, Dept.of Fish & wildlife Biology,colorado state univ.U.S.A.)

14:20—14:45　台灣兩棲類、爬蟲類之保育研究及趨勢
(呂光洋教授　國立師範大學生物系)

14:45—15:25　兩棲爬蟲類之保育
(Dr.J.L.Vial,IUCN/ Species Survival Commission)

15:25—15:40　茶敘時間

主持人：黃永桀處長(行政院農業委員會林業處處長)

15:40—16:05　台灣陸域瀕臨絕種野生動物之研究概況
(簡明龍先生　台灣省特有種生物中心副主任)

16:05—16:30　台灣哺乳動物研究之現況及趨勢
(裴家騏副教授　屏東農業技術學院森林及自然資源學系)

16:30—16:55　穿山甲之人工飼育
(趙榮台主任　台灣省林業試驗所植保系)

16:55—17:20　台灣圈養瀕臨絕種哺乳類動物之研究現況
(夏良宙教授　屏東農業技術學院獸醫學系)

Tentative Schedule

April 19,1993

09:00—09:10	Opening Address	Mr.W.T.Hong, M.D. Director, The Zoological Society of Taipei
09:10—09:20	Welcome Address	Mr.T.C.Huang,ph.D. Mayor,Taipei City
09:20—09:30	Guest Speaker	Mr.M.H.Sun,ph.D. Chairman,Council of Agriculture, Executive Yuan
09:30—09:50	The International Aspect of Wildlife Conservation	Mr.S.N.Ling.Ph.D Vice Chairman Council of Agriculture. Executive Yuan.
09:50—10:15	Current Status of Wildlife Conservation in Taiwan	Mr.S.W.Lee Deputy Director,Forestry Department, Council of Agriculture
10:15—10:40	The Conservation of Endangered Birds of Taiwan -- a Case Study of Lanyu Scops Owls (*Otus scops botelensis Kuroda*)	Professor S.R.Liu,ph.D.Institute of Zoology Academia Sinica.
10:40—11:00	Tea Time	
11:00—11:25	Current Researches on Fish Conservation in Taiwan	Professor K.H.Chang,ph.D. Institute of Zoology, Academia Sinica
11:25—11:50	Conservation of Rare Sea Water Fishes in Taiwan	Professor K.J.Shao,ph.D. Institute of Zoology, Academia Sinica
11:50—13:00	Lunch	
13:00—13:40	Freshwater Fish Conservation in Japan	Professor H.Kawanabe,ph.D. Department of Zoology, Kyoto University,Japan
13:40—14:20	Conservation of Freshwater Fishes in the United States	Professor R.Behnke,ph.D. Department of Fish and Wildlife Biology, Colorado State University,U.S.A.
14:20—14:45	Current Researches on the Conservation of Amphibians and Reptiles in Taiwan	Professor K.Y.Lue,ph.D. Department of Biology, National Taiwan Normal University

14:45—15:25	Conservation of Reptiles and Amphibians	Mr. J.L.Vial,Ph.D.IUCN/ Species Survival Commision
15:25—15:40	Tea Time	
15:40—16:05	Current Researches on the Terrestrial Endangered Wildlife of Taiwan	Mr.M.L. Jan. Deputy Director,Taiwan Endemic Species Research Institute.
16:05—16:30	Current Researches on Mammale of Taiwan	Mr. J.C. Pei.Ph.D. Assistant Professor, Department of Forestry Natural Resources Ping Tung College of Agricultural Technology.
16:30—16:55	The Breeding of the pangolin.	Mr. J.T.Chao.Ph.D Director, Division of Plant protection, Taiwan Forestry Institute.
16:55—17:20	Corrent Researches on the Breeding of Endangered Mammals of Taiwan.	Professor.L.C.Hsia Ph.p Department of Veterinary Medicine, Ping-Tung College of Agricultural Technology.

第二天：1993年4月20日(星期二)

主持人：林曜松教授(台灣大學動物學系)

09:00—09:25　梅花鹿之復育

(王穎教授　國立師範大學生物系)

10:15—10:40　櫻花鉤吻鮭之族群現況與保育

(林曜松教授　台灣大學動物學系)

09:50—10:15　台灣珍稀及瀕臨絕種昆蟲之保育及研究趨勢

(楊平世教授　台灣大學植病系)

10:15—10:30　茶敘時間

主持人：周延鑫教授(中央研究院動物學研究所)

10:30—11:10　英國昆蟲保育之研究

(Dr.K.J.Gaston, Dept,Entomology,The Natural History Museum,U.K.)

11:10—11:35　野生動物棲地的保育——以大武山自然保留區為例

(李玲玲教授　台灣大學動物學系)

11:35—12:00　台北動物園瀕臨絕種動物之保育

(陳寶忠副園長　台北市立動物園)

12:00—13:00　午餐

主持人：陳寶忠副園長(台北市立動物園)

13:00—13:40　北美動物園瀕臨絕種動物之保育研究

(Director, Dr. Terry L. Maple,Zoo Atlanta of USA)

13:40—14:20　CONSERVATION PARKS AND WILDLIFE HEALTH

(Director, Wildlife Health science NYZS/ The wildlife conservation society, Dr.Robert A. Cook, Bronx Zoo of USA)

14:20—15:00　世界瀕臨絕種動物保育研究之趨勢

(Chairman, Dr.U.S.Seal, CBSG.)

15:00—15:20　茶敘時間

15:20—16:00　COORDINATED BREEDING PROGRAMMES FOR ENDANGERED SPECIES IN CONTINETAL EUROPE AND THE BRITISH ISLES: WITH REFERENCE TO THE WORK OF THE WILDLIFE PRESERVATION TRUSTS

(Director. Dr. Jeremy J C Mallinson,Jersey Wildlife Preservation Trust)

16:00—16:40　THE BREEDING OF ENDANGERED SPECIES IN ZOO IN SOUTH AFRICA

(Director, Dr.W.Labuschagne,National Zoo. of S.A.)

主持人：洪理事長文棟先生行政院農業委員會林副主委享能先生

16:40—17:30　綜合討論及記者招待會(所有演講者)

April 20,1993

09:00—09:25	The Restoration of Formosan Sika (*cervus sippon taiouanus*)	Professor.Y.Wang.ph.D. Department of Biology, National Taiwan Normal University.
09:25—09:50	Current Population and the Conservation of the Formosan Landdlocked Salmon. (*Oncorhynchus mason formosanus*)	Professor Y.S.Lin,ph.D. Department of Zoology, National Taiwan University.
09:50—10:15	Current Researches of the Conservation of Rare and Endangered Insects of Taiwan	Professor P.S.Yang,ph.D. Department of Plant Pathology and Entomology,National Taiwan University
10:15—10:30	Tea Time	
10:30—11:10	Current Research on the Insect Conservation in the United King dom	Professor K.J. Gaston,ph.D. Department of Entomology, The Natural History Museum,U.K.
11:10—11:35	Conservation of Wildlife Habitat-- a Case Study of Dawushan Natural Reserve	Professor L.L.Lee ,ph.D. Department of Zoology, National Taiwan University.
11:35—12:00	Conservation of Endangered Animals at the Taipei City Zoo	Mr.B.C.Chen.Acting Director Taipei Zoo
12:00—13:00	Lunch	
13:00—13:40	Conservation of Endangered Animals at Zoos in the North America	Mr.T.L.Maple ,ph.D. Director,Zoo Atlanta of U.S.A.
13:40—14:20	Conservation Parks and Wildlife Health	Mr.R.A.Cook,VMD. Director, Wildlife Health Science NYZS, The wildlfe Conservation Society Bronx Zoo,U.S.A.
14:20—15:00	Cerrent Status on the Global Conservation of Endangered Animals	Mr.U.S.Seal,ph.D. Chairman,CBSG.
15:00—15:20	Tea Time	
15:20—16:00	Coordinated Breeding Programmes for Endangered species in Continental Europe and the British Isles: with Reference to the work of the wildlife Preservation Trusts	Mr.J.L.Mallinson.Ph.D Jersey wildlife Preservation Trust.
16:00—16:40	The Breeding of Endangered Species in Zoos in South Africa.	Dr.W.Labuschagne. Director, National Zoo of South African.
16:40—17:30	General Discussion and Press Conference	all Lectures.

專家、學者簡介

姓名：林享能

學歷：政治大學外交系學士
文化大學政治研究所碩士

經歷：外交部科長、駐海地大使館、駐阿根廷大使館祕書
外交部中南美司副司長、駐委內瑞拉商務辦事處主任
駐智利代表、外交部國令小組負責人

現職：農業委員會副主任委員

NAME:Shiang-Nung Ling

TITLE:Vice Chairman, Council of Agriculture.

EDUCATION:

-National Cheng Chi University, Dept. of Diplomacy

-University of Chinese Culture. M.A.political Sicence.

EMPLOYMENT RECORD:

-Section Chief, Ministry of Foreign Affairs.

-Secretary, Embassy of The R.O.C.in Haiti.

-Secretary, Embassy of the R.O.C.in Argentine.

-Deputy Directer Department of Central & South American Affairs, Ministry of Foreign Affairs.

-Director, Commercial Office of Taiwan in Venezulla.

-Government Representative, Commercial Office in Chile.

-Coordinator, Congress Affairs, Ministry of Foreign Affairs.

姓名：李三畏

學歷：國立成功大學土木系畢
美國科羅拉多州立大學土地資源碩士

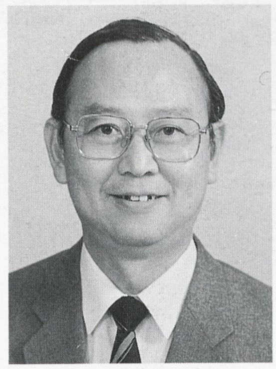
經歷：台灣省山地農牧局技士　農復會副工程師、工程師
行政院農業委員會技正、技正兼組長
行政院農業委員會簡任技正兼科長

國立台灣大學、中興大學兼任講師、副教授
現職：行政院農業委員會林業處副處長

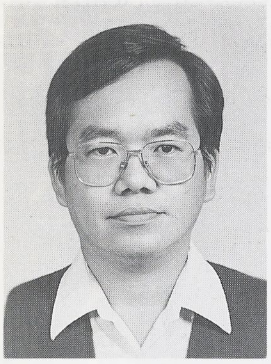
NAME:San-Wei Lee
TITLE:Council of Agriculture, Executive Yuan, Forestry Department. Deputy Director.
EDUCATION:
National Cheng-Kung University, B.S.
Colorido State University M.S. U.S.A.
EMPLOYMENT RECORD:
-Assistant Specialist, Mountain Agriculture Resources Development Bureau.
-Sino-American Joint Commision of Rural. Developmentk Ass't Engineer. Engineer.
-Council for Agriculture Planning and Development.Executive Yuan Specialist, Division Chief.
-Part-time Associate Prof. National Taiwan University.

姓名：劉小如
學歷：康乃爾大學野生動物學博士
經歷：東海大學兼任副教授、教授
台灣大學兼任副教授、教授
中央研究院動物所副研究員
現職：中央研究院動物研究所研究員

NAME:Severinghaus, hucia hiu
TITLE:-Research Fellow, Institute of Zoology Academia Sinica.
EDUCATION:
PhD. Dept. of Natural Resoruces: Wildlife Cornell University U.S.A.
EMPLOYMENT RECORD:
Institute of Zoology Academia Sinica.



姓名：張崑雄
學歷：國立台灣大學理學院動物系理學士
日本國立東京大學大學院生物系研究科農學碩士
日本國立東京大學大學院農學系研究科農學博士
經歷：中央研究院動物研究所副所長
中央研究院動物研究所所長
國立中山大學文理學院院長
國立中山大學理學院院長
國立中山大學海洋科學學院院長
現職：中央研究院動物研究所研究員
國立台灣大學理學院動物學系教授
中央研究院學術諮詢總會執行祕書



姓名：邵廣昭

學歷：美國紐約州立大學石溪分校生態與進化系博士

經歷：國立台灣大學海洋研究所、動物系合聘教授、兼任教授
國立中興大學昆蟲研究所兼任教授
中研院動物所助理研究員、副研究員
國立中山大學兼任副教授

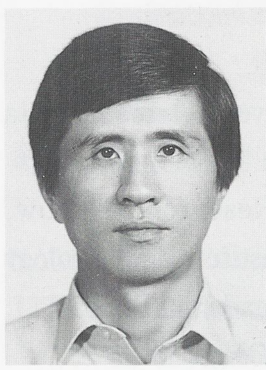
現職：國立臺灣海洋大學海洋生物研究所教授兼所長（借聘）
中央研究院動物研究所研究員

NAME:Kwang-Tsao Shao

TITLE:-Professor & Director, Institute of Marine Biology, National Taiwan Ocean University.
-Research Fellow, Institute of Zoology, Academia Sinica.

EDUCATION:
Ph.D Dept.of Ecology & Evolution, State University of New York at stony Brook.

EMPLOYMENT RECORD:
-Professor, Institute of Oceanography, National Taiwan University
-Professor, Institute of Entomology, National Chung-Hsin University
-Executive Secretary. National Committee of CODATA in Taipei, China.

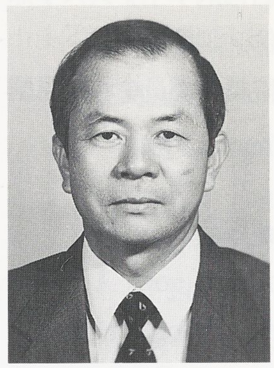


姓名：呂光洋

學歷：博士

經歷：輔大生物系助教
師大生物系副教授
內政部營建署國家公園委員會委員

現職：師大生物系教授



姓名：簡明龍

學歷：國立台灣大學農學院獸醫系畢業
美國堪薩斯州立大學碩士

經歷：高雄區農業改良場(1962、10-1971、4)技佐、技士、股長
台灣省畜產試驗所(1971、5-1987、2)技士、技正、系主任、分所長
台灣省政府農林廳(1987、3-1992、6)科長

現職：台灣省特有生物研究保育中心研究員兼副主任

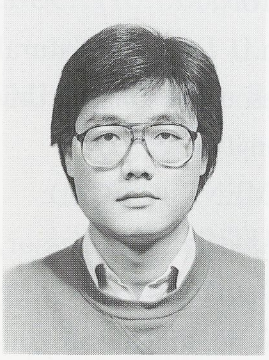
NAME:Ming-Lung Jan

TITLE:Deputy Director, Taiwan Endemic Species Research Institute.

EDUCATION:
1. B.S.in Agr.,National Taiwan University, Taiwan ,ROC.
2. M.S.in Poultry Science, Kansas State University, Manhattan , Kansas, U.S.A.

EMPLOYMENT RECORD:

1. Specialist, Kaohsiung District Agricultrtre Improvement Station.
2. Chief of Poultry Division, Taiwan Livestock Research Institute.
3. Director of Heng Chun Station, Taiwan Livestock Research Institute.
4. Chief of Animal Husbandry Division, Dept. of Agr.and Forestry, Provincial Government of Taiwan, ROC.



姓名：裴家騏

學歷：美國蒙大拿大學野生動物學博士

經歷：私立輔仁大學生物系兼任講師

現職：屏東技術學院森林資源系副教授

NAME:Kurtis Pei

TITLE:-Associate Professor of Wildlife Biology, Dep. of Forest Resource Management And Technology. National PingTung Polytechnic Institute.

EDUCATION:

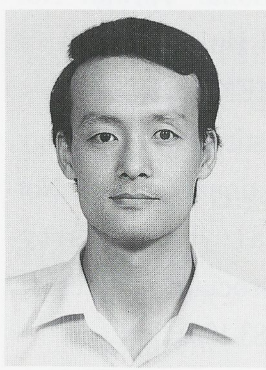
-University of Montana, Missoula(Ph.D)

-University of Washington, Seattle(M.S.)

-Fu-Jen University, Taipei(B.S.)

EMPLOYMENT RECORD:

-Associate Professor of National PingTung Polytechnic Institute.



姓名：趙榮台

學歷：國立喬治亞大學博士

經歷：國立自然科學博物館籌備處副研究員

省林業試驗所森林生物系副研究員

現職：林試所森林保護系研究員兼系主任

NAME:Jung-Tai Chao

TITLE:Research Scientist and Head, Division of Forest Protection Taiwan Forestry Research Institute.

EDUCATION:University of Georgia, Athens, Georgiak, U.S.A. 1979-1984, PhD (Entomology)1984

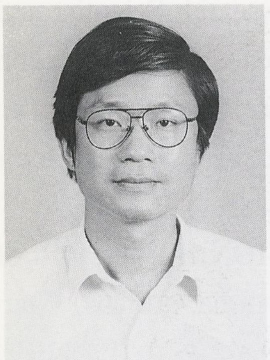
EMPLOYMENT RECORD:

-Taiwan Forestry Research Institute 1991 -present, Research Scientist and Head. Division of Forest Protection.

-University of Oxford, Oxford, U.K.1990 (March-August), Academic visitor, wildlife Conservation Research Unit, Department of Zoology.

-Taiwan Forestry Research Institute 1986-1991, Associate Research Scientist, Division of Forest Biology.

-Preparatory Office, National Museum of Natural History 1984-1986, Associate Research Scientist, Division of Collection and Research.



姓名：夏良宙

學歷：愛丁堡大學畢

經歷：台灣養豬科學研究所助理研究員、研究員、副研究員

現職：國立屏東技術學院教授

NAME:Liang-Chou,Hsia

TITLE:-Professor of Ping.

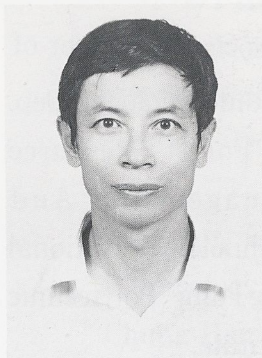
EDUCATION:Ph.D of Edinburgh University

EMPLOYMENT RECORD:

-Assistant Researcher (1970-1976)

-Associated Researcher (1976-1984) of Pig Research Institute.

-Research fellow(1984-1993)



姓名：王穎

學歷：俄亥俄州立大學野生動物博士

經歷：師大生物研究所副教授

現職：師大生物研究所教授

NAME:Ying Wang

TITLE:-Institute of Biology, National Taiwan Normal University Professor

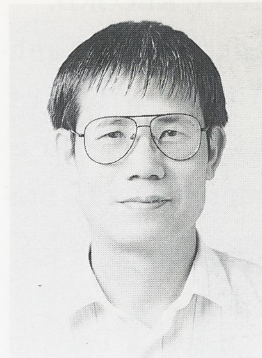
EDUCATION:

National Taiwan Normal University.B.S.

EMPLOYMENT RECORD:

-Institute of Biology, National Taiwan Normal University-Associate Professor. 1983-1988

-Institute of Biology, National Taiwan Normal University- Professor. 1988-1993



姓名：林曜松

學歷：美國康乃爾大學自然資源系博士

經歷：台灣大學動物系副教授

台灣大學動物系講師

台灣大學動物系助教

現職：台灣大學動物學系教授兼系主任

NAME:Yao-Sung Lin

TITLE:Professor and Chairman.Dept. of Zoology National Taiwan University

EDUCATION:

Ph.D Dept. of Natural Resources Cornell University U.S.A.

EMPLOYMENT RECORD:

-Associate Professor, Dept. of Zoology National Taiwan University

-Instructor,Dept.of Zoology National Taiwan University

-Teaching assistant Dept.of Zoology National Taiwan University

姓名：楊平世
學歷：台大農學博士
經歷：台大植病系助教
台大植病系講師
台大植病系副教授
現職：台大植病系教授兼系所主任

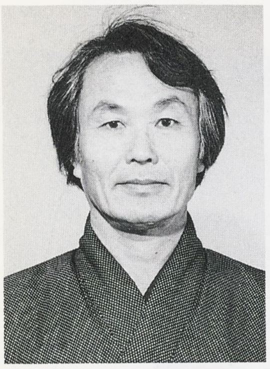
NAME:Ping-Shih Yang
TITLE:Head and professor of Dept. of plant Pathology and Entomology, National Taiwan University
EDUCATION:Doctor of Agriculture.
EMPLOYMENT RECORD:
Teaching assistant, NTU;
Lecture, NTU;
Associate professor, NTU.

姓名：李玲玲
學歷：美國加州大學戴維斯校區生態博士
經歷：國立台灣大學動物學系博士後副研究員
現職：國立台灣大學動物學系副教授

NAME:L.L.Lee.
TITLE:Associated professor Dept. of Zoology National Taiwan University.
EDUCATION:Ph.D University of california, Davis
EMPLOYMENT RECORD:
Post Doc. associated researcher National Taiwan University.

姓名：陳寶忠
學歷：屏東農專畜牧科畢
淡江大學企管系畢
經歷：台北市立動物園技正、組長、研究員
現職：台北市立動物園副園長

NAME:Pao-chung Chen
TITLE:Acting Director of Taipei Zoo.
EDUCATION:
-Animal Husbandry Pintung Agriculture College.
Business Management
-TanKang University
EMPLOYMENT RECORD:
Curator, General Curator of Animal Collection, General Superintendent of Taipei Zoo.



NAME: KAWANABE Hiroya

Nationality: Japanese

TITLE:Professor of Kyoto University (Faculty of Science)

Director of the Centre for Ecological Research, Kyoto

EDUCATION:Kyoto University Graduate School of Sciences Doctor Course (1960)

EMPLOYMENT RECORD:

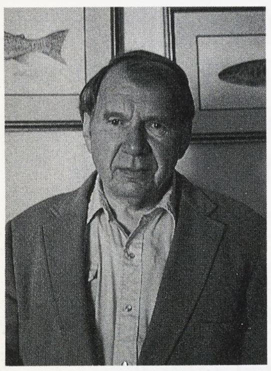
-Instructor of Kyoto University (1960-1961)

-Lecturer of Kyoto University (1961-1967)

-Associate Professor of Kyoto University (1967-1977)

-Professor of Kyoto University (1977-)

-Director of Centre for Ecological Research (1991)



NAME:Robert J. Behnke

TITLE:Professor

Department of Fishery and Wildlife Biology

Colorado State University

Fort Collins, CO 80523

EDUCATION:

1957 B.A. Zoology Connecticut University

1960 M.A. Zoology University of California

1965 Ph D. Zoology University of California

Graduated Connecticut University with distinction and high honors. M.A. thesis on the trouts of the Great Basins; Ph.D. thesis on systematics of family Salmonidae. Fields for Ph.D. qualifying examination:general zoology, ecology, vertebrate zool ogy, entomology and vertebrate physiology.

EMPLOYMENT RECORD:

1947-1952:Yale and Towne Hardware Co.

1952-1954:U.S. Army

1956:Chesapeake Biological Laboratory, Solomons, Maryland, assistant to the late Dr. R. Mansueti; studies on fishes of Chesapeake Bay

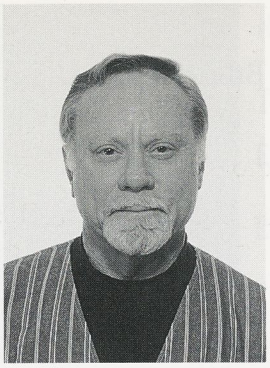
1957-1964:University of California, Research Assistant, teaching assistant and research biolo gist

1965:American Academy of Science, Exchange scholar

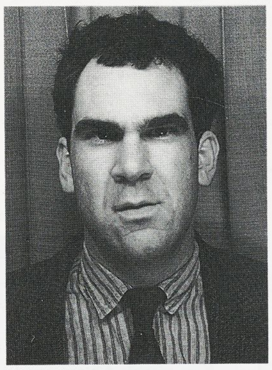
1966:University of California, Assistant Professor of Zoology, teaching ichthyology course

1966-1974:U.S. Fish and Wildlife Service, Assistant Unit Leader, Colo. Coop. Fishery Unit and Research Biologist

1974-present:Colorado State University, part-time teaching, part-time private consulting and advising



NAME:James L. Vial
TITLE:IUCN/Species Survial Commission



Name: Kevin J. Gaston
Nationality: British
EMPLOYMENT RECORD:

-September 1991 - Present. Senior Research Fellow, Dept. of Entomology, The Natural History Museum, London

-September 1989 - August 1991. Junior Research Fellow, Dept. of Entomology, The Natural History Museum, London

EDUCATION:

October 1986 - August 1989. DPhil. Biology, University of York

October 1983 - July 1986. BSc. (Special Hons.) Zoology, University of Sheffield

---

NAME:Terry L. Maple
TITLE:Director, Zoo Atlanta. U.S.A.
EDUCATION:

A.B.	1968	University of the Pacific (Psychology)
M.A.	1971	University of California at Davis(Psychobiology)
Ph.D.	1974	University of California at Davis(Psychobiology)

EMPLOYMENT RECORD:

Academic Appointments

Assistant Professor, Emory University, 1975-78.
Associate Professor, Georgia Institute of Technology, 1978-82, (Tenured 1982).
Professor, Georgia Institute of Technology, 1984-present.
Goordinator, Experimental Psychology Program, Georgia Institute of Technology, 1989-91.

NAME: Robert A. Cook

TITLE:Director of Animal Wildlife Health Science NYZS, Bronx Zoo of U.S.A.

EMPLOYMENT RECORD:

1990 - Date:Chief Veterinarian
N. Y. Zoological Society, Bronx, New York

1988 - 1990:Clinical Veterinarian
N. Y. Zoological Society, Bronx, New York

1983 - 1985:Staff Veterinarian
Cheyenne Mountain Zoological Park, Colorado Springs, Co.

1981 -1983: Small and Exotic Animal Practitioner
Aspenwood Animal Hospital, Denver, Co.

1980: Intern
The Animal Medical Center, New York, N.Y.

EDUCATION:

1985 - 1988:Residency, Zoo Medicine Animal Health Center New York Zoological Society Bronx, New York 10460

1980 - 1981:Internship, Small Animal Medicine & Surgery The Animal Medical Center New York, New York

1976 -1980: University of Pennsylvania School of Veterinary Medicine V. M. D., Magna Cum Laude

1972 -1976: Michigan State University Bachelor of Science - Microbiology and Public Health

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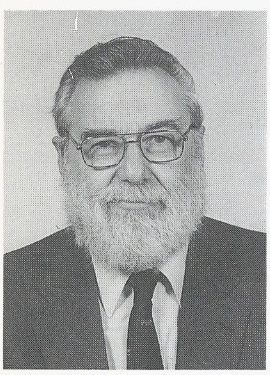
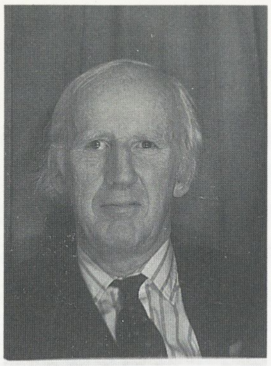


NAME: SEAL, ULYSSES SAMUEL

EDUCATION:Emory Univ., Atlanta, Ga. Psychology B.A. 1949
Emory Univ., Atlanta, Ga. Psychology M.A. 1950
Emory Univ., Atlanta, Ga. Biochemistry Ph.D. 1957
University of Minnesota Biochemistry Post Doc. 1957-59

EMPLOYMENT RECORD:

Career Research Scientist VAMC Minneapolis, MN	1980-91
Research Chemist, VAMC Minneapolis, MN	1959-91
Post-Doctoral, Univ. Minnesota, Minneapolis, MN	1957-59
Professor, Biochemistry, University of Minnesota	1971-
Professor, Fisheries & Wildlife, Univ. of Minnesota	1976-
Professor, Ecology and Animal Behavior, Univ. of Minn.	1986-
Chairman, Captive Breeding Specialist Group	1980-
Consultant, CBSG	1991-



NAME: Jeremy J C Mallinson

TITLE: Director, Jersey Wildlife Preservation Trust

EDUCATION:The King's School, Caterbury

EMPLOYMENT RECORD:
- Editorial Boards of Zoo Biology
- Editorial Boards of the International Journal for the Study of Animal Problems
- Editorial Boards of the New Biovdiversity and Conservation
- Chairman of the Editorial Board of the International Zoo Yearbook
- U.K. Board of Trustees of the Dian Fossey Gorilla Fund
- Honorary Director of the Wildlife Preservation Trust, U.S.A and Wildlife Preservation Trust Canada

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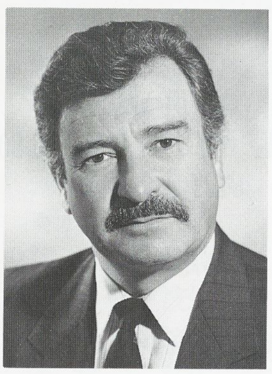

NAME:Willie Labuschagne

TITLE:Director:

National Zoological Gardens Of South Africa

EDUCATION:

* Matriculated in 1962
* 1967 B.Sc
* 1968 B.Sc (Honours) (Wildlife Manage ment)
* 1980 M.Sc (Wildlife Management)

EMPLOYMENT RECORD:

1963 - 1964:South African Bureau of Standards - Microbiologist.

1969 - 1970:Mammal Research Institute - Research Officer.

1971 - 1972:Department of Technical Agricultural Services - Senior Entomologist.

1972 - 1976:Johannesburg Zoological Gardens - Zoologist.

1977 - 1985:Johannesburg Zoological Gardens - Director.

1985 - Present:National Zoological Gardens of South Africa - Director.

參加人員名冊

●師大環境教育中心
周　儒　台北市汀州路88號　(02) 9355232
●人猿基金會
裴馬克　台北市辛亥路一段93號16樓之一　(02) 3626786
祈偉廉　台北市辛亥路一段93號16樓之二　(02) 7754771
張瓊如　台北市辛亥路一段93號16樓之一　(02) 3626788
何偉敏　台北市辛亥路一段93號16樓之一　(02) 3626786
Jacqueline Blsner　台北市辛亥路一段93號16樓之一　(02) 3626786
●中華民國自然生態保育協會
宋培生 執行祕書　台北市文山區秀明路一段79巷5弄25號1樓 9362801
●中興大學植物研究所
許飛霜 研究生　台中市中興大學植物研究所(04)2873181轉419再轉57
●玉山國家公園管理處
許重洲　南投縣水里鄉民生路112號 (049) 702200
蘇麗君　嘉義縣阿里山鄉雪峰小隊轉塔塔加遊客中心
林貴春 保育課　南投水里民生路112號　(049) 773121轉273
●林試所保護系
陳一銘 助理　台北市南海路53號　(02) 3817101轉802
葉文琪 技工　台北市南海路53號　(02) 3817101轉802
葛兆年 助理　台北市南海路53號　(02) 3817101轉310
趙榮台 研究員兼系主任　台北市南海路53號　(02) 3817101轉800
范義彬 助理　台北市南海路53號　(02) 3817101轉318
●國立台灣科學教育館
蔣中柱 編輯　台北市南海路41號　(02) 3116733
●新竹市立動物園
施偉中 獸醫　新竹市公園路279號　(035) 222194
●六福村野生動物公園
黃志碩 獸醫　新竹縣關西鎮仁安里拱子溝60號 (035) 872626
●新環境基金會
張美麗 總編輯　台北市羅斯福路二段12號2F　(02) 3969522
楊淑惠 祕書　台北市羅斯福路二段12號2F　(02) 3969522
●觀光局東館處
史國漢 管理課辦事員　臺東縣臺東市松江路一段500號 (089) 281620
李瑞和 花蓮管理站主任　臺東縣臺東市松江路一段500號 (089) 781452
陳崇賢 綠島管理站主任　臺東縣臺東市松江路一段500號 (089) 672026
歐介中 臺東管理站主任　臺東縣臺東市松江路一段500號 (089) 850785
●台北市野鳥學會
王季新 理事長　台北市復興南路一段295巷13弄6號1F　7840270
李建安 繫放組組長　台北市復興南路一段295巷13弄6號1F　3259190
李平篤 活動組組員　台北市復興南路一段295巷13弄6號1F　3259190
●陽明山國家公園
陳育賢 技正　台北市陽明山竹子湖路1—20號　(02) 8935580
●省立鳳凰谷鳥園
江德龍 園長　南投縣鹿谷鄉鳳凰村仁義路1—9號 (049) 753100
鄭福財 組長　南投縣鹿谷鄉鳳凰村仁義路1—9號 (049) 753100
劉春田 組長　南投縣鹿谷鄉鳳凰村仁義路1—9號 (049) 753100
廖添富 組長　南投縣鹿谷鄉鳳凰村仁義路1—9號 (049) 753100

林 柏 煌 技佐 南投縣鹿谷鄉鳳凰村仁義路 1—9 號（049）753100
王 宏 銘 技士 南投縣鹿谷鄉鳳凰村仁義路 1—9 號（049）753100
陳 石 養 技佐 南投縣鹿谷鄉鳳凰村仁義路 1—9 號（049）753100
●師大生物系
黃 璧 祈 助教 台北市汀州路四段 88 號 (02) 9356662 轉 730
張 永 達 講師 台北市汀州路四段 88 號 (02) 9356662 轉 730
●台灣省水產試驗所
許 慧 文 養殖系助理 基隆市和一路 199 號 4622101 轉 2504
陳 宗 雄 漁業生物系副研究員 基隆市和一路 199 號 4622101 轉 2413
●觀光局
盧 春 成 台北市忠孝東路四段 290 號 9 F (02) 7218541 轉 394
曾 國 基 東北角管理處 台北縣貢寮鄉福隆村興隆街 36 號 (02) 499115 轉 121
陳 水 源 澎湖管理處處長 澎湖縣馬公市中華路 236 號 (06) 9279100
陳 佩 妤 澎湖管理處 澎湖縣馬公市中華路 236 號 (06) 9299100
●國立自然科學博物館
陳 慧 娟 助理研究員 台中市館前路一號 (04) 3226940 轉 268
陳 彥 君 助理研究員 台中市館前路一號 (04) 3226940 轉 268
薛 攀 文 副研究員 台中市館前路一號 (04) 3226940 轉 331
周 文 豪 副研究員 台中市館前路一號 (04) 3226940 轉 331
顏 重 威 副研究員 台中市館前路一號 (04) 3226940 轉 331
黃 文 山 助理研究員 台中市館前路一號 (04) 3226940 轉 331
張 譽 騰 副研究員 台中市館前路一號 (04) 3226940 轉 331
●水土保持局
陳 振 盛 股長 南投縣中興新村光華路 6 號 (049) 339191
姜 樺 秀 技佐 南投縣中興新村光華路 6 號 (049) 339191
陳 志 偉 技士 南投縣中興新村光華路 6 號 (049) 339191
李 益 義 技佐 南投縣中興新村光華路 6 號 (049) 339191
黃 政 吉 技佐 南投縣中興新村光華路 6 號 (049) 339191
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王 慶 益 技佐 南投縣中興新村光華路 6 號 (049) 339191
鄭 麗 枝 辦事員 南投縣中興新村光華路 6 號 (049) 339191
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祝 瑞 敏 技佐 南投縣中興新村光華路 6 號 (049) 33919
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何 一 先 繫放組負責人 台北市復興南一段 295 巷 13 弄 6 號 2 F (02) 7067219
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鄭振寬 研究助理　台北市汀州路四段88號　(02) 9326234轉325
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林政彥 研究助理　台北市汀州路四段88號　(02) 9326234轉325
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林斯正 動物組　南投集集鎮民生東路一號　(049) 761274
陳立禎 動物組　南投集集鎮民生東路一號　(049) 761274
吳福正 動物組　南投集集鎮民生東路一號　(049) 761274
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馬聖麟 動物組　南投集集鎮民生東路一號　(049) 761274
張治國 動物組　南投集集鎮民生東路一號　(049) 761274
鄭錫奇 動物組　南投集集鎮民生東路一號　(049) 761274
張簡琳玟 動物組　南投集集鎮民生東路一號　(049) 761274

陳祈瑞 動物組 南投集集鎮民生東路一號 (049) 761274
黃安璟 動物組 南投集集鎮民生東路一號 (049) 761274
黃士元 植物組 南投集集鎮民生東路一號 (049) 761274
孫于卿 植物組 南投集集鎮民生東路一號 (049) 761274
沈明雅 植物組 南投集集鎮民生東路一號 (049) 761274
艾台霖 植物組 南投集集鎮民生東路一號 (049) 761274
邱健介 植物組 南投集集鎮民生東路一號 (049) 761274

●ㄅㄆㄇ猴園

楊永賢 園長 新竹縣寶山鄉三峰村53—9號 (035) 761333

●屏東技術學院

毛俊傑 森林系學生 台北市民生東路五段260巷21號2F (02) 7683048
林益仁 助理 台北市林森北路62號
黃修德 助理 屏東縣內浦鄉老埤村昌南路254號 (08) 7703202轉7151
戴永禔 副教授 屏東縣內浦鄉老埤村昌南路254號 (08) 7703202轉7143

●台灣大學動物系

曹先紹 北市羅斯福路動物系 (02) 3631694
李培芬 副教授 北市羅斯福路台大動物系 (02) 3631694
楊懿如 博士班學生 北市羅斯福路台大動物所 (02) 3631694
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張明雄 博士班學生 北市羅斯福路台大動物系生態室 (02) 3631694
丁定蘇 碩士研究生 北市羅斯福路台大動物系生態室 (02) 3631694
陳惠琦 碩士研究生 北市羅斯福路台大動物系生態室 (02) 3631694

●台灣大學漁試所

莊鈴川 技士 北市羅斯福路台大動物系生態室 (02) 3631694

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陳亮憲 講師 台北市文化大學生物系辦公室 (02) 8610511轉327

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林麗紅 技士 北市南海路37號 (02) 3124068
楊惠良 約聘研究員 北市南海路37號 (02) 3124048
巫宗南 約聘研究員 北市南海路37號 (02) 3124048

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陳擎霞 教授 北縣新莊輔仁大學生物系 (02) 9031111轉2464

●台灣省立博物館

黃淑芬 推廣組組長 北市襄陽路2號 (02) 3117959轉260

●中研院動物研究所

徐芝敏 副研究員 南港區研究院路二段128號 (02) 7899220 7899542

●陽明醫學院生理科

徐西華 北市大安路一段206巷12號2F (02) 8212301轉374

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郭燕婉 祕書 台北市文山區新光路二段30號 (02) 9382300轉312
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姚重志 推廣組組長 台北市文山區新光路二段30號 (02) 9382300轉233
王虎城 服務隊義工 台北市文山區新光路二段30號 (02) 9382300轉347
李雪娥 推廣組服務員 台北市文山區新光路二段30號 (02) 9382300轉240
張 衍 服務隊義工 台北市文山區新光路二段30號 (02) 9382300轉347
* 王定新 推廣組技佐 台北市文山區新光路二段30號 (02) 9382300轉234
胡鳳珠 服務隊義工 台北市文山區新光路二段30號 (02) 9382300轉347
陳憶民 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
賴俊豪 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
林裕智 動物組技工 台北市文山區新光路二段30號 (02) 9382300轉257
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鄭世嘉 推廣組約聘編譯 台北市文山區新光路二段30號 (02) 9382300轉346
林秀美 推廣組約聘輔導教師 台北市文山區新光路二段30號 (02) 9382300轉345
李順仁 推廣組輔導員 台北市文山區新光路二段30號 (02) 9382300轉231
陳明慧 推廣組臨編輔導員 台北市文山區新光路二段30號分機347
* 陳美汀 技工 台北市文山區新光路二段30號 (02) 9382300轉228
邱淑雍 檢驗員 台北市文山區新光路二段30號 (02) 9382300
季昭華 獸醫 台北市文山區新光路二段30號 (02) 9382300
周 健 獸醫 台北市文山區新光路二段30號 (02) 9382300
高康敏 技工 台北市文山區新光路二段30號 (02) 9382330轉228
21 紀純真 推廣組輔導員 台北市文山區新光路二段30號 (02) 9382300轉302
金志美 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
陳建志 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
張 媛 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
黎瑞華 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
* 趙明杰 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
陳玉燕 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
陳芝婷 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
溫永昌 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
曾淑珠 動物組技士 台北市文山區新光路二段30號 (02) 9382300轉206
22 王美譽 服務隊義工 台北市文山區新光路二段30號 (02) 9382300轉349
黃仲平 服務隊義工 台北市文山區新光路二段30號 (02) 9382300轉349
林惠莉 推廣組服務員 台北市文山區新光路二段30號 (02) 9382300轉302
李宏仁 服務隊義工 台北市文山區新光路二段30號 (02) 9382300轉347
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* 林惠珍 推廣組服務員 台北市文山區新光路二段30號 (02) 9382300轉231
王彩碧 推廣組輔導教師 台北市文山區新光路二段30號 (02) 9382300轉234
田鳳鳴 編審 台北市文山區新光路二段30號 (02) 9382300轉234
吳怡欣 技工 台北市文山區新光路二段30號 (02) 9382300轉213
陳翠霞 約聘輔導教師 台北市文山區新光路二段30號 (02) 9382300轉234

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發言條

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發言條 ____

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策劃單位：
樸實總合有限公司

執行單位：
疼惜新手足工作組
有魚工作室

疼惜新手足
THEY ARE MY BROTHERS

主辦單位：
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ZOOLOGICAL SOCIETY OF TAIPEI (ZST)
行政院農業委員會

協辦單位：
台北市動物園
台灣大學植物病蟲害學系，動物學系
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台大全球變遷研究中心
台北國際會議中心


THE RAIN FOREST
ENDANGERED

This card was with beautiful basket
of oriental fruits

Dear Dr. Behnke,

May this add to your pleasure.

Hung, Wen-ton
The Zoological Society of Taipei

The Chairman Paul M. H. Sun
of the Council of Agriculture
Executive Yuan
requests the pleasure of the company of

Dr. Robert Behke

at a dinner

on Tuesday, April 20, 1993

at 18:30

at the Council of Agriculture
37 Nanhai Road, Taipei

Regrets only: Tel: 3812991 Ext: 6086 *Business suit*

台北市動物園之友協會
The Zoological Society of Taipei

Hung, Wen Ton

Board Chairman

30 Sec. 2 Hsin Kuang Road
Taipei, Taiwan 11628 Republic of China
☎(02)939-0663

台北市動物園之友協會
The Zoological Society of Taipei

理事長 洪文棟

台北市文山區11628新光路二段30號
☎(02)939-0663 FAX：(02)939-0663

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COUNCIL OF AGRICULTURE
EXECUTIVE YUAN
中華民國台灣台北市古亭區 10728 南海路三十七號
37 NANHAI ROAD, TAIPEI, TAIWAN 10728
REPUBLIC OF CHINA
TEL: (02) 3812991

Dr. Robert Behke

October 11, 1994

Eric Smith
2466 S. Bannock St.
Denver, CO 80223

Professor Robert Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

Dear Dr. Behnke,

I am writing to follow up on our conversation of October 6 concerning my travel to the People's Republic of China. I'd like to thank you for your time and for your helpful suggestions. Based on your information that there are, indeed, salmonid populations on the Chinese mainland, I am preparing an informal "proposal suggestion" which will be reviewed by the Durfee Foundation. A more detailed proposal and itinerary will be required by the end of December.

The Durfee Foundation is funded by the estate of a successful entrepreneur, who, during the 1920's, went to China on what he remembers as a "wonderful adventure." He decided to allow others the opportunity to pursue similar adventures and he made significant funds available to individuals with "creative and personally significant visions." The Durfee Foundation Adventure Capital awards are available to recent graduates of the Claremont Colleges, and they prefer proposals addressing an avocational interest, as opposed to career development.

My suggestion to explore China for its potential fly fishing was enthusiastically received by the program coordinator at my Alma Mater. He has assured me, based on the level of funding available, and his experience with the kinds of proposals that have been funded in the past, that mine is almost certain to be successful.

I am, in short, probably going to China next summer -- probably with the resources to visit difficult or even unexplored areas.

Over the next six weeks or so I will be finalizing my proposal and planning my itinerary. Any information which you might have available would be most helpful and most appreciated. I would be grateful for the opportunity to discuss with you questions of fish biology and distribution if it is at all convenient to your schedule. I would welcome the chance to work with the Chinese graduate students you mentioned last week. Also, if you know of an individual familiar with the aquatic insects of China, I would certainly appreciate such a contact.

My goals for this trip are primarily to fly fish and enjoy the challenge of exploration and the prospect of discovery, the but chance to learn about relatively undocumented Chinese fish and fisheries can certainly complement my objectives. I have a physics degree and some coursework in biology, but my knowledge of ichthyology is limited to what I've read in your articles in *Trout*. I am, however, a diligent student, and I'd be honored to work with you with the aim of using the opportunity of my trip to further scientific understanding of the fish of China.

I hope to hear from you soon. I realize that you must have many demands on your time, but I hope that I'm not making too large an imposition. Once again, thank you for your time last week, and although I will try to contact you in the next several weeks, please don't hesitate to contact me if I can clarify any of the ideas I've presented.

Sincerely,

Eric Smith

Eric Smith

(303) 871-9543
(303) 572-5471 (w)
(303) 572-5499 fax

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XINJIANG

The Silk Road threading through Xinjiang's deserts and mountains carried China's trade westward and eventually opened the way for Islam's expansion eastward. Seven of the 12 minorities here are Muslim, most of whom speak Turkic languages and for centuries used Arabic script. The Uygur, once called "high carts," raise fruit, wheat, cotton, and rice by extensive irrigation. Their faces combine Indo-Iranian and Mongoloid features.

The Kazak, renowned for their horsemanship, and the Kirgiz, who keep Bactrian camels, have reduced their pastoral wanderings as herders of sheep and goats and live in communes during winter. The Xibe, transplanted from the northeast as part of a border guard 300 years ago, are the largest single group of Manchu speakers in the country.

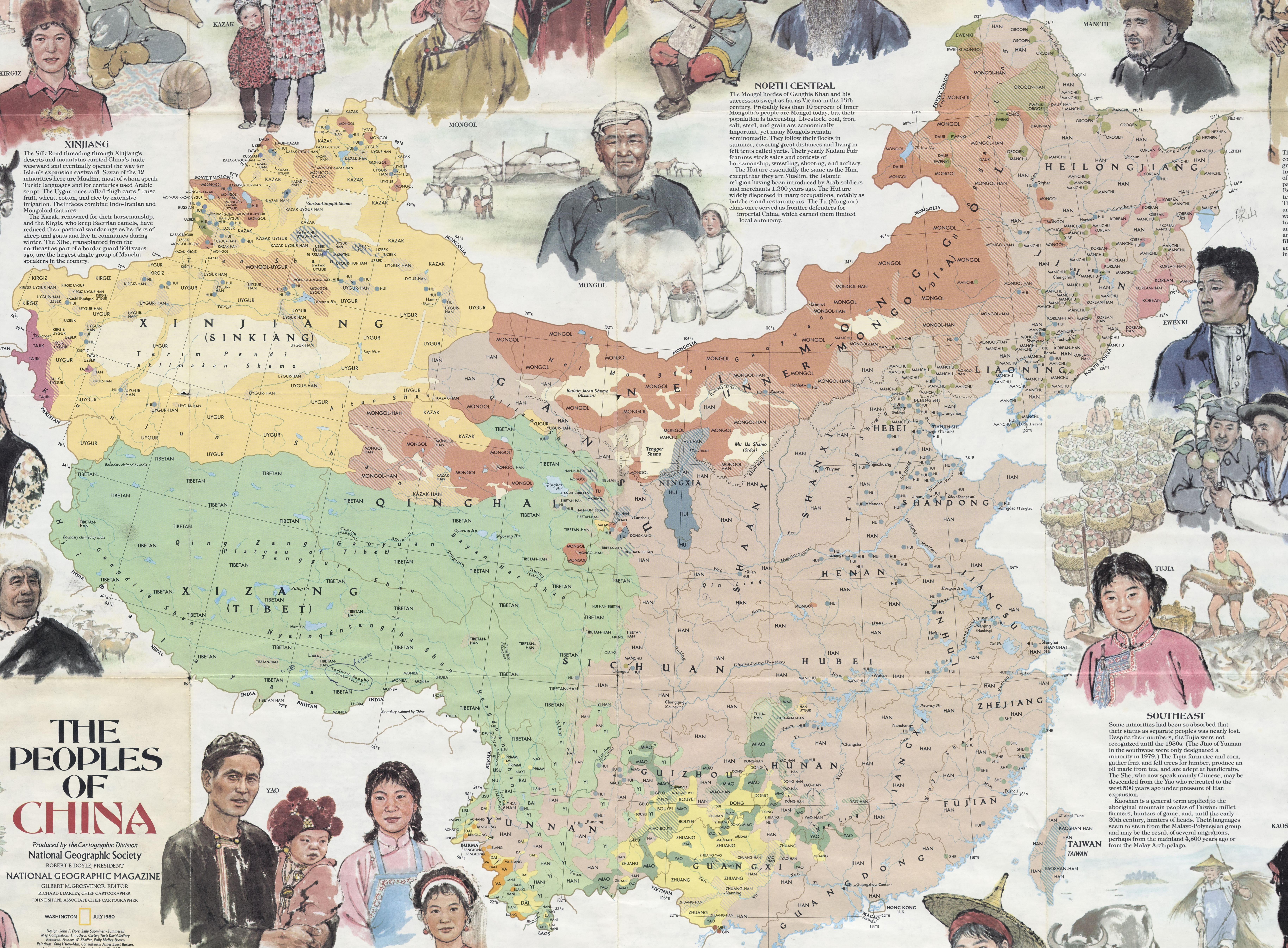
NORTH CENTRAL

The Mongol hordes of Genghis Khan and his successors swept as far as Vienna in the 13th century. Probably less than 10 percent of Inner Mongolia's people are Mongol today, but their population is increasing. Livestock, coal, iron, salt, steel, and grain are economically important, yet many Mongols remain seminomadic. They follow their flocks in summer, covering great distances and living in felt tents called yurts. Their yearly Nadam Fair features stock sales and contests of horsemanship, wrestling, shooting, and archery.

The Hui are essentially the same as the Han, except that they are Muslim, the Islamic religion having been introduced by Arab soldiers and merchants 1,200 years ago. The Hui are widely dispersed in many occupations, notably as butchers and restaurateurs. The Tu (Monguor) clans once served as frontier defenders for imperial China, which earned them limited local autonomy.

NORTHEAST

The Manchu, once herders and hunters, conquered China in the 17th century. They were gradually assimilated and are now found in all trades across the northeast, with little remaining of their ancient customs or language. Only in the past 25 years, however, have the Oroqen and Ewenki begun giving up the birch-bark and hide tents of migrant hunters for a more settled life. They still hunt, but also breed deer, tend flocks, and farm. Many now live in communes with warehouses, barns, and pens. The Daur have a tradition of grain and vegetable farming and animal husbandry, as well as logging, hunting, and fishing. Korean immigrants have been filtering into China for centuries. Once rice growers, they have lately joined in the industrialization of Manchuria.



TIBETAN HIGHLANDS

Herders of yaks, sheep, and goats and farmers of barley, peas, and tubers, the Tibetans sparsely inhabit a high, desolate region surrounded by mountains and barricaded on the east by the canyons of the Yangtze, Mekong, and Salween Rivers. The advent of Buddhism in the seventh century led to a theocratic state intermittently controlled from China from the 13th century until 1959, when it took full power in the aftermath of a rebellion. Serfdom was abolished, government secularized, communes established, and mechanized agriculture and other modernizations begun. Surface transportation is as yet rudimentary; the first railroad may reach Lhasa in five to ten years.

SOUTHEAST

Some minorities had been so absorbed that their status as separate peoples was nearly lost. Despite their numbers, the Tujia were not recognized until the 1950s. (The Jino of Yunnan in the southwest were only designated a minority in 1979.) The Tujia farm rice and corn, gather fruit and fell trees for lumber, produce an oil made from tea, and are adept at handicrafts. The She, who now speak mainly Chinese, may be descended from the Yao who retreated to the west 500 years ago under pressure of Han expansion.

Kaoshan is a general term applied to the aboriginal mountain peoples of Taiwan: millet farmers, hunters of game, and, until the early 20th century, hunters of heads. Their languages seem to stem from the Malayo-Polynesian group and may be the result of several migrations, perhaps from the mainland 4,500 years ago or from the Malay Archipelago.

KAOSHAN

THE PEOPLES OF CHINA

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JOHN F. SHUPE, ASSOCIATE CHIEF CARTOGRAPHER

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Design: John F. Dorr, Sally Suominen-Summerall
Map Compilation: Timothy J. Carter; Text: David Jeffery
Research: Frances W. Shaffer, Polly McRee Brown
Paintings: Yang Hsien-Min; Consultants: James Evert Bosson, University of California at Berkeley; June Teufel Dreyer, University of Miami; MaryEllen Alonso, Harvard University

HAN
YAO
ZHUANG
BAI
YI
DAI
MIAO
LI
SHE

BROCADED with many threads, the great robe of China is trimmed with various patterns at cuffs, collar, and hem. Border regions are embroidered with the homelands of most of China's 56 minority peoples. Though only 6 percent of the population, these groups number some 56 million and inhabit more than half of the country's territory, much of it deserts, steppes, or mountains.

The national minorities, as they are called in China, differ from the predominant Han Chinese in one or more of the following ways: language, customs, historical development, religion, race. They vary in numbers from 12,090,000 Zhuang to 600 Russians. Those pictured around the map represent most of the populous minorities, with a sampling of others to suggest their diversity. Though shown in traditional costumes, many daily wear such utilitarian garments as shown for the Han. (The box at lower right lists all of China's peoples and keys their distribution.)

What was to become the Chinese empire grew from Neolithic settlements in the Yellow River Basin. Peoples on the empire's borders were simply and officially barbarians, and in the third century B.C. China built that most colossal artifact of policy toward those to the north: the Great Wall to keep them out.

With the Han Dynasty (206 B.C. to A.D. 220), China expanded into Central Asia and sent armies into Mongolia. Trade along the Silk Road reached as far west as Rome.

Chinese imperial fortunes rose and fell over the centuries, but even in eras of ascendancy no uniform policy governed the treatment of minorities. Those who were lowland farmers were absorbed by the Han majority (named for the dynasty); others were taxed and their lands garrisoned. Some paid only nominal tribute and allegiance, while still others retreated into remote mountain strongholds.

The Han majority was overrun by the Mongols under their khans (1260-1368), who did not adopt Chinese ways, and by the Manchu who, as the last dynasty (1644-1911), gradually adopted them.

Comprehensive policies for minorities issued after the Communist revolution include limited regional autonomy, training programs, freedom to develop native languages, and cultural and economic assistance. Use of the symbol for dog as part of written characters for ethnic names was abolished and the symbol for man substituted.

During the Great Leap Forward (1957-59) and the tumultuous Cultural Revolution (1966-69), the rights of minorities were restricted. Rebellions were suppressed in Tibet in 1959 and in Xinjiang (Sinkiang) in 1962. In recent years the rights of minorities have been reaffirmed and their development accelerated. They have also been excepted from the national birth-control campaign.

These diverse peoples supply most of China's livestock, have in their territories most of China's mineral resources, and inhabit China's borders with, among others, the Soviet Union and Vietnam. Often their kinsmen live across those national boundaries. Such factors argue for an even greater role for China's other peoples in the campaign for peaceful national development.

SOUTHWEST

Largest of the minorities, the Zhuang share with the Dai (ethnic kin to the people of Thailand) common linguistic roots and a love of festival singing and dancing. But unlike the more remote Dai, the Zhuang have had a close affiliation with the Han for centuries. So, too, have the Bai, rice farmers from villages in the high plains of Yunnan, whose ancestors were among the original inhabitants of the region.

Scattered in small stockaded villages in rugged mountains, the Yao raised rice, maize, and sweet potatoes by slash-and-burn farming. With the advent of better communications and transportation, they have a developing economy based on new hydroelectric power and increased irrigation. Fierce warriors, the Yi evolved an aristocratic society (even their slaves had slaves) and a religion based on the reading of sacred writings.

SOUTH

Dispersed from southern China across northern Vietnam, Laos, and into Thailand, the Miao (Hmong) vary in dialect, styles of farming, and designation: Black, White, Red, Blue, Flowery, and Cowrie Shell Miao among others. Forced southward by the Han, often despised and exploited, many settled in distant mountains, raising millet and buckwheat by slash-and-burn farming, their diet supplemented by domestic animals and hunting. Modernization—improved farming methods, organization of communes, road building—has been made difficult by the rugged terrain in which the Miao are scattered.

Native to the mountains of Hainan Island, the Li long had a history of rebellion against Chinese authority. In 1943 they rose against the Nationalist occupiers and were joined by local Communist guerrillas and later by the Chinese Red Army in the first large-scale collaboration of a minority during the civil war.

A KEY TO ETHNOLINGUISTIC GROUPS IN CHINA

The peoples of China are classified into five broad language groupings, listed below, and into more closely related language families, as indicated by color. (An exception are the Hui, distinguished from the Han not by language but by their Muslim religion.)

With five exceptions, names for the various peoples are given in Pinyin, the official Chinese system of transcribing Chinese symbols into the Roman alphabet. The exceptions are: Tibetan, Manchu, Korean, Kaoshan, and Russian.

Tinted areas on the map show the extent of language families (Tibeto-Burman, for example), while the location of specific peoples is shown in type.

Tinted circles denote the presence of a people but not their extent. All locations and population estimates are taken from the most current data compiled by the People's Republic of China.

SINO-TIBETAN
Sinitic
Han 900,000,000
Hui 6,490,000
Tai
Bouyei 1,720,000; Dai 760,000; Dong 1,110,000; Li 680,000; Maonan 31,000; Mulam 73,000; Primmi 22,000; Sui 230,000; Zhuang 12,090,000
Tibeto-Burman
Achang 18,000; Bai 1,050,000; Drung 4,100; Hani 960,000; Jingpo 83,000; Jino 10,000; Lahu 270,000; Lisu 470,000; Lhoba 300,000; Monba 40,000; Naxi 230,000; Nu 19,000; Qiang 85,000; Tibetan (Zang) 3,450,000; Tujia 770,000; Yi 4,850,000
Miao-Yao
Gelo 26,000; Miao 3,920,000; She 330,000; Yao 1,240,000

ALTAIC
Turkic
Kazak 800,000; Kirgiz 97,000; Salar 56,000; Tatar 2,900; Uygur 5,480,000; Uzbek 7,500; Yugur 8,800
Mongol
Bonan 6,800; Daur 78,000; Dongxiang 190,000; Mongol 2,660,000; Tu 120,000
Tungus-Manchu
Ewenki 13,000; Hezhen 800; Manchu (Man) 2,850,000; Oroqen 3,200; Xibe 44,000
Korean
Korean (Chaoxian) 1,680,000

MALAYO-POLYNESIAN
Kaoshan (Gaoshan) 300,000
AUSTROASIATIC
Mon-Khmer
Benglong 10,000; Blang 52,000; Va 260,000
Vietnamese
Gin 5,400
INDO-EUROPEAN
Iranian
Tajik 22,000
Slavic
Russian (Russ) 600
UNINHABITED

SCALE 1:7,150,000
1 CENTIMETER = 71.5 KILOMETERS OR 1 INCH = 113 MILES

characters--Tr.) ... Yülui (... Fishes), 38-72, 496, K'ohsüeh Ch'upanshe.

(3) Li Shihchen. 1596 (sic--Tr.). Pents'ao Kangmu, Vol. 44 ... (illegible characters--Tr.).

(4) Li Sizhong. 1966. "A New Subspecies of Fine-Scaled Tsinling Gui", Tungwu ... (illegible characters--Tr.): 92-94.

(5) Li Sizhong et al. 1979. Sinkiang Yüluichih. 8-14, 59- ... (illegible characters--Tr.) ... Min Ch'upanshe.

(6) Li Sizhong. 1981. Chungkuo Tanshui Yülui Fenpu Ch'ühua. 1- ... (illegible characters--Tr.) ... Ch'upanshe.

(7) Wu Yünfei and Ch'en Yüan. 1979. "Regional ... (illegible characters--Tr.) of the Kuolo and Yüshu in Ch'inghai Province", (illegible characters--Tr.) ...wu Fenlui Hsüehpao, 4 (3): 287-296.

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(10) Cheng Yungliang and Lin Meihua. 1964. "Initial Investigation of the Old River Course Submerged Under Liaotung Bay", ibid. (Collection of Summarizations), 61, K'ohsüeh Ch'upanshe.

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(14) Nelson, J. S. 1976. Fishes of the World. New York, London, Sydney, Toronto, John Wiley and Sons: 97-100.

Original Title: "Investigation of the Geographical Distribution of Salmonid Fishes in China": 1984, Tungwu Fenlui Hsüehpao, 3: 34-37.

Fishes without Japanese names were referred to by their scientific names. Tentative Japanese names were assigned as follows: i. e., Hucho taimen was referred to as "Amur Itou", H. ishikawai as "Korai Itou", H. bleekeri as "Choko Itou", Brachymystax lenok tsinlingensis as "Tsinling Kokuchimasu", and Oncorhynchus masou formosanus as "Taiwan Yamame".

Double parenthese indicate translator's notes (by the Chinese-Japanese translator Sato--Tr.).