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People's Republic of China  
*Fisheries Development in Qinghai Province*

## **A Management Plan for the Naked Carp Fishery of Qinghai Lake**

*A report to the Government of the People's Republic of China  
by the Food & Agriculture Organization of the United Nations  
acting as executing agency for the United Nations Development Program*

*Prepared by*

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UNITED NATIONS DEVELOPMENT PROGRAM  
FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, January 1993

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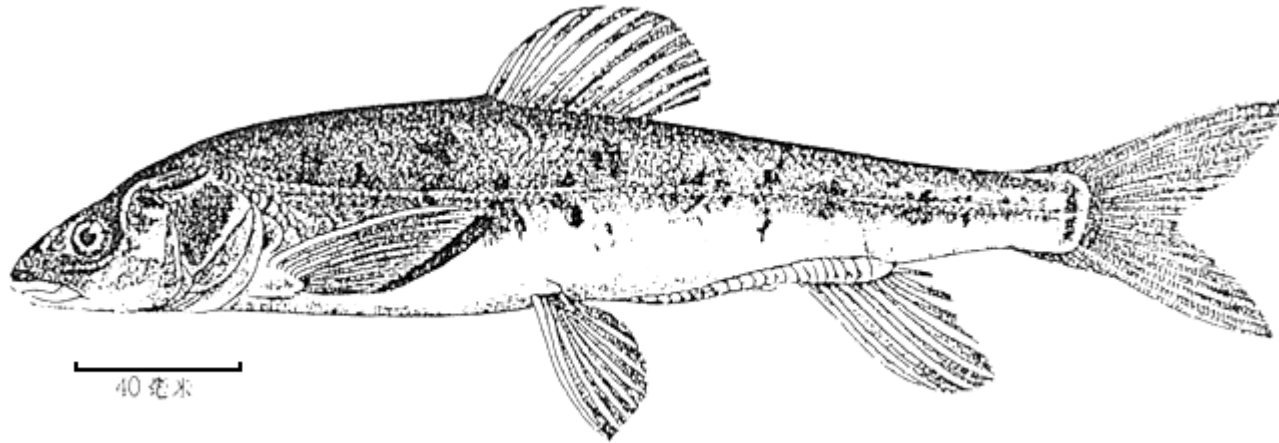
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**The naked carp, *Gymnocypris przewalskii* (Kessler)**

Scale 40 cm. After Li.

## EXECUTIVE SUMMARY

### ***Conclusions And Recommendations***

This investigation was undertaken to provide advice about management of the fishery resource of Qinghai Lake. It deals only incidentally with social, cultural and political factors, although these are vitally important in determining the best course for future development. Nor does it deal directly with fishery economics, other than to suggest ways to increase profitability through improved presentation and marketing.

#### **Rationalisation**

##### *Coordinating Authority*

Privatisation of the fishery now would be premature, although it may be the best long-term objective from the government's viewpoint. The fishery first needs to be placed on a more secure footing by rationalising its structure and operations, gathering more information about its status and performance and establishing better mechanisms for management. This review should be implemented by a government agency like the Bureau of Aquatic Products. Although the government may gradually relinquish control of some components (e.g. the Fish Factory), it should retain a supervisory role indefinitely. Some enhancement of the Bureau's resources of personnel and facilities would be necessary.

##### *Staffing*

The rationalisation should include provision for appointments of skilled personnel. Progress in this investigation has been hampered by a lack of continuity and expertise among members of the Lake Investigation Team. Most team members have had a short tenure before being transferred elsewhere, and most have had part-time commitments to unrelated work. Training programs have been rendered ineffectual because staff have not had an opportunity to develop and refine their skills, and the team has had little chance to develop a corporate spirit. Without expectations of continued employment morale suffers and there are few personal incentives for improved performance. Under these circumstances it is difficult for middle levels of management to delegate responsibilities, set timetables for completion of tasks and offer encouragement and guidance.

The managing authority should review its staff development policy to ensure that members have opportunities and incentives to acquire and refine specialised skills. The pool of expertise could be increased by recruiting staff from other parts of China, by sending staff elsewhere for training and by importing advisors for training courses.

##### *Monitoring*

In a fishery, as in any other business venture, management relies upon "performance" indicators to determine the status of the resource and its utilisation. Only sparse data have been available to support this investigation, and many deficiencies will be apparent in the report. Thus, one of the primary functions of an expanded authority should be to gather data about (a) the lake environment, (b) the fish population and (c) the fishery.

##### **(a) Lake Environment**

The most vulnerable parts of the environment are the feeder streams, especially the Buha and Shaliu rivers, which are vital spawning areas for the naked carp. These already show signs of degradation:

- The channels of the inflowing rivers, especially the Buha, are adjusting their gradients in response to the falling lake level. This is causing extensive bank erosion and siltation that must adversely affect the quality of spawning environments and the survival of eggs and juvenile fish.
- Weirs on several rivers (e.g. Haergai, Qianji, Shaliu) are impassable barriers for migrating fish, and have eliminated upstream spawning areas. Diversions of water for irrigation have severely depleted downstream flows during the spawning season. Irrigation will promote salinisation of local land and water resources.
- As the human population grows, and as agricultural and industrial activities increase, river water quality is likely to deteriorate. There are possible signs of nutrient enrichment in the Heima River, and the Shaliu (influenced by the town of Gangca) also is vulnerable to nutrient enrichment and other forms of pollution. Nutrient enrichment (eutrophication) of the lake would affect the composition and productivity of the benthos and plankton communities.

The falling lake level warrants concern, especially with regard to irrigation diversions, as the loss of extensive littoral areas has reduced feeding areas for the fish. There is no firm evidence for a corresponding rise in the salinity of the lake (section 3.3), but this requires monitoring because experiments suggest that a minor increase in salinity would be lethal for the juvenile fish (section 4.4). Increasing salinity would also affect the fish indirectly, by affecting their food resources.

Emphasis should be given to monitoring the main feeding areas for the fish, especially areas near the mouths of the principal rivers. The composition and dynamics of the plankton and benthos communities should be monitored because they are food resources for the fish, and because they are sensitive indicators of changes in the lake environment

#### (b) Fish Population

Present knowledge of the productivity of the fish population (as distinct from the yield of the fishery) is based on incomplete data, and should be regarded as an estimate subject to refinement and review. Continuing observations of the size and composition of the spawning stock and assessments of spawning success and recruitment are required.

#### (c) Fishery

Current estimates of the total yield of the fishery also are based on incomplete data. Records compiled by the Fish Factory are for purposes other than stock management, and are of unknown accuracy. The licensed gillnet fishermen are believed to take about 800 tonnes annually, but their activities are not closely supervised and the accuracy of the estimated catch is unknown. Unauthorised fishermen also account for an unknown quantity of fish, perhaps of the order of 1000 tonnes annually. It is not possible to say confidently whether the present yield of the fishery is within the limits of sustainability, determined by the production of the population.

The Bureau should compile statistics describing the quantities of fish and the composition of the catches taken by all partners, legal and otherwise. This task would be comparatively easy in regard to the Fish Factory, more difficult in the case of the licensed gillnet component, and very difficult in the case of the unauthorised fishermen. Nevertheless, the fishery cannot be managed effectively without better knowledge of

what may amount to more than 60% (800 plus 1000 tonnes) of the present estimated total yield.

Given better estimates of the catches taken by each component of the fishery, the Bureau will be able to impose regulations and quotas based on more information than is now available, and therefore more likely to promote maintenance of a sustainable yield.

Information gathered by the Bureau should be analysed and published in the form of regular (annual) reports.

#### *Policing Regulations and Quotas*

The inadequacy of enforcement of current regulations governing the fishery (Appendix IV) is shown by the magnitude of the unauthorised catch (1000 tonnes annually). Policing activities are constrained by the small numbers of officers around the lake, and some of the police may participate in unregulated fishing. If, as seems likely, it is impractical to deploy a larger contingent of police around the lake, a compromise would be to strengthen police resources in the vicinities of the main spawning areas, the Buha and Shaliu rivers.

Apart from enforcing catch limits and other regulations, the police could perform an valuable service by gathering data about spawning stocks and spawning environments.

#### *Protection of Spawning and Recruitment*

The most vulnerable features of the fish population, and hence the fishery, relate to processes implicated in spawning and recruitment. Specific, enforceable regulations need to be developed to address issues relating to the spawning population:

- Ideally, a moratorium should be enforced on fishing the spawning stock. This should be subject to periodic review, and might be eased at some future stage given more complete data about the composition of the stock and the impact of trawling. If a complete ban is impractical, strenuous efforts should be made to protect the spawners from excessive fishing pressure. These might include a larger size limit than applies elsewhere in the lake. It is noted that present restrictions on fishing in the Buha and Shaliu rivers are widely disregarded, reflecting inadequate enforcement.
- Weirs should not be permitted along the Buha River, and existing weirs on other rivers should be modified to provide passes for the migrating fish. These could take the form of artificial channels skirting the weir and regulated by stop-logs designed to retain the necessary water level in the impoundment. Fish ladders could be installed, subject to information about the ability of naked carp to navigate instream obstacles. Alternatively "portage" schemes might be developed, so that spawners are netted below the weirs and transported a short distance upstream. The potential value of such works should be assessed beforehand by determining the upstream extent of likely spawning habitat.
- Limits should be imposed on the quantities of water diverted from the rivers, to guarantee minimum flows consistent with successful spawning. River flows should be monitored above and below each offtake. Diversions from the Buha especially should be discouraged as this river contributes most of the inflow to the lake, and circulation within the lake is strongly influenced by the Buha current.

- Discharges of pollutants including sediment, nutrients and other domestic, agricultural or industrial wastes should be permitted only if they are consistent with successful spawning. Again, the Buha warrants special protection.
- Bank erosion and siltation should be limited, so far as possible, by bank stabilisation works in actively eroding areas.

### *Fishing Methods*

A key issue to be addressed by the managing authority is to decide what proportions of the catch should be taken by trawling as opposed to gillnets. The new trawler fleet introduced by the Fish Factory in 1989-90 has substantially increased the catch per unit effort relative to that obtained using lower-powered wooden trawlers. In 1990 the quota of 1200 tonnes was virtually filled in one month (April) within 20 km of the factory. The trawlers are capable of supporting a still greater increase in effort, and may be pressured to do so in order to recoup some of the money expended in upgrading the fleet and construction of accommodation and other facilities at the factory.

An increase in trawling effort cannot be supported, and the present operation cannot be allowed to continue without modification. The age composition of samples from the trawler catch in 1989-92 show that at least half of the catch, and sometimes a much larger portion, consists of immature fish (below 7 years of age). If this situation persists, recruitment and production will decline and the fishery must collapse. In general, gillnets provide better control over the minimum size limit, and should cause less damage to the fishery than the present trawling operation.

### **Fish Factory Operations**

#### *Status of the Factory Quota*

The quota of 1200 tonnes imposed on the factory trawler catch in 1987 should be maintained pending review. Future variations should depend upon the judgement of the Bureau. It is recognized that limiting the trawling effort in this way places the government in a difficult situation, given the degree of investment since 1989.

#### *Trawl Mesh Size*

The trawl mesh size should be increased to ensure that the age of first capture (the age at which fish enter the fishery, also the age at which they become reproductively mature) is not less than 7 years. A mesh size of 10 cm is proposed as an interim measure, subject to the results of further monitoring.

#### *Staffing*

Although an integral part of the fishery, the factory operation is distinctive in ways that relate to its methods of fishing, and its means of handling, processing and marketing the catch. The comments made earlier in relation to staffing the managing authority apply here, but the factory also needs to develop its own policies. For example, development of specialist staff would be necessary to support proposals to increase the market value of naked carp products.

#### *Monitoring*

The task of monitoring the trawler catch (e.g. quantities taken, areas fished, time and effort statistics, catch composition) should be undertaken by employees of the managing authority rather than the factory itself. This would help to ensure the accuracy and reliability of the information gathered, and promote consistent, comparative recording

methods across the fishery. The factory management apparently needs to be persuaded of the value of such records: although the trawler logs have been invaluable in the course of this investigation, their purpose is to support administration rather than stock management

### *Product Improvement*

#### (a) General

Naked carp is widely regarded as an unattractive table fish, and its market value is low. The poor image stems, in part, from deficiencies in preparation, presentation and marketing. It is likely that the market value could be significantly increased, and might conceivably approach that of common carp, greater by a factor of 5-10. The existing factory operation is, by any standard, an unsophisticated one, and a variety of cost-effective reforms could easily be implemented. If market values are increased, a variety of initiatives, including a naked carp hatchery, could become economically viable.

#### (b) Handling and Processing

Both handling and processing methods could be made more efficient and hygienic, and modified to avoid unnecessary damage to the fish. A range of measures is suggested, including improved cold-storage facilities on board the boats and after freezing, and in transit to market. Both areas require supervision by inspectors or foremen cognisant of the need to maintain high standards of efficiency and product quality.

#### (c) Marketing

Fresh naked carp command a higher price than the frozen product, and as a minimum the factory could increase profitability by marketing a greater proportion of its catch as fresh fish. This is presently possible only in April, because uninsulated transport is then possible, but the introduction of insulated vehicles, cooled by ice or refrigeration, could extend the marketing season for fresh fish throughout summer and autumn.

The frozen block product is unattractive to consumers. The fish are sometimes damaged by handling and freezer burn, and lose texture after thawing. The practice of keeping blocks in cold storage for long periods is suspect because temperature control is known to be inadequate. The practice of re-freezing blocks that thaw in transit must be discontinued because of the high risk of bacterial contamination. The lack of cleaning (gutting) would encourage deterioration, even in cold storage, and the retention of gonads is a problem for consumers unaware that these may cause digestive upsets. Consumers dislike the high bone content of naked carp, and although this is a lesser problem with larger fish, the composition of the catch is presently skewed towards young fish.

More innovative approaches could be developed to presentation and marketing. As a first step, a pilot-scale mincing plant could be established to experiment with consumer responses to new product options. Canning is another option. Both options would avoid the problems of boniness and deterioration in transport to remote markets. To develop such options, the factory should employ one or more post-harvest and marketing specialists as part of its permanent staff.

### *Prospects for Privatisation*

The factory is not yet a viable, profitable concern, but could be made so within perhaps 5-10 years. It could then be privatised, subject to government policy, although it should still remain under the supervision of the Bureau as a cooperating member of the lake fishery. The process of privatization should be gradual rather than rapid.



### *Licensed Gillnet Fishing*

A survey is needed to establish the extent of use of gillnets under license, and to obtain better estimates of the quantities of fish taken and the composition of the catch. The basis for the current annual catch estimate of 800 tonnes is unknown.

The minimum permissible gillnet mesh size at present is variously reported as 70-90 mm. The catch data should be compared against the minimum-age limit applied to the trawl fishery (properly 7 years) to determine whether this limit should be changed.

### **Unlicensed Fishing**

Even if it were possible to eliminate illegal fishing, this would need to be weighed against the consequences for local residents for whom it may be an important source of food and income. The primary objectives should be determine the size of the catch and to monitor this activity so far as possible. An enforceable catch limit is needed, in the interests of preserving the rights of other users.

### **Other Initiatives**

#### *Translocations of Naked Carp*

Naked carp from Qinghai Lake have been successfully translocated to Huangqi Lake, Inner Mongolia, as part of a fishery rehabilitation project, and a three-fold increase in growth rate has been reported. Similar results could be obtained in other areas, particularly in saline lakes at lower altitudes.

#### *Introduction of Exotic Species*

The introduction of rainbow trout, or other fishery species, to Qinghai Lake should be strongly discouraged in the interests of conserving the natural lake ecosystem. It is unlikely that the endemic naked carp population could withstand predation by trout, or competition from trout for spawning areas.

#### *Prospects for a Naked Carp Hatchery*

Another component of this project, described in a separate report, has established the technology for artificial propagation of naked carp and demonstrated the feasibility of using hatcheries to augment natural recruitment. Experiments with fingerlings have shown that considerably faster growth rates are attainable under conditions of pond culture. Hatchery development may not be economically justifiable at present, but it could become so if the market value of naked carp products is increased. Hatcheries would help to maintain recruitment to the lake population in the event that the spawning sites are further degraded and natural recruitment declines.

#### *Investigations of other Capture Fisheries in Qinghai*

Capture fisheries presently account for about 90% of fisheries production in Qinghai Province, and aquaculture for the remainder. There is potential for further development of capture fisheries, particularly for the established fisheries in Ngoring, Gyaring and Keluke lakes. A possible extension of the present investigation would be maintain work on Qinghai Lake, and to use this as a model for management of the three other lake fisheries.

#### *Links with Aquaculture Development*

The proposed extension of capture-fishery investigations would complement plans for development of rainbow trout farming, and would help to maintain a balanced, cohesive approach to development of the provincial fisheries. A joint venture to develop

aquaculture and capture fisheries would provide economies of scale, in that some facilities and staff could be shared resources. There would also be opportunities for environmental scientists to contribute to studies of the impact of aquaculture development and the selection of potential aquaculture sites, and to determine the potential for extensive aquaculture of naked carp. Numerous other cross-links could be developed, and so consolidate the interactions developed as part of the present investigation.

#### *Ecosystem Management*

It would be in the interests of all users of the lake's resources, including the fishery, if the lake environment were to be managed comprehensively, as an ecosystem. This would require investigations to determine the limits to exploitation by fisheries, irrigators, pastoralists and others, and to develop a management plan that is consistent with the need to sustain the ecosystem in the long term.

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