Bulletin On the Ecological and Environmental Monitoring Results of the Three Gorges Project 2004

State Environmental Protection Administration

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Content

Summary

2003 is a year with the significance of a milestone for the construction of the Three Gorges Project. In this year, the second stage of the project passed inspection and acceptance and realized the three major goals of water storage, navigation opening and power generation smoothly. The comprehensive efficiency played its primary role. The project has smoothly come to the third stage in which the construction, production and operation are made simultaneously.

In 2003, the social and economic development in the reservoir area was rapid with the regional Gross Domestic Production (GDP) increasing by 11.9% compared with the previous year. The industrial structure was optimized continuously. All sectors in the area saw sustained and rapid growth and people living in the reservoir area saw steady improvement in their living standards and normal condition of public health. Settlement of migrants, restructuring of relocated enterprises and protection of the environment all went on smoothly.

In 2003, the overall ecological situation of the Three Gorges reservoir area remained unchanged generally. The climate was relatively warm with relatively much precipitation. Serious flood or water logging disasters did not occur in wide area. Water quality of the reservoir area was good on the whole, all at or superior to Grade III. Before water storage at the second stage, the bottom of the reservoir was better well cleaned, so there was no obvious change of water quality in the period of storing water, mostly at Grade III. Environmental quality in the construction area was good on the whole. Fish fry runoff volumes of the “four major home fishes” (grass carp, black carp, silver carp and flathead) dropped at different degrees. In Yibin and Hejiang sections at the upper reaches of the Yangtze River, varieties of common fish and peculiar fish decreased a little compared with 2002. Along with the water storage up to 135 meters and continuous restructuring of agricultural industry, the area of cultivation and area under crops decreased by 9.0% and 6.6% respectively. Soil fertility of the farmland was at middle level and its heavy metal content was at the normal level.

In the key earthquake monitoring area and the head to middle part of the reservoir area, earthquake activities were mainly spreading in the belts of Wushan - Badong - Zigui, Yichang - Changyang in 2003 with frequency and intensity increasing a little.

In 2003, industrial wastewater discharged directly into the Yangtze River from 54 key industrial pollutant sources in the reservoir area amounted to 184 million tons, 27.8% over 2002. The major pollutants were COD and ammonia nitrogen. The urban wastewater directly discharged into the Yangtze River from 66 outlets amounted to 404 million tons, 26.6% over 2002. The major pollutants are total phosphorus, $BOD_5$and COD. Oil-containing wastewater discharged from vessels amounted to 421,200 tons, 17.6% lower than 2002, with treatment rate at 95%. Application amount of fertilizers in the reservoir area was in a dropping trend, but still not used with a rational ratio. The total application amount of pesticides decreased.

Chapter 1 Progress of the Three Gorges Project

In 2003, the Three Gorges Project realized the three major goals of water storage, navigation opening and power generation smoothly. The comprehensive efficiency played its primary role. The project has smoothly come to the third stage in which construction, production and operation are made simultaneously.

On April 16, the third stage of the RCC cofferdam that controls the whole period of construction reached the height of 140m, 45 days ahead of the schedule. In late May, the State Inspection and Acceptance Commission of the Three Gorges Project held meeting and the second stage of the project passed acceptance smoothly. On June 1, the reservoir started to store water. The water level reached 135m by June 10. The two-way 5-stage lock was tested for navigation successfully on June 18 and the traffic was officially opened to social vessels. The first batch of hydrogenerator units on the left bank was put into operation in July and 6 sets of the units were officially combined to the grid by the end of 2003. In order to have the project play the role of its comprehensive efficiency even better, the water level of the reservoir was lifted to the height of 139m starting from November 5 as approved by the State Commission of the Three Gorges Project Construction.

In 2003, the engineering work completed in the Three Gorges Project was: digging of 3.4217 million m^3 of earth and stones, filling and construction of 7.2549 million m^3 of earth and stones, concrete pouring of 2.2458 million m^3, 20,831 tons of metal structure and electronic machine buried and installed, 1,032.9 tons of generator sets buried, 20,701 tons of generator sets installed, 4,166 m^3 of bitumen concrete wall, 115,201m of fixing grouting, 14,035.6m of curtain grouting and 23,437m^2 of joint grouting.

As shown by the monitoring data of safety indexes gathered after the water storage period in the second stage of the Project, all the constructions are in good status and working performance. All the indexes are kept within the designed allowable level. In 2003, the Three Gorges Power Plant generated 8.6 billion kW/h, over the planned amount for the whole year. By the end of 2003, the two-way lock had completed 4,386 times of on-loading safe passage of 34,880 t/v carrying 1.08 million t/p and 13.76 million tons of cargoes. The navigation through the dam area was safe, smooth and orderly.

In the period of navigation interruption, transshipment over the dam realized the target of “safe, smooth and orderly” pointed out by the State Council. No serious injury and fatal accidents had happened. As accumulated in the whole year, 1,203,136 t/p of passengers, 117,180 rolling vehicles, 9,410 standard containers, 6,820 commodity vehicles and 11,690 tons of other goods were transshipped over the dam.

Chapter 2 Economic and Social Development

2.1 Population, Society and Economy

By the end of 2003, the total population in the Three Gorges reservoir area was 19.8517 million, with an increase of 0.7% compared with that by the end of the previous year, among which the agricultural population was 14.1438 million and the non-agricultural population was 5.7079 million. Non-agricultural population accounted for 28.8% of the total population, with 1.1 percentage points higher than 2002.

In 2003, the local GDP of the reservoir area was 161.057 billion yuan, 11.9% over 2002 based on comparable prices. The local GDP of reservoir areas under the jurisdiction of Chongqing and Hubei was 146.359 billion Yuan and 14.698 billion Yuan, 12.5% and 5.8% over 2002 respectively. The increased value of the primary industry of the reservoir area was 20.589 billion yuan, 4.7% over 2002. The increased value of the secondary industry was 78.028 billion yuan, 13.8% over 2002. And the increased value of the tertiary industry was 62.440 billion yuan, 11.9% over 2002. The industrial structure was further optimized and ratio of increased value of the primary, secondary and tertiary industries in local GDP was adjusted from 13.5:47.0:39.5 to 12.8:48.4:38.8.

Table 2-1 Major Statistical Indicators of Economic and Social Development of the Reservoir Area in 2003

Indicator	Indicator Value	Increase over 2002 (%)
Total grain output (ten thousand tons)	635. 81	-3. 0
Oil plants output (ten thousand tons)	21. 27	11. 9
Tobacco output (ten thousand tons)	4. 17	-5. 4
Total meat output (ten thousand tons)	111. 73	3. 7
Aquatic product output (ten thousand tons)	13. 38	4. 5
Increased value of TVEs (100 million yuan)	345. 29	30. 5
Financial income of local budget (100 million yuan)	71. 76	12. 3
Fixed assets investment of the wholesociety (100 million yuan)	966. 61	25. 3
Total retail value of social consumer goods (100 million yuan)	671. 11	13. 5
Per capita dispensable income of urban residents (yuan)	7768	10. 2
Per capita dispensable income of urban residents (yuan)	2142	6. 7
Savings of urban and rural residents (100 million yuan)	1412. 21	16. 8

Economy of different sectors in the reservoir area continued to develop rapidly in 2003. The increased value in industry was 55.248 billion yuan, 14.8% over 2002 based on comparable prices; the increased value in construction sector was 22.780 billion yuan, 11.3% over 2002. Freight transportation of the whole society was 293.04 million tons, 5.3% over 2002; transportation of passengers was 524.11 million people-times with an increase of 0.9%; and post and telecommunication hit 6,669.35 million yuan in business with an increase of 24.1%.

In 2003, the financial budgetary expenses on education and public health in the reservoir area

were 2.385 billion yuan and 606 million yuan, 9.9% and 14.1% over 2002 respectively. By the end of the year, there were 482,900 technicians in the reservoir area, 0.2% under those by the end of 2002. For every ten thousand primary and middle school students, there were 486 full-time teachers, 9 people less than those at the end of 2002. Broadcast coverage rate was 95.3%, 0.1 percentage point over the previous year and TV coverage rate was 96.7%, keeping the level of the previous year.

2.2 Migration Settlement

In 2003, migration settlement went on smoothly. The total number of people removed and resettled was 153,031; the efficient reconstruction area of various types of buildings was 2.5166 million m^2, and the number of industrial and mineral enterprises removed was 133.

● Countryside

The number of resettled rural migrants was 22,587 and the number of rural migrants redeployed in production activities was 28,140. New constructions included 179 ponds, 101 aqueducts, and 81 countryside roads of 241.49 km in total. Houses built covered 476,800 m^2, including 475,000m^2 for migrants. Migrants removed out of the Three Gorges reservoir area contracted land of 1.3932 million m^2, built houses of 71,900m^2 and roads of 359.08km, and constructed 18,000m of domestic water supply pipelines and 103,400m of electricity transmission lines.

● Cities

In the urban, 80,326 residents were removed. 1.3735 million m^2 of land was flattened; 37 new roads with a total length of 43,580m were constructed; 141,000m of electricity distribution and transmission lines and 29,000m of broadcasting and TV lines were laid, and 1.564 million m^2 of buildings were constructed with 1.0671 million m^2 for resident housing.

● Towns

In towns, 21,978 people were removed and 475,800m^2 of buildings were constructed with 275,800m^2 for resident housing.

● Industrial and mineral enterprises

133 industrial and mineral enterprises were removed and reconstructed.

● Special facilities

12 roads totaled 125.76km and 2,125.3m of large and medium-sized bridges were reconstructed. 27 docks, 19 water power stations and 12 water-pumping stations were constructed. 142,800m of electricity transmission and distribution lines, 157,500m of communication lines and 380,000m of broadcasting and TV lines were laid. 4 post offices and 3 broadcasting and TV relay stations were constructed.

● Environmental protection

A total of 13.5913 million yuan was invested in migration and environmental protection in the migrant settlement area.

● Cleaning of the reservoir bottom

For the security of water quality in the Three Gorges reservoir area, cleaning of the reservoir bottom was started in 2003 before water storage. The cleaning work covered 12 districts and counties to be submerged under the water level of 135m, including Yiling District, Zigui County, Xingshan County and Badong Country of Hubei Province and Wushan Country, Fengjie County, Yunyang County, Wanzhou Prefecture, Zhongxian County, Shizhu County, Fengdu County and Fuling District of Chongqing Municipality.

119,641 common pollutant sources, 1,528 infectious pollutant sources and 38,803 tombs were cleaned up. In key regions, the area of deratization amounted to 160.161million m^2. As shown by the result of located monitoring, the rat density was under 1%, meeting the criteria on cleaning up. 2.38 million tons of domestic garbage at 314 spots, 2.42 million tons of common industrial solid waste at 217 spots and 16,300 tons of hazardous waste at 141 spots were cleared up. All the 19 waste radioactive pollutant sources (including 3 in Wanzhou Prefecture under the 135m water level) were treated safely. Except the Signal Stations for the Yangtze River navigation and a few telecommunication lines and poles and bridges, those to be dismantled later as approved, cleaning of buildings of 14.9605 million m^2 in total had been completed. 83,300 mu of wood patches and more than 2.9 million dotted trees were cleared up. The replantable big trees and ancient trees were replanted.

Under the field guidance of China National Center for Disease Control and Prevention, 6 tombs and 3 livestock buried spots infected by anthrax, 3 buried spots of suspected anthrax infected dead human bodies and 7 suspected anthrax infected tombs left in Fengjie County during the Anti-Japanese War were completely cleared up strictly according to the clearing up criteria and relative provisions. Through sampling test of Chongqing Municipal Center for Disease Control and Prevention, The clearing works were all up to the standard.

● Twinning support

2003 is a year in which the amount of capital input for twinning support reached the top in ten years and also a year in which the capital for economic cooperation projects took the largest share. Twinning support of 3.025 billion yuan was input to the Three Gorges reservoir area (including 2.870 billion yuan for economic cooperation projects and 155 million yuan for public welfare projects). 139 new economic cooperation projects were introduced; 35 Hope schools were constructed; 420 person-times of various kinds of persons were trained; 4 person-times of cadres were exchanged. 420 visiting delegations with 2772 people to the reservoir area were accepted.

By the end of 2003, twinning support put to the three Gorges reservoir area had amounted to 16.095 billion yuan, including 14.222 billion yuan for economic cooperation projects and 1.873 billion yuan for public welfare projects. The number of economic cooperation projects had exceeded 2500. 761 Hope schools had been constructed. 2,981 person-times of employment and 5,797 person-times of training for different kinds of talents had been provided to the migrants. 409 person-times of cadre exchange had been arranged.

Chapter 3 State of the Natural Ecological Environment

3.1 Climate

In 2003, climate in the Three Gorges reservoir area was continuously relatively warm with rainfall a little more. The temperature in the middle and west part of the reservoir area was obviously higher than previous years and the east part kept the level of normal years. The climate was relatively warm in all the four seasons, especially in winter. Rainfall was relatively much in winter and spring, and less in summer and autumn. In regional distribution of rainfall, the west part is relatively less and the middle and east part relatively much. There were no large area heavy disasters in flood season. Foggy days of the reservoir area were mainly concentrated in autumn and winter. The average foggy days were less than normal years. The average wind speed in the Three Gorges reservoir area was lower than normal years. In all stations, change of average wind speed was not much.

Table 3-1 Monitoring Results of Meteorological Elements in Meteorological Stations in the Three Gorges Reservoir Area in 2003

Name of station	Average Temperature (℃)	Comparative Humidity (%)	Rainfall (mm)	Evaporation (mm)	Average Wind Speed (m/s)	Sunshine Hours (h)	Foggy Days (d)	Thunder Storm Days (d)
Chongqing	18.9	80	1033.2	563.4	1.7	878.5	25	27
Changshou	18.0	81	1078.6	1140.7	1.4	1128.0	40	28
Fuling	18.7	79	1168.1	706.9	0.3	1144.4	79	31
Wanzhou	18.7	80	1461.2	627.4	0.6	1272.5	19	33
Fengjie	18.1	74	1366.0	718.9	1.5	1356.4	5	23
Wushan	18.5	73	1179.5	1085.1	1.0	1358.3	5	30
Badong	17.1	73	1113.5	1463.0	1.8	1239.8	69	41
Zigui	17.9	78	1014.8	1306.6	0.8	1429.2	0	26
Bahekou	16.6	81	1220.7	1135.3	1.5	1025.8	0	29
Yichan	16.8	79	1240.6	1219.7	1.3	1078.7	19	32

The average rainfall in the reservoir area was 1184mm, nearly 10 percent points more than normal years. Its regional distribution features were: relatively less in the west part and normal or relatively much in the mid east part. The most rainfall was found in Wanzhou, reaching up to 1,461.2mm; the rainfall in Zigui was the least, just 1,014.8mm. Compared with normal years, the rainfall was 20 percent points more in Wanzhou and Fengjie of the middle part and 10 percent points less in Chongqing and Changshou of the west part. In time distribution, the average rainfall of the reservoir area was relatively much in winter of 2002/2003 and spring of 2003, and relatively less in summer and autumn.

The rainfall distribution took a feature of single peak. The peak was in July with average rainfall reaching 218.8mm, 25 percent points more than the same period of normal years. The

average rainfall in autumn in the reservoir area was 20 percent points less than normal years. The spatial distribution was uneven in different stations and seasons, with drought occurring in winter and summer and low temperature and unbroken overcast rainy days found in spring and autumn in some areas.

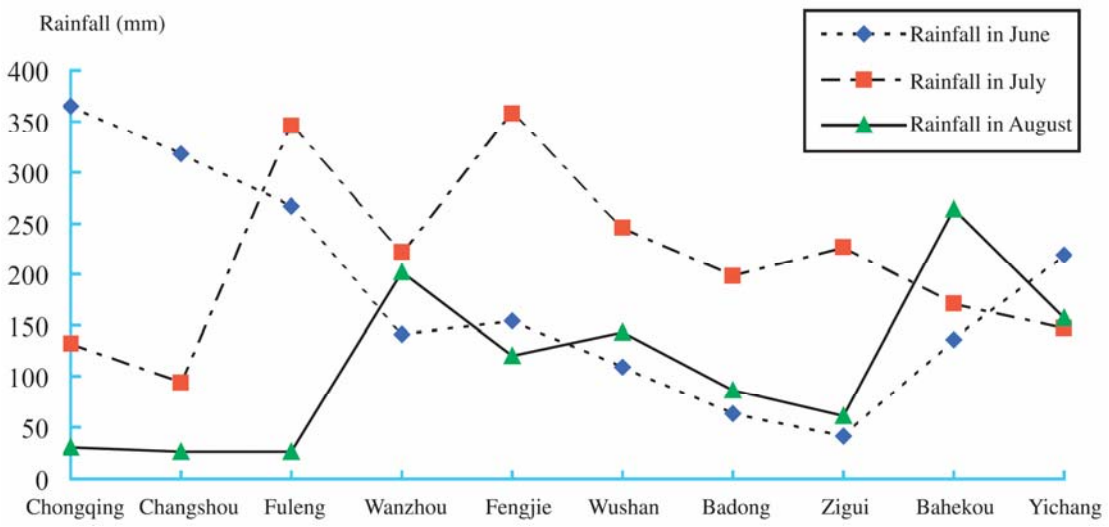


Figure 3-1 Rainfall Distribution Curve in June, July and August 2003 in the Three Gorges Reservoir Area

In 2003, the average temperature in the Three Gorges reservoir area was 18.1℃ 0.6℃higher than normal years and 0.2℃ higher than 2002. The change of temperature was within the actual range of normal years. As shown by the results of statistics and analysis of the temperature anomaly changes from June to November of successive years in the reservoir area and the temperature climate background area (Hubei, Sichuan and Chongqing), the trend of temperature change in the reservoir area was quite consistent with that of the background area. Water storage exerted no obvious influence to the change of temperature of the reservoir area. The spatial distribution feature of temperature in 2003 was: normal or 0.1-0.2℃ lower in the east part; 0.3-0.7℃ higher in the middle and west parts. The temperature of Fengjie was 1.9℃ higher than normal, the most obvious change. In time distribution, the temperature was relatively higher in all the four seasons. The average temperature of the reservoir area was 0.2-0.4℃ higher than the same period of the normal years in each season. The change to warm was the most obvious in winter, up to 1.1℃ higher than normal on average.

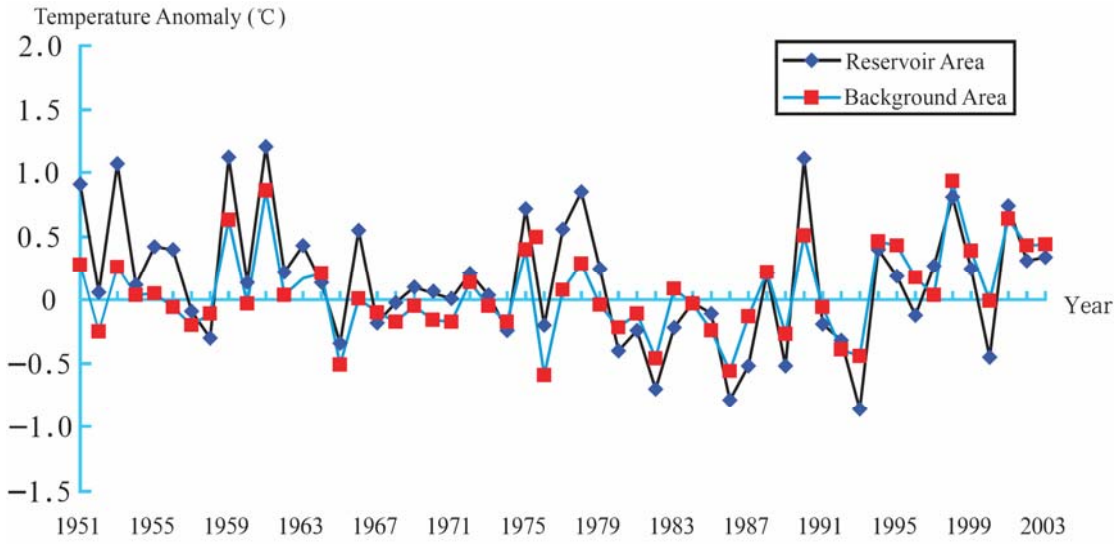


Figure 3-2 Changes for Years of Temperature Anomaly from June to November in the Three Gorges Reservoir Area and Its Background Area

In 2003, the average wind speed in the Three Gorges reservoir area was 1.1 m/s, 0.2 m/s lower than normal years. In all stations, seasonal changes and monthly changes of average wind speed were not much.

Average foggy days in the Three Gorges reservoir area numbered 29 days, 9 days less than normal years. The spatial and temporal distribution features were: foggy days in the west part were more than those in the east part; and in autumn and winter over those in spring and summer. Foggy days in most part of the reservoir area were obviously less than normal years. Except in Fuling, foggy days in the area west of Wushan were just equal to or less than half of those in normal years. As part with the least foggy days in the reservoir area, Zigui and Bahekou had not seen a single foggy day in two successive years. There was no obvious change in number of foggy days after the reservoir starting to store water.

The average comparative humidity in the Three Gorges reservoir area was 77%, close to that of normal years. The average comparative humidity at each station was 73-81%. Compared with normal years, the humidity was 6-7% higher in Wushan and Zigui but normal in other stations. The average evaporation in the Three Gorges reservoir area was 981mm, over 20% less than that of normal years. The regional distribution feature was going down from the east to the west.

In 2003, major meteorological disasters in the Three Gorges reservoir area were heavy fog in winter, periodical low temperature and continuous rain in spring and autumn, drought in spring, high temperature and drought in summer, and geological disasters like flood, waterlogging and landslide caused by strong convective weather like rainstorm, strong wind and hails.

In the spring and autumn, some places in the Three Gorges reservoir area once occurred low temperature and continuous rain, exerting impact on the plants to be harvested in summer and the spring plantation activities and worsening the crop pests and diseases. In mid May, the whole area of Chongqing suffered 5-7 continuous rainy days, causing production losses or no harvest in some

places.

In the spring and summer, drought occurred in the Three Gorges reservoir area, exerting bad impact on the growth of crops and the life of local people. Among others, west part of the reservoir area suffered continuous drought from winter to spring. The drought situation in some counties and cities under the jurisdiction of Chongqing Municipality was serious, causing heavy losses of the crops sown in spring, spring silkworm and vegetables because short of water and difficulty in drinking water supply for hundreds of thousand people and big livestock. Some water consuming enterprises had to stop production. From late of July to middle of August, continuous high temperature and drought occurred in most part of the reservoir area. Such weather even continued to late of August in several places. Among others, in Fengdu, Fengjie, Wanzhou, Shizhu, Rongxian, Yongchuan and Shapingba etc. under the jurisdiction of Chongqing Muncipality, the direct economic losses caused by drought exceeded 160 million yuan.

In spring, summer and autumn, strong convection weather occurred frequently in some places of the Three Gorges reservoir area, causing a number of meteorological disasters induced by rainstorm, heavy wind and hail. From March to May, the reservoir area saw at least 4-6 times of strong convection weather. Heavy rainstorm, strong wind and hail damaged houses and crops and blocked communications, causing heavy economic losses. Among others, Chadianzi and Lucongpo saw a heavy hail thick up to 2 inches from March 31 to April 1. The heavy rainstorm caused mountain torrents and landslide. From April 16 to May, Wushan County, Jiangbei District, Liangping County and Wanzhou District of Chongqing Municipality were struck one after another by rainstorm, thunderstorm and hail, which caused geological disasters including landslide and mud-rock flow etc.

3.2 Terrestrial Plants

As shown by the results of summary analysis of plant species in the Three Gorges reservoir area made in 2003, there were 6,088 species of tracheophyta including more than 1,100 classes under species (subspecies, varieties and deformities), respectively belonging to 208 families and 1,428 genus, accounting for about 20% of the national total, among which the species of seed plants account for 22% of the national total. No new plant species was discovered. According to preliminary analysis, forest vegetation in the Three Gorges reservoir area could be classified into 15 community groups and 76 communities; the shrub vegetation can be classified into 5 community groups and 16 communities.

As shown by the results of tracking monitoring of the ancient trees in the Three Gorges reservoir area, the overall status was basically stable. There were 4,394 ancient trees older than 100 years belonging to 135 species in the reservoir area.

3.3 Terrestrial Animals

There are 561 species of terrestrial spinal animals in the Three Gorges reservoir area respectively belonging to 4 classes, 29 orders, 83 families and 285 genus.

As shown by the result of waterfowl monitoring investigation in the winter, great change had

occurred in distribution, species and quantity of overwintering waterfowls in the area affected by the 139m water level (the main navigation channel of the Yangtze River and some tributaries) after the second stage of water storage of the Three Gorges Project construction. The most obvious change occurred in the main navigation channel of the Yangtze River. In the section affected by the water level (from Zhongxian County to Maoping, Zigui) the quantity of waterfowls dropped sharply with the eye-caught quantity less than 10% of that before water storage. There was also change in species. Among natatories, only a few species could be seen, including mallard, anas poecilorhyncha, mandarin duck and cotton teal etc., most of which occasionally appeared at the estuaries of the tributaries and near town ports. The Tadorna ferruginea and Mergus merganser etc. that used to be seen had disappeared. A new species of natatores as newly recorded bird in the Three Gorges reservoir area - Melanitta fusca appeared in the river section from Maoping, Zigui to Xiangxi estuary. In the channel area of 4 tributaries of the Yangtze River investigated, species and quantity of waterfowls had increased rather obviously, but just limited to a few species including grebe (a kind of waterfowl catching little fish in relatively deep water).

The Daning River in Wushan Country is one of the main habitats of mandarin ducks, which belong to the second-class national protected animals. According to the result of the monitoring investigation, quantity of mandarin ducks had no obvious change in Daning River area.

3.4 Fishery Resources and Environment

3.4.1 Fishery resources

In 2003, the natural fishing catch in the Three Gorges reservoir area, the section down the dam, Dongting Lake, Poyang Lake and the estuary area was 69,705 tons, 11% less than that of 2002. In Yunyang section, Jianli section and Wuxue section of the reservoir area, the fry run-off amount of the four major home fishes dropped at different levels; tapertail anchovy and Chinese turtle crab rose to some extent; and output of eel rose by a big margin.

Reservoir area: in 2003, the natural fishing catch in the Three Gorges reservoir area was 2,973 tons, a little less than that of 2002. The composition of the catch was 614 tons of largenmouth bronze gudgeon, 581 tons of bronze gudgeon, 323 tons of common carp, 274 tons of river *Parasilutus asotus*, 274 tons of *Pseudobagrus*, 153 tons of *Leiocassis longirostris*, 146 tons of grass carp and 90 tons of silver carp.

Monitoring of fishing catch showed that six species of fishes including bronze gudgeon, largemouth bronze gudgeon, common carp, river *Parasilutus asotus*, *Pseudobagrus* and *Leiocassis longirostris* accounted for 72% of the total catch, less than the percentage of 2002, but remaining the major economic fishes in the reservoir area.

Section down the dam: in 2003, the natural fishing catch in the section down the dam was 2,450 tons, a little less than that of 2002. The composition of the catch was 1,078 tons of bronze gudgeon, 353 tons of river *Parasilutus asotus*, 200 tons of *Pseudobagrus*, 217 tons of common carp and 135 tons of the “four major home fishes”.

Monitoring of fishing catch showed that bronze gudgeon, river *Parasilutus asotus* and common carp accounted for 67% of the total, being the main economic fishes in section down the dam.

Biological composition of the catch showed that river *Parasilutus asotus*, *Leiocassis longirostris* and bronze gudgeon caught were small and young.

Spawning sites of the "Four Major Home fishes": fry run-off amount of the "four major home fishes" in Yunyang section of the reservoir area, Jianli section down the dam and Wuxue section were monitored synchronously in June 2003. The results showed that at the same time of realizing the three major targets of storing water, opening navigation and generating power, spawning and breeding of the "four major home fishes" were also affected negatively. The fry run-off amount of all the "four major home fishes" dropped at different degrees.

In may and June 2003, the fry run-off amount of the "four major home fishes" in Jianli section was 406 million tails, 21.3% of 2002; that in Yunyang section was 290 million tails, 81.5% of 2002; and that in Wuxue section was 525 million tails, 23.6% of 2002.

Dongting Lake: in 2003, the total catch of the entire lake was 29,516 tons, 9.4% lower than that of 2002. There were 45 spawning sites of common carp and crucian carp, covering an area of 290.8 km^2. There were 196,000 tails of spawning common carp, weighting at 353 tons and their spawn amount at 5.331 billion, 8.8%, 9.0% and 11.5% less than 2002 respectively. There were 271,000 tails of spawning crucian carp, weighting at 101 tons and their spawn amount at 3.829 billion, 9.1%, 9.8% and 2.7% less than the previous year respectively.

There were 34 feeding sites, covering an area of 751 km^2. Among them, 13 were in east Dongting Lake, covering 449 km^2; 16 were in south Dongting Lake, covering 119 km^2 and 5 were in west Dongting Lake, covering 183 km^2. Main fishes in the feeding sites were common carp, silver carp, fathead, snail carp, grass carp, river *Siniperca chuatsi* and *Parasilurus asotus* and the amount of the feeding community was 6.624 billion tails.

Poyang Lake: the natural fishing catch of the entire lake in 2003 totaled 33,500 tons. There were 33 spawning sites, covering an area of 433 km^2. The spawn amount was 4.897 billion.

The area of feeding sites in the lake area was 460 km^2, 140 km^2 less than 2002. The feeding sites were mainly distributed in the middle part and the south part of the lake area. Main fishes in the feeding sites were common carp, crucian carp, snail carp, grass carp, silver carp, fathead, Siniperca chuatsi and river *Parasilurus asotus* etc.

Estuary area: in 2003, biological indicators of tapertail anchovy on length and weight all had no much difference. The total average output of individual ship in the entire flood season was 34.1% higher than that of 2002 and the total average value of individual ship in the entire flood season was 11.6% lower than that of 2002. The total catch was 1,256.88 tons, much higher than that of 2002.

Biological indicators of parent crabs were obviously higher than 2002. Average weight was 168.2g; average shell length and width were 62.87mm and 70.32mm respectively.

In 2003, 1,487 of eel catching licenses were issued in flood season, a little more than 2002 (1,340). The total output was 8,896.59 kg, much higher than that of 2002. Average indicators of individual ship were also higher than normal years.

3.4.2 Fishery environment

In 2003, seven monitoring stations (Yibin Station, Banan Station, Wanzhou Station, Jingzhou Station, Yueyang Station, Lake Outlet Station and Estuary Station) were set up in the mainstream of the Yangtze River, Dongting Lake and the estuary area to monitor the water quality of key fishery water bodies in the Yangtze River basin, and to make water quality evaluation based on the Fishery Water Quality Standard (GB11607-89) and watershed functional grade evaluation of the items prescribed in the Standard according to the Water Quality Standard for Surface Water Environment (GB3838-2002). The results showed that water quality of the key fishery water bodies in the Yangtze River basin was sound on the whole, which generally could meet the growing and breeding requirements of fishes. But parts of the water bodies were polluted to some extent. The major pollutants were oil, volatile phenol, non-ion ammonia and total phosphorous.

The major pollutants in the three important fishery water bodies of Yibin, Banan and Wanzhou in the upper reaches of the Yangtze River were copper, oil, volatile phenol and total phosphorous. Among them, the main pollutant in Yibin was copper, 100% over the standard; the main pollutants in Banan were total phosphorous, oil and volatile phenol; and the main pollutant in Wanzhou was total phosphorous.

The major pollutants in the three important fishery water bodies of Jingzhou, Yueyang and the Lake Outlet in the middle reaches of the Yangtze River were non-ion ammonia, oil, copper and total phosphorous. Compared with 2002, the pollution degree of copper and non-ion ammonia in Jingzhou fishery water body was decreased. In Yueyang fishery water body, only non-ion ammonia exceeded the standard in rearing period; pollution of copper was a little lightened and the pollution of total phosphorous still existed. The monitoring values of copper and zinc in the Lake Outlet fishery water body exceeded the standards of fishery water quality.

Results of water quality monitoring on the spawning sites of the Four Major Home fishes in the section from Yichang to Chenglingji of the Yangtze River in May and June of 2003 indicated that: the major pollutants affecting the water quality were oil and non-ion ammonia. In part of the water bodies in Zhicheng and Jianli Sanzhou, non-ion ammonia exceeded the standard at a rate of 33.3%. Oil pollution in Jianli Sanzhou exceeded the limit to Grade III of surface water environmental quality with exceeding rate at 100%. Compared with the situation in 2002, pollution of copper, zinc and lead was a little lightened.

Results of water quality monitoring on Yichang spawning sites of Chinese sturgeon (Acipenser sinensis) in September and October of 2003 indicated that: water body pollution of non-ion ammonia in the core of Chinese sturgeon spawning site between Dajiang Power Plant and Miaozui exceeded the standard at a rate of 5.9%. Oil pollution was at same level of 2002. Pollution degree of copper, cadmium and mercury reduced a little. The monitored value of dissolved oxygen was obviously higher than the same period of 2002.

Water quality in the fishery water bodies of Dongting Lake was improved as a whole compared with the situation of 2002. The major pollutants were copper, total nitrogen and total phosphorous. Copper exceeded the water quality standards in rearing period and the exceeding rates in breeding period and overwintering period were 37.5% and 28.6% respectively. Both total nitrogen and total phosphorous exceeded the limit to Grade III of surface water environmental quality standard at

deferent degrees in the three functional periods.

In estuary area of the Yangtze River, volatile phenol and total phosphorous all exceeded the limit value of Grade Ⅱ surface water environmental quality standard in eel season, tapertail anchovy season and winter crab season. Compared with the situation of 2002, pollution degrees of oil, mercury and copper dropped a little.

3.5 Peculiar Fishes and Rare Aquatic Animals

3.5.1 Peculiar fishes in the upper reaches of the Yangtze River

In 2003, 63 species (sub-species) of fishes in total were collected in Yibin section and Hejiang section in the upper reaches of the Yangtze River, 26 species less than 2002. Among them, 36 species were collected in Yibin section and 55 species in Hejiang section, 7 and 23 species less than 2002 respectively.

14 species of peculiar fishes were collected in Yibin section and Hejiang section of the Yangtze River, accounting for 32.6% of all the peculiar fishes affected by the Three Gorges Project. Among them, 7 species were collected in Yibin section and 13 species were collected in Hejiang section. Compared with the situation of 2002, 10 species of peculiar fishes decreased in the two sections. Among them, 6 species decreased in Yibin section, including *Paracobitis potanini, Botia reevesae, Rhinogobio cylindricus, Gobiobotia nudicorpa, Schizothora chongi and Liobagrus marginatoides.* 1 species *Platysmacheilus nudirentris* increased in this section. 7 species decreased in Hejiang section, including *Paracobitis potanini, Platysmacheilus nudiventris, Abbotina obtusirostris, Gobiobotia nudicorpa, Schizothora chongi, Liobagrus marginatoides and Sinogastromyzon sichangensis.*

3.5.2 Rare fishes

As observed in the breeding process of Chinese sturgeon spawn got from the intestine of bottom layer fishes, Chinese sturgeon spawned only one time in the autumn of 2003, which was approximately from midnight of November 5 to early morning of November 6, just in a short period and a small scale. The spawning site was located between the area of the Three Gorges dam's flood discharge gate and Zhenchuanmen section of the Yangtze River. The concentrated spawning site was located in the 3 km river section from the flood discharge gate area to Yichang Shipyard and then to the river center and the deep slot section to the left bank near material dock on the upper reaches of Miaozui.

Spawn-eating fishes had been eating spawn of Chinese sturgeon till November 11. These spawn-eating fishes included largemouth bronze gudgeon, bronze gudgeon, *Pseudobagrus vachelli, Rhinogobio ventralis Sauvage, Rhinogobio cylindricus, Leptobotia elongata, Leiocassis crassilabris, Gobiobotia filifer and Leiocassis longirostris.* Among them, *Pseudobagrus vachelli* had the highest capacity for eating spawn. The individual capacity was 1-191 grains and the average 61.7 grains. The next was bronze gudgeon, with individual capacity of 1-89 grains and the average 18.6 grains. The following was *Rhinogobio ventralis Sauvage*, with individual capacity of 8-25 grains and average 16 grains.

In 2003, one tail of *Psephurus gladius* and one tail of *Myxocyprinus asiaticus* were mistakenly

caught within the area of Yibin City. The *Psephurus gladius*, a female, was 352cm long and weighted 150 kg. Since it was wounded, experts rescued it in Yibin and released it to the Yangtze River after installing an electronic tracing equipment on it. On January 30, 2003, it disappeared. The *Myxocyprinus asiaticus* was about 140 cm in length and weighted 35 kg. It failed to respond to save and medical treatment and was then made as a specimen.

In 2003, mistake catch of the rare fishes - *Acipenser dabryanus* and *Psephurus gladius* did not happen in the section from Shangzhongba in Jiaotan Village in Hejiang to Tongqianwan in Wanglong Village (about 60km) in the upper reaches of the Yangtze River. In mid April, one tail of *Myxocyprinus asiaticus* with 95cm long was mistakenly caught. After several days, it died because it was wounded too seriously. Then it was made as specimen.

In 2003, No activity of *Psephurus gladius* was observed in Yichang section in the middle reaches of the Yangtze River. According to the report, on December 11, 2002, one tail of female *Psephurus gladius* was mistakenly caught. It was about 15-25 years old, 330cm long and weighted at 117kg. It failed to respond to the emergency treatment and died. Postmortem examination showed that this *Psephurus gladius* had spawned one time. There were still about 1 million grains of spawn left in the abdominal cavity. This had been the first time to find such kind of fish in the Yangtze River section under Gezhou Dam since 1995.

3.6 Agricultural Ecology

3.6.1 Ecological environment of agriculture fields

In 2003, survey was conducted on 181 towns and villages in 19 counties in the reservoir area with the same survey base as 2002. Investigation results showed that along with the water storage reaching up to 139m and the agricultural restructuring, agricultural planting and sowing fields dropped greatly in the area. Backup wasteland suitable for agriculture was not much and reversion of slope farmland was sped up. Re-cropping index of farmland was high and agricultural production still concentrated on grain crop cultivation, but the percentage of economic crops was increasing year by year. Soil fertility of agricultural fields in the reservoir area was at middle level and its heavy metal content was normal.

In 2003, agricultural acreage in the reservoir area was 209,066 hectares, 9.0% less than the 232,162 hectares in 2002. Total sowing area in the reservoir area was 531,599 hectares, 6.6% less than that in 2002. Among these, the area of grain crops was 390,105 hectares and that of economic crops was 141,494 hectares, accounting for 73.4% and 26.6% of the total respectively. Compared with 2002, the proportion of economic crops was raised because the area of orange plantations increased and that of grain crops decreased.

In 2003, surveys on the cultivation of slope farmland showed that ecological rehabilitation focused on farmland reversion to forest and grassland was continuously carried out in 11 counties and cities in the reservoir area. The area of slope farmland over 25^{o} reversed to forest and grassland totaled 4332.7 hectares. In terms of cultivation types, paddy fields mainly grew crops with two harvests per year, accounting for 61.3%, basically the same as in 2002. The arid land mainly grew crops with three harvests per year, accounting for 65.0%, a little less than that of 2002. Because cropping index of farmland was high and farming activities were frequent in the

reservoir area, slope farmland was still the main factor causing water and soil erosion.

In 2003, monitoring results of 44 representative fixed soil monitoring stations of paddy fields and arid fields showed that soil contents of nitrogen, phosphorus and potassium were basically the same as those of 2002 and contents of heavy metals were within the background value and attained the first level standard of the soil environmental quality. The farmland had not been polluted.

3.6.2 Investigation on the influence of orange belts

In 2003, the results of monitoring and investigation on the 181 towns and villages in the 19 counties in the reservoir area showed that: orange cultivation area was expanded and orange production in the reservoir area was increased. No abnormality was discovered by soil examination of the orange belts.

The orange cultivation area in the reservoir area was 31,626 hectares, 14.9% more than that of 2002. Total yield was 316,800 tons, 17.8% more than that of 2002. Yield per hectare was 10,017kg, a little higher than that of 2002.Investigaion on yield proportion of oranges of different qualities showed that the first level, second level and third level oranges accounted for49.8%, 35.2% and 14.9% respectively. Compared with 2002, there was no much change.

Monitoring results on the fixed soil monitoring spots in orange belts showed that the contents of total nitrogen, total phosphorus, total potassium, and alkali dissolved nitrogen, quick-acting phosphorus and quick-acting potassium didn’t change much. The contents of heavy metals were within the range of background value and attained the first level standard of the soil environmental quality.

3.6.3 Rural energy

The results of monitoring and investigation on 181 villages and towns in the 19 counties of the reservoir area in 2003 showed that: the energy in the rural areas still mainly depended on the direct combustion of fuel wood and straw. Direct combustion of fuel wood accounted for the largest proportion, about 40.6% of the total. The proportion of straw combustion, small coal kilns, small hydropower and biogas was 37.3%, 17.5%, 1.2% and 3.4% respectively.

In 2003, investigation on the number of biogas pools and biogas production amount in the rural areas showed that popularization rate of rural biogas had been raised, mainly because of the large-scale spreading of bio-energy (biogas) bonded ecological homestead construction and high-efficiency eco-agricultural construction in the reservoir area. In the 1.085 million rural households in the reservoir area, there were 76,742 biogas pools with an annual production of 28.945 million m^3. There were 7.07 biogas pools per hundred households, with biogas production of 26.68 m^3, rising in a large degree compared with 2002. But the proportion of bio-energy in rural energy structure was still quite low, just accounting for 3.4% of the total rural energy demand.

3.6.4 Insect pests of crops

In 2003, the results of monitoring and investigation on 181 towns and villages in the 19 counties in the reservoir area showed that: the extent of crop insect pest in the reservoir area was medium with total area affected by insect pests decreased significantly and actual losses lightened. No explosion and major harm of certain insect pest took place.

Total area affected by insect pests was 431,140 hectare·times, decreasing significantly compared with the situation of 2002; area controlled was 348,250 hectare·times; control rate was 80.8%; grain loss recovered was 146,378.3 tons; and actual loss was 40,348 tons. The base number of the snout moth's lava over the winter in the rice paddy fields in the reservoir area was 1,131 per hectare.

Table 3-2 Statistics of Main Crop Insects Pest in the Three Gorges Reservoir Area in 2003

Type of Insects Pest	Area Affected (hectare·times)	Area Controlled (hectare·times)	Control rate (%)	Losses Recovered (t)	Actual losses (t)	Extent of Pest
Rice paddy bores	97500	103680	106.3	31630.4	5548.8	Medium to serious
Rice flying flea	37020	38210	103.2	25739.0	2533.8	Medium
Rice blast	19760	25550	129.3	24643.9	6485.6	Medium to serious
Sheath and culm blight of rice	33970	30020	88.4	10244.2	1899.1	Medium
Corn ring spot	7100	11170	157.3	722.9	401.4	Light
Wheat ibberellic disease	15510	11440	73.8	2335.7	1914.9	Light
Potato late disease	15230	13370	87.8	2281.0	589.6	Light
Sheath and culm blight of corn	20190	18530	91.8	5094.6	949.9	Light
Orange red and yellow spiders	27920	28230	101.1	8105.1	1584.1	Medium
Rats	156940	68050	43.4	35581.5	18440.8	Medium to serious

3.7 Geological Disasters

3.7.1 Earthquakes

In 2003, monitoring was made on the earthquakes occurred in the key monitored area of the Three Gorges (110°14′ -111°05′ E, 30°40′ -31°10′ N) and the area from the reservoir head to the middle (108°20′ -112°00′ E, 29°55'-31°45′ N).

In 2003, 235 times of earthquakes occurred in the key monitored area. Among them, there were 165 times of $0.0 \leqslant M_L < 0.9$ ones, 66 times of $1.0 \leqslant M_L < 1.9$ ones and 4 times of $2.0 \leqslant M_L < 2.9$ ones. The highest-level earthquake ($M_L=2.2$) happened in Zigui on November 25. There were 541 times of earthquakes happened in the area from the head to middle of the reservoir area, including 287 times of $0.0 \leqslant M_L < 0.9$, 220 times of $1.0 \leqslant M_L < 1.9$, 33 times of $2.0 \leqslant M_L < 2.9$ and 1 time of $3.0 \leqslant M_L < 3.9$. The highest-level earthquake ($M_L=3.6$) happened in Lichuan on November 14. The earthquakes in this year mainly spread along the belts of Wushan - Badong - Zigui, Yichang - Changyang. Earthquake intensity and frequency increased to some degree, which had obvious relation to water storage of the reservoir.

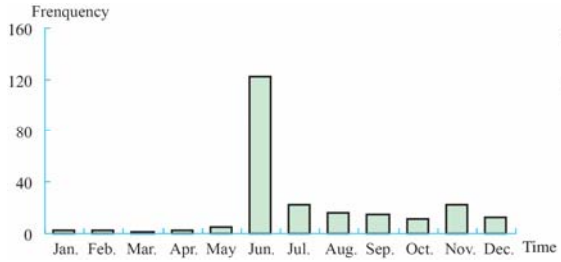


Figure 3-3 Earthquake Frequency in the Key Monitored Area of the Three Gorges in 2003

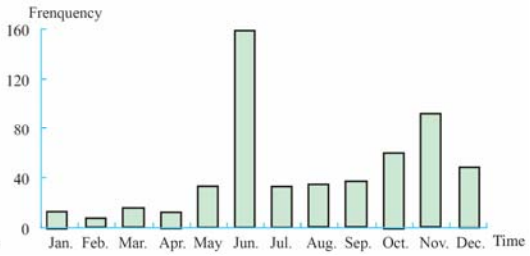


Figure 3-4 Earthquake Frequency in the Area from the Reservoir head to middle of the Three Gorges in 2003

3.7.2 Collapses, landslips and mud-rock flows

● Monitoring and early warning

In 2003, investigations of landslips, collapses and mud-rock flows were further carried out on the Three Gorges reservoir area. There were already 4,719 places experiencing landslips and collapses in total in the reservoir area. 1,216 places of them were under monitoring and early warning. On the basis of public monitoring and prevention on all these places, professional monitoring was carried out in 124 places, including GPS monitoring, RS monitoring and comprehensive tridimensional monitoring. All these efforts had made important achievement.

In 2003, under the influence of heavy rain and storm in flood season and water storage of the reservoir, part of the landslip bodies and slope in the submerged area sped up deforming. The monitoring and early warning system had played an important role, found out the potential danger in time and sent out alarm immediately. Local governments gave quick response and took effective measures to protect people's lives and properties. There were 14 places experiencing dangerous situation of landslips and collapses in Zigui County of Hubei Province, including 4 places successfully forecasted by the professional monitoring system and 10 places successfully forecasted through public monitoring and prevention mechanism. Safety of about 3,200 people was protected. The landslip and collapse monitoring and warning system in the non-backwater zone also made important achievement. For example, the successful forecast of the landslip in 345 Community of Taoping, Qukou in Chongqing's Kai County protected the safety of 410 people.

The landslip in Qianjiangping, Shaxi Town of Zigui County on the left bank of the Qinggan River, a south tributary of the Yangtze River (5 km away from the estuary) was a successful mode of the public monitoring and prevention mechanism. Fissures were found on the back edge of the slope on June 16, and the slope deformation became worse by July 12. Governments of the county and town took decisive measures in time to add 20 new monitoring spots and evacuated 1200 villagers and workers from 129 households and 4 enterprises. At 00:20 of July 13, a mud and rock layer, long about 1,200m, wide about 800m, with edge height difference over 300m, about 2400 $\times 10^4 m^3$, slid into the river and formed a big dam. Because residents were evacuated in advance, personal casualties and property losses were reduced to the minimum.

● Assessment of geological safety

In order to provide a basis for the inspection and acceptance of the second stage of water storage and immigration project in the Three Gorges Project and further strengthen geological

disasters control in the Three Gorges reservoir area, the Office of State Council Three Gorges Project Construction Committee entrusted the Ministry of Land and Resources to organize overall assessment on geological safety for the second stage of immigration project of the Three Gorge Project, i.e. assessment on the influence degree of major geological disasters including collapses, landslips and mud-rock flows to the safety of immigrant settlement areas and the key immigration projects.

Geological safety assessment was made with towns, townships and rural resident spots (more than 100 people, including professional facilities) as regional units and with major bridges and other important spots as engineering units of the assessment. The 12 counties (districts) in the lower stream of Fuling under the influence of the second stage of water storage were divided into 385 units (110 units in Hubei, 275 units in Chongqing). Through data review and on-the-spot investigation, there were 301 units (84 in Hubei and 217 in Chongqing) belonging to safe geological units or basically safe geological units, accounting for 78.2% of the total units; and there were 84 units (26 units in Hubei and 58 units in Chongqing) belonging to relatively poor safe geological units and unsafe geological units, accounting for 21.8% of the total units. Safe and basically safe geological units in the immigrant settlement areas (including reconstruction projects) accounted for 80%. Many rural residents settlement spots were located in relatively poor safe geological units and unsafe geological units.

The assessment believed that the geological safety status of the assessment units in counties (districts) of Chongqing Municipality would have not essential influence to the second stage of water storage. Local governments had adopted measures to the relative poor safe geological units and unsafe geological units. Water storage would have some influence to the landslip stability of some townships and towns in parts of Badong County, Hubei Province, but would not cause large scale deforming and destruction.

● Control and prevention projects

In order to ensure smooth progress of the Three Gorges Project construction and the safety of ecological environment in the reservoir area, The Programming on Geological Disasters Control in the Second Stage of Three Gorge Reservoir Area formulated by the Ministry of Land and Resources and Approved by the State Council required that before water stored in the 135m high dam by Jun 2003, 198 collapse and landslip control projects (56 projects in Hubei and 142 projects in Chongqing), 81 sections of collapsed bank protection (22 sections in Hubei and 59 sections In Chongqing) must be completed. In carrying out the program, both Hubei and Chongqing made some adjustment and actually completed 173 collapse and landslip control projects (44 in Hubei and 129 in Chongqing) and 74 sections of bank protection (59 sections in Hubei and 52 sections in Chongqing). Before the second stage of storing water in June 2003, Hubei and Chongqing had completed 100 collapse and landslip control projects and 59 sections of bank protection, integral projects or underwater parts, totaling 159 projects (or sections) including 24 projects (sections) in Hubei and 135 projects (sections) in Chongqing. Through overall inspection and acceptance at county (district) level and province (prefecture) level or sampling inspection and acceptance at state level, the entire project completed was qualified. All these projects played important roles in guaranteeing stability of the slump structures and the reservoir bank.

According to the instruction of Premier Wen Jiabao: “in the construction of the Three Gorges Project, we must respect the nature and protect the nature, adopt practical measures to permeate the whole process of construction with the strategy of sustainable development, try efforts to realize perfect harmony between the project and the nature” and “relevant departments should formulate and perform as soon as possible programming on greening belts around the reservoir, programming on geological disaster control in the third stage of the Three Gorges reservoir area and work plan of clearing of the floating matters on the Three Gorges Reservoir area and the upper reaches, further improving ecological environment of the reservoir area”, the third-stage programming on geological disaster control was also coming on the way under the organization and leadership of the Ministry of Land and Resources while the tasks of second-stage geological disaster control closing to the end. On the basis of field verification on the new collapses and landslips, the collapses and landslips that need to be controlled as decided in the second stage and the bank section with poor stability, geological programming investigation and survey were made on 986 places of collapses and landslips as well as 358 km of reservoir bank. 957km^2 of 1:5000 topographic mapping measurement, 482km^2 of 1:5000 geological mapping measurement and 1,397km of geological profile survey were completed; 1,608 holes (drilling footage: 80,400m) and 402 shallow wells (drilling footage: 6,030m) were drilled; and 75,800$m^3$of trenching and 1,816km of geophysical prospecting were completed.

Chapter 4 State of Pollution Sources Discharge

4.1 Investigation and Monitoring on Key Industrial Wastewater Pollution Sources

In 2003, the 54 key industrial pollution sources that discharge wastewater to the Yangtze River directly discharged a total of 184 million tons of industrial wastewater into the Yangtze River, with an increase of 27.8% compared with 2002. The largest amount of industrial wastewater discharge was from the main urban area of Chongqing Municipality (including districts of Ba'nan, Dadukou, Jiulongpo, Nan'an, Yuzhong, Jiangbei, and Yubei), with a discharge of 60.119 million tons, accounting for 32.8% of the total.

The 54 key industrial pollution sources discharged a total of 25,000 tons of various pollutants, with an increase of 152.5% compared with 2002. Among these pollutants, COD was 24,087.5 tons, ammonia nitrogen was 848.9 tons, oil was 84.4 tons, hexad chromium was 949.6 kg and volatile phenol was 467.0 kg, increasing by 155.3%, 92.7%, 22.9%, 45.2% and 6.9% compared with 2002 respectively. Lead was 9.6 kg, decreasing by 90.5% compared with 2002. Major pollutants were COD and ammonia nitrogen with pollution loading up to 78.0% and 18.3% respectively, accumulative pollution loading up to 96.3%. Major areas of pollutant emission centered on districts of Fuling, Changshou, Dadukou and Jiulongpo with pollution loading up to 47.8%, 24.4%, 12.7% and 4.8% respectively, accumulative up to 89.7%.

Table 4-1 Discharge of Pollutants from 54 Key Industrial Wastewater Sources that Discharged Wastewater Directly into the Yangtze River in the Three Gorges Reservoir Area in 2003

Region	Wastewater (10,000t)	COD (t)	Oil (t)	Ammonia nitrogen(t)	Cr^{+6} (kg)	Pb (kg)	As (kg)	Volatile phenol (kg)	Cyanide (kg)
Jiangjin	3365.6	726.8	0.1	0.9	0.0	0.0	0.0	250	28.0
Dadukou	35.9	76.1	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Jiulongpo	2636.1	1899.7	59.6	202.9	377.1	0.0	0.0	0.0	0.0
Yuzhong	90.6	72.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nan'an	980.3	764.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
Jiangbei	1211.6	466.9	0.0	1.5	27.2	9.6	0.0	0.0	0.0
Yubei	1057.4	1160.1	0.3	45.8	0.0	0.0	0.0	0.0	45.0
Changshou	3468.8	6653.9	19.0	80.8	542.0	0.0	0.0	217.0	0.0
Fuling	3036.3	11350.1	0.0	510.9	3.3	0.0	0.0	0.0	2.8
Fengdu	7.2	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zhongxian	464.2	344.9	0.0	6.0	0.0	0.0	0.0	0.0	0.0
Wanzhou	1000.5	210.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Yunyang	770.3	289.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fengjie	232.0	64.5	0.0	0.0	0.0	0.0	6.5	0.0	0.0
Total	18356.7	24087.5	84.4	848.9	949.6	9.6	6.5	467.0	75.8

The major industrial sectors of the 54 key industrial pollution sources were chemical materials and products manufacturing sector, foodstuff, tobacco and beverage processing sector, chemical fibre manufacturing sector and producing and supplying sector of electricity, coal, gas and water with pollution loading up to 42.6%, 31.6%, 8.8% and 7.5% respectively, accumulative up to 90.4%. The wastewater discharged accounted for 81.0% of the total discharge of industrial wastewater.

4.2 Investigation and Monitoring on Urban Wastewater

In 2003, there were 66 outlets that discharged urban wastewater directly into the Yangtze River, with total discharge of 404 million tons, 26.6% more than that in 2002. The wastewater discharge volume from the main urban area of Chongqing Municipality, Wanzhou District and Fuling District was comparatively large, 253 million tons, 43 million tons and 28 million tons, accounting for 62.6%, 10.6% and 6.9% of the total respectively.

The total pollutants in the urban wastewater amounted 261,300 tons, 27.0% more than that of 2002. Among them, COD, BOD_5 and ammonia nitrogen were 157,700 tons, 76,800 tons and 9,700 tons, accounting for 60.4%, 29.4% and 3.7% of the total volume of pollutants respectively. The major pollutants were total phosphorus, BOD_5 and COD, with pollution loading 47.3%, 24.9% and 15.4% respectively. The accumulative loading reached 87.6%. The pollutants in the wastewater came mainly from the main urban area of Chongqing Municipality, Wanzhou District, Fuling District, Changshou District and Ba'nan District, with pollution loading 62.5%, 10.7%, 7.0%, 4.2% and 2.6% respectively. The accumulative loading reached 87.0%.

Table 4-2 Statistics of Wastewater Directly Discharged into Yangtze River in the Three Gorges Reservoir Area in 2003

City	Number of outlets	Discharge (10000t)	COD (t)	BOD_5 (t)	Ammonia nitrogen (t)	Total nitrogen (t)	Total phosphorus (t)	Volatile phenol (t)	Total (t)
Jiangjin	1	368.89	1438.68	700.89	88.53	132.80	22.13	0.22	2383.25
Ba'nan	2	1062.13	4142.29	2018.04	254.91	382.37	63.73	0.64	6861.98
Main urban area of Chongqing	19*	25266.27	98538.44	48005.91	6063.90	9095.86	1515.98	15.16	163235.25
Changshou	3	1714.58	6686.84	3257.69	411.50	617.25	102.87	1.03	11077.18
Fuling	8	2829.81	11036.25	5376.63	679.15	1018.73	169.79	1.70	18282.25
Fengdu	4	682.80	2662.90	1297.31	163.87	245.81	40.97	0.41	4411.27
Zhongxian	2	932.48	3636.66	1771.70	223.79	335.69	55.95	0.56	6024.35
Wanzhou	9	4339.54	16924.22	8245.13	1041.49	1562.24	260.37	2.60	28036.05
Shizhu	1	83.66	326.28	158.96	20.08	30.12	5.02	0.05	540.51
Yunyang	3	557.74	2175.20	1059.71	133.86	200.79	33.46	0.33	3603.35
Fengjie	4	1045.77	4078.50	1986.96	250.98	376.48	62.75	0.63	6756.30
Wushan	3	836.62	3262.80	1589.57	200.79	301.18	50.20	0.50	5405.04
Badong	5	571.69	2229.58	1086.21	137.20	205.81	34.30	0.34	3693.44
Zigui	2	153.38	598.18	291.42	36.81	55.22	9.20	0.09	990.92
Total	66	40445.34	157736.82	76846.14	9706.88	14560.32	2426.72	24.27	261301.15

* For the main urban area of Chongqing Municipality, only the outlets that discharge wastewater in to the Yangtze River were included, while the outlets that discharge wastewater into Jialing River were excluded.

4.3 Investigation on Urban Garbage

In 2003, a total of 1.3506 million tons of urban garbage was generated in the Three Gorges Reservoir area, 562,400 tons less than 2002. The main urban area of Chongqing Municipality generated the largest amount, i.e., 842,200 tons, accounting for 62.4% of the total urban garbage. Wanzhou District, Fuling District and Changshou District also generated large amount of garbage, i.e., 144,700 tons, 94,300 tons and 57,200 tons, accounting for 10.7%, 7.0% and 2.6% of the total respectively.

4.4 Investigation on Pollution in Towns to Be Moved Out

In 2003, investigation was conducted again on pollutant discharges from the 89 key towns and townships to be moved out with pollution loading accounted for 80% of the total. The number of key towns and townships investigated was 3 less than that of 2002 because some towns had been combined.

The total number of permanent residents in these towns was 1.328 million (for some towns, only the residents to be moved out were considered). The annual wastewater discharge reached 74 million tons, with 25,400 tons of COD, 11,900 tons of BOD_5, 2,200 tons of ammonia nitrogen and 450 tons of total phosphorous.

By June 2003, the cleaning up of the Three Gorges reservoir had been completed. The garbage accumulated for many years under the water level line of 135m had been cleaned up. In 2003, the domestic garbage generation of the towns to be moved out amounted to 508,000 tons, among which, Fuling District and Wanzhou District generated more than others, accounting for 22.6% and 18.7% of the total respectively. All these new generated garbage was treated through burying or burning.

In 2003, a total of 202 township enterprises were re-examined in 12 industrial sectors including food and beverage processing, tobacco industry, chemical industry and textile industry. The annual wastewater discharge from the township enterprises to be moved out was 9.2862 million tons, of which 7.6457 million tons were treated, with a treatment rate of 82.3%. Major pollutants were COD and BOD_5, i.e., 1,269.62 tons and 1,181.73 tons respectively. The solid waste generated from these enterprises was 445,400 tons per year, of which 307,400 tons were reused, while 80,200 tons were disposed. The accumulated waste reached 48.6119 million tons.

The results of reinvestigation made in 2003 on pollutant discharges from towns to be moved out in the Three Gorges reservoir area were basically the same as that of 2002. But compared with 2002, discharge volume of each industrial sector dropped a little, especially the chemical industry and textile industry. Volume of wastewater treatment increased in all sectors and discharge volume decreased or increased in different sectors but within a narrow range. The main cause for the decrease of wastewater discharge in paper milling and manufacturing sector was that the municipal government of Chongqing devoted more efforts to rectifying the small paper mills with low yield but high pollution.

4.5 Monitoring of Pesticides and Chemical Fertilizers

In 2003, investigation was made on the use of pesticides and chemical fertilizer in the 181 towns and villages of the 19 counties in the reservoir area. The results showed that the use of chemical fertilizers had a trend of declining but the ratios of their use were still not reasonable. It was still common to give more favor to nitrogen and phosphorus fertilizers than to kalium fertilizer, resulting in over loss of nitrogen and phosphorus polluting the water body of the Yangtze River. The total consumption of pesticides was reduced. The organic phosphorus pesticides were used in the largest amount.

4.5.1 Chemical fertilizers

In 2003, the total use of chemical fertilizers in the reservoir area, calculated as pure amount, was 110,200 tons, 14.2% decrease compared with 2002, in which 77,900 tons of nitrogen fertilizer, 22,000 tons of phosphorus fertilizer and 10,300 tons of kalium fertilizer 12.0%, 21.2% and 15.6% decrease compared with 2002 respectively. The per hectare use of fertilizers was 527.5 kg, 4.7% decrease compared with 2002.

The ratio of nitrogen, phosphorus and kalium was 1:0.28:0.13, still unreasonable with over use of nitrogen and phosphorus fertilizers.

Table 4-3 Use and Loss of Chemical Fertilizers in the Reservoir Area in 2003

Type of fertilizer	Total use (10,000 t)	Total loss (10,000 t)	Utilization rate by crops %	Residue rate in soil %	Surface runoff rate %	Ground leaching rate %	Volatilization of Gaseous nitrogen %	Phosphorus fixed in soil %
Nitrogen	7.79	0.80	35.16	30.31	9.53	0.54	24.46	—
Phosphorus	2.20	0.13	34.16	13.18	5.27	0.72		46.67
Kalium	1.03	—	—	—	—	—	—	—
Total	11.02	—	—	—	—	—	—	—

4.5.2 Pesticides

In 2003, the use of pesticides in the reservoir area, calculated as pure amount, was 645.37 tons, 17.2% decrease compared with 2002. Among them the use amounts of organic phosphorus, organic nitrogen, pyethroids, herbicides and others were 399.2 tons, 81.75 tons, 41.79 tons, 31.52 tons and 91.11 tons respectively, forming a new pattern like this: organic phosphorus>others>organic nitrogen>pyethroids>herbicides in order. The per hectare use was 3.09 kg, decreased by 8.0% compared with 2002.

The use of organic phosphorus accounted for more than a half of the total use, showing that high toxic pesticides were widely used in the reservoir area.

Table 4-4 Use of Pesticides in the Reservoir Area in 2003

Type of pesticides	Amount used (t)	Percentage (%)
Organic phosphorus	399.20	61.86
Organic nitrogen	81.75	12.67
Pyethroids	41.79	6.47
Herbicides	31.52	4.88

Others	91.11	14.22
Total	645.37	100.0

4.6 Monitoring of Mobile Pollution Sources

4.6.1 Basic situation

In 2003, the Gezhouba lock and the temporary bock of the Three Gorges operated a total of 14,175 times passing through a total of 84,179 vessel-times, which transported 2.04 million passengers, 30.77 million tons of cargoes. The above figures represented 86.6%, 102.0%, 77.6% and 138.9% of those in 2002. 244 vessel-times of vessels carrying first-level hazardous cargoes with actual weight of 116,000 tons passed through the lock. The passing through volume of hazardous cargoes decreased compared with that of 2002. Handling capacity of major docks in the reservoir area was over 23.00 million tons of cargoes and 11.68 million passengers, increased by 7% and decreased by 25% compared with those of 2002 respectively.

In 2003, investigation was made on installation and use of equipment for prevention of oil pollution in 372 vessels. More than 95% of the vessels with power above 220KW were installed with equipment for prevention of oil pollution and used them well. For small vessels, the situation was ratherpoor while the worst was the small cargo and passenger vessels. Most of the vessels did not install sewage storage and treatment facilities, and the sewage was discharged directly into the river.

4.6.2 Oil-containing wastewater from vessels

In 2003, there were more than 130 registered shipping companies in the reservoir area with over 9,500 vessels, of which 5,873 vessels discharged oil-containing wastewater. 421,200 tons of oil-containing wastewater in total were discharged in 2003, 17.6% less than that in 2002. The treatment rate was 95%. Total pollutants discharged amounted to 82.63 tons, including 65.94 tons of oil, 17.3% more than 2002 and 16.69 tons of suspended substances, 27.1% less than 2002.

Table 4-5 Discharge of Major Pollutants in Oil-containing Wastewater

Type of vessels	Oil-containing wastewater (10,000t)		Oil (t)		Suspended substances (t)	
	Discharge	Percentage (%)	Discharge	Percentage (%)	Discharge	Percentage (%)
Tour vessels	1.00	2.4	0.04	0.1	0.17	1.0
Passenger ships	16.72	39.7	5.85	8.9	5.15	30.9
Cargo ships	12.73	30.2	58.88	89.3	7.00	41.9
Tugboats	8.71	20.7	1.05	1.6	3.30	19.8
Others	2.96	7.0	0.12	0.2	1.07	6.4
Total	42.12	100.0	65.94	100.0	16.69	100.0

4.6.3 Sewage

In 2003, the total number of passengers transported in the reservoir area was 11.60 million and total number of crewmembers was more than 50,000. The sewage discharged into the river was estimated at 1.30 million tons, 17% less than the same period of 2002. The pollutants discharged

were 493.8 tons, including 363.1 tons of COD, 128.1 tons of BOD_5 and 2.6 tons of total phosphorus.

4.6.4 Rubbish from vessels

In 2003, there were 8 rubbish collection units and 6 rubbish collection boats in the reservoir area with collection capacity over 4,300 tons. They collected 500,000 m^3 of rubbish floating close to the dam that mainly discharged from the bank.

Chapter 5 Status of Water Environmental Quality

5.1 Basic situation of Water Environmental Monitoring

In 2003, the monitoring of water environmental quality in the Three Gorges reservoir area included water quality monitoring in annual water season, monitoring of pollution belt along the riverbank in urban area and water quality monitoring in the second-stage water storage in the Three Gorges project. The assessment standard and test method were according with “the Water Quality Standard for Surface Water Environment”(GB3838 - 2002).

5.1.1 Annual water quality monitoring in the reservoir area

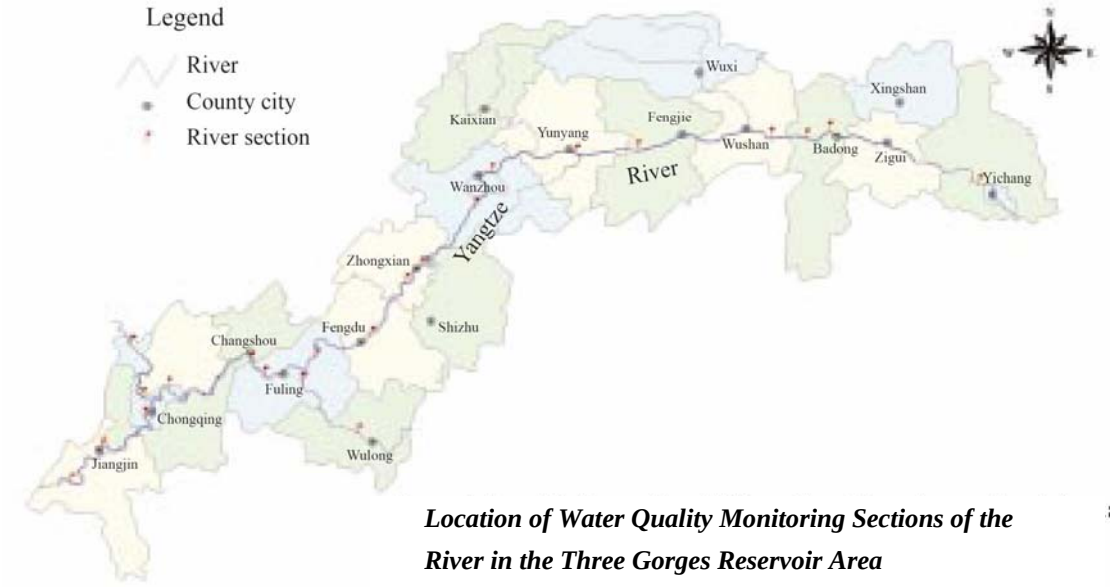
In 2003, 18 monitoring sections were set up in the Three Gorges reservoir area, including 15 mainstream sections and 3 subsidiary stream sections. 6 times of monitoring on water quality of rivers in urban areas in the reservoir area were conducted during three periods: dry season (February), normal season (May) and flood season (August). Three vertical lines, left, middle and right, were set up at each section to collect water sample from 0.5m deep under the surface for analysis.

5.1.2 Water quality monitoring in the second stage of water storage

On June 1, 2003, the Three Gorges reservoir started the second stage of water storage. In order to master the water quality status in the second stage of water storage in time, the State Environmental Protection Administration conducted synchronous monitoring on the water quality in the reservoir area day by day from May 25 to June 20. 6 monitoring sections were set up from Chongqing to the front of dam in Zigui, Hubei Province. There were 8 indicators monitored including dissolved oxygen, permanganate index, ammonia nitrogen, total phosphorus, volatile phenol, oil, lead and fecal Coliform bacteria.

5.1.3 Monitoring of pollution belt along the riverbank of urban area

In 2003, water quality monitoring along the river bank of the Yangtze River in the urban area of Fuling, Wanzhou and Zhongxian County during two periods: dry season (end of February) and normal season (end of May). 18 sections for sample collection were set up in the 29 km river course including 8 in Wanzhou urban area, 6 in Fuling urban area and 4 in Zhongxian urban area. 6 sample collection points were set up with different intervals in each section according to the actual situation of pollutant dispersion and water flow to collect surface water sample from 0.5m depth under the water surface for analysis. The water depth, flow speed and the distance to the bank of the sample collection points were also measured.



Location of Water Quality Monitoring Sections of the River in the Three Gorges Reservoir Area

5.2 Water Quality in the Reservoir Area

5.2.1 Water quality in the reservoir area

The assessment of water quality in the reservoir area included 15 indicators: pH, dissolved oxygen, permanganate index, BOD_5, ammonia nitrogen, oil, volatile phenol, total phosphorus, COD, cyanide, mercury, lead, cadmium, arsenic and hexad chromium. The results of the monitoring showed that in 2003, the overall water quality in the reservoir area was good and met or excelled the water quality standard for Grade III in all sections. There was no section where the water quality was under Grade I. Sections where the water quality met Grade II and Grade III accounted for 22.2% and 77.8% of the total area of all sections respectively.

Dry Season: The overall water quality in the Three Gorges reservoir area was generally good. There was no section where the water quality was under Grade I. Sections where the water quality met Grade II, Grade III and Grade IV accounted for 33.3%, 55.6% and 11.1% of the total monitored sections respectively. The exceeding standard factor was total phosphorus.

Normal Season: The overall water quality in the reservoir area was fairly good. There was no section where the water quality was under Grade I. Sections where the water quality met Grade II and Grade II accounted for 33.3% and 66.7% of the total monitored sections respectively.

Flood Season: The overall water quality in the reservoir area was fairly good. There was no section where the water quality was under Grade I. Sections where the water quality met Grade II and Grade II accounted for 33.3% and 66.7% of the total monitored sections respectively.

5.2.2 Annual variation

Compared with 2002, the water quality in the Three Gorges reservoir area had no obvious change in 2003, mostly meeting the water quality standard for Grade Ⅲ.

Table 5-1 Assessment Result of Water Quality in the Three Gorges Reservoir Area in 2003

River nature	City	Section	Dry Season	Normal Season	Flood Season	Whole Year
Main stream	Yongchuan City	Zhutuo	II	II	II	II
	Jiangjin City	Huangqian	III	III	III	III
	Yuzhong District	Wanglongmen	II	II	III	III
	Jiangbei District	Cuntan	III	III	III	III
	Changshou District	Huangcaoxia	II	III	III	II
	Fuling District	Yazuishi	II	II	III	II
	Fuling District	Qingxichang	II	III	III	III
	Fengdu County	Mishiquan	III	III	III	III
	Zhongxian County	Jiutiaohe	III	II	III	III
	Zhongxian County	Lianerqi	III	III	III	III
	Wanzhou District	Tongziyuan	IV(总磷 0.03)	III	II	III
	Wanzhou District	Shaiwangba	IV(总磷 0.08)	III	II	III
	Yunyang County	Xiayansi	III	III	III	III
	Fengjie County	Baidicheng	III	III	III	III
	Wushan County	Beishi	III	II	III	III
Tributaries	Yuzhong District	Daxigou	III	III	II	III
	Fuling District	Maliuzui	II	II	II	II
	Beibei District	Beiwenquan	III	III	II	III

Note: 1.The times exceeding the standard were calculated based on the standard for Grade III in the Water Quality Standard for Surface Water Environment (GB3838-2002)

2.Fators and their exceeding the standard was put in the brackets.

Table 5-2 Comparison of the Annual Variation of Water Quality of River in Urban Areas in the Three Gorges Reservoir Area

Season	Dry Season		Normal Season		Flood Season		WholeYear	
Year	2002	2003	2002	2003	2002	2003	2002	2003
Total number of monitored sections	16	18	16	18	16	18	16	18
Percentage of sections with Grade I and II water quality (%)	68.8	33.3	0	33.3	25.0	33.3	43.8	22.2
Percentage of sections with Grade III water quality (%)	25.0	55.6	87.5	66.7	56.2	66.7	50.0	77.8
Percentage of sections with water quality meeting or excelling Grade III (%)	93.8	88.9	87.5	100.0	81.2	100.0	93.8	100.0

5.3 Water Quality in the Second Stage of Water Storage

The results of monitoring conducted from May 25 to June 20, 2003 showed that water quality in the reservoir area had no obvious change. The whole water quality mostly belonged to Grade III. The monitored value of volatile phenol, oil and lead met the requirement for Grade I water quality; dissolved oxygen, permanganate index and ammonia nitrogen met the requirement for Grade II

water quality and total phosphorus basically met the requirement for Grade III water quality. With consideration of the index of fecal Coliform bacteria, the water quality belonged to Grade IV or sub-V as a whole.

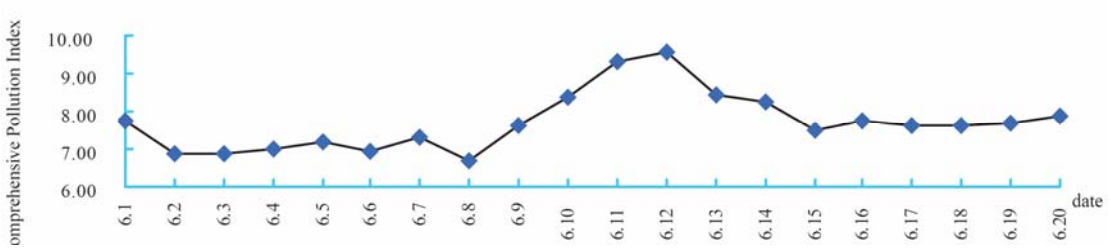


Figure 5-1 Trend of Daily Change of Comprehensive Pollution Index

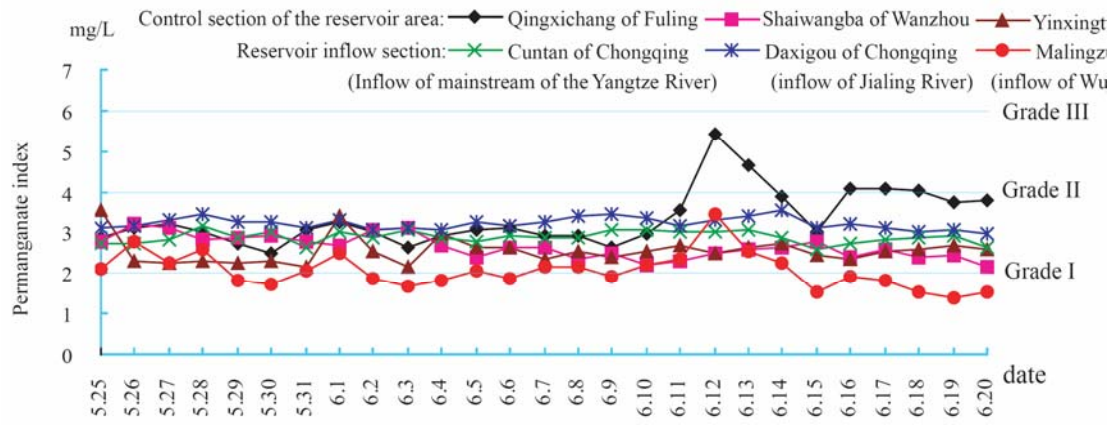


Figure 5-2 Trend of Daily Change of Permanganate Index Density

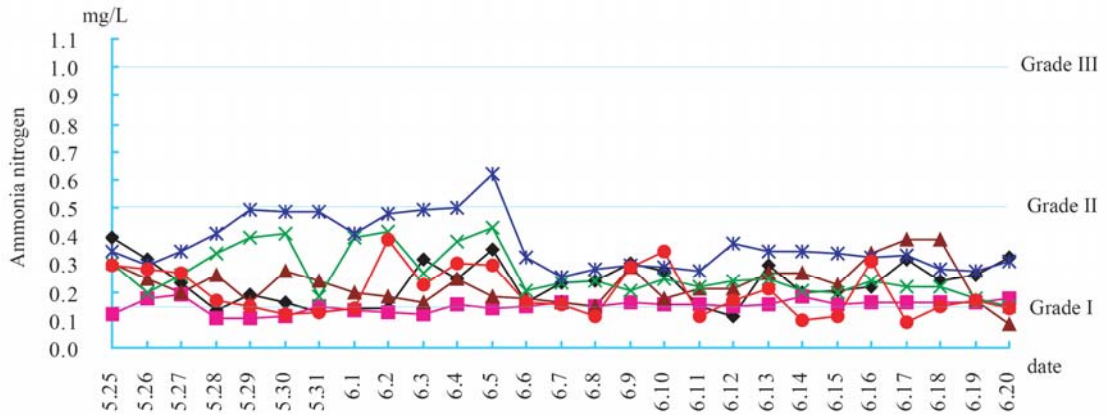


Figure 5-3 Trend of Daily Change of Ammonia Nitrogen Density

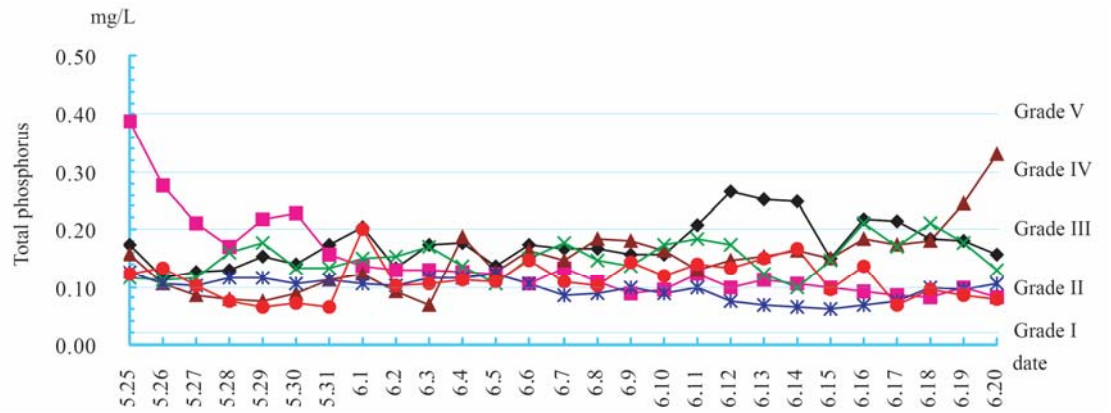


Figure 5-4 Trend of Daily Change of Total Phosphorus Density

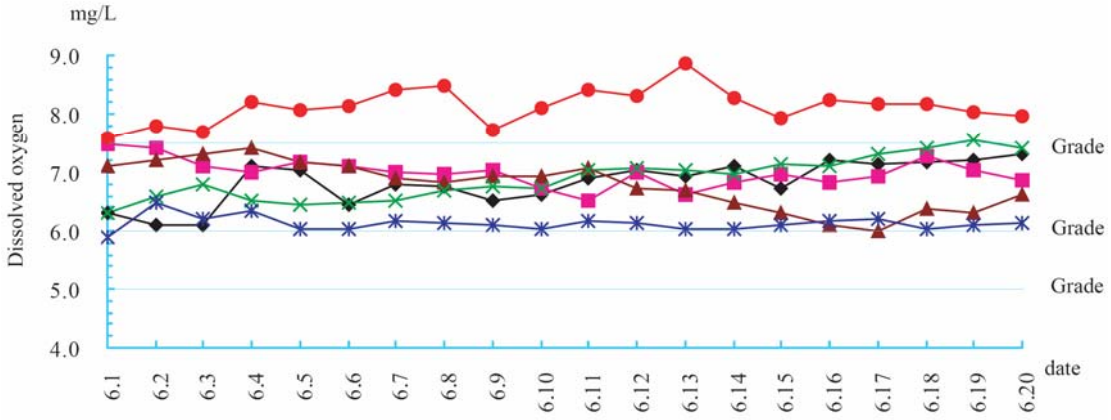


Figure 5-5 Trend of Daily Change of Dissolved Oxygen Density

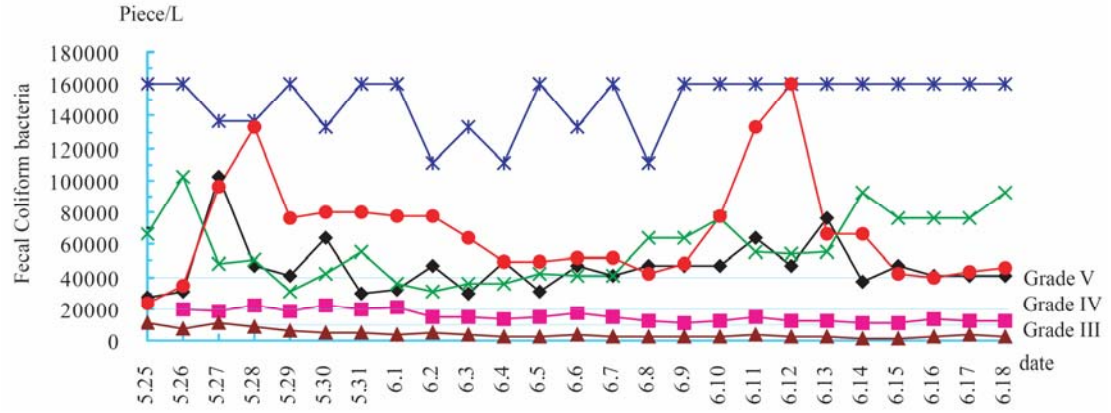


Figure 5-6 Trend of Daily Change of Fecal Coliform Bacteria Density

5.4 Pollution Belt of Urban Area Along the Riverbank

The factors of monitoring on the pollution belt of urban area along the riverbank were permanganate index, total nitrogen and total phosphorus. The results of monitoring showed that there were obvious riverbank pollution belts in urban areas of Wanzhou County and Zhongxian County. The riverbank pollution belts in Fuling urban area were relatively narrow.

● Dry Season

The pollution belt with pollution exceeding the baseline level in Wanzhou urban area was about 12,600m long (permanganate index) and 110m wide, accounting for 70.4% of the total length of monitored sections and 25% of the average width of the river surface. The pollution belt with pollution exceeding the standard was about 300m long (permanganate index),and 5m wide, accounting for 1.7% of the total length of the monitored section and 2% of the average surface width of the river, mainly spreading around the sewage outlets of big cities with a distance about 10m away from the outlets.

The pollution belt with pollution exceeding the baseline level in Zhongxian urban area was 1,200m long ((permanganate index) and 40m wide, accounting for 25.5% of the total length of the monitored sections and 8.6% of the average surface width of the river. There was basically no pollution belt exceeding standard.

The pollution belt with pollution exceeding the baseline level in Fuling urban area was about 4,500m long (total phosphorus) and 120m wide, accounting for 75% of the total length of the monitored sections and 30.2% of the average surface width of the river. There was no pollution belt exceeding standard.

● Normal Season

The pollution belt with pollution exceeding the baseline level in Wanzhou urban area was about 14,100m long (total phosphorus) and 110m wide, accounting for 78.8% of the total length of the monitored sections and 17.1% of the average surface width of the river. The pollution belt exceeding standard was about 900m (total phosphorus) and 15m wide, accounting for 5.0% of the total length of the monitored sections in the urban area and 2.3% of the average surface width of the river.

The pollution belt with pollution exceeding the baseline level in Zhongxian urban area was about 3,950m long (permanganate index) and 105m wide, accounting for 84.0% of the total length of the monitored sections and 16.8% of the average surface width of the river. The pollution belt exceeding standard was about 2,990m (total phosphorus) and 80m wide, accounting for 63.6% of the total length of the monitored sections in the urban area and 12.8% of the average surface width of the river.

The pollution belt with pollution exceeding the baseline level in Fuling urban area was about 2,900m long (total phosphorus) and 20m wide, accounting for 48.3% of the total length of the monitored sections and 4.0% of the average surface width of the river. The pollution belt exceeding standard was about 2,900m (total phosphorus) and 20m wide, accounting for 48.3% of the total length of the monitored sections in the urban area and 4.0% of the average surface width

of the river.

Table 5-3 Scope of Pollution Belts of Urban Areas of Wanzhou, Zhongxian and Fuling Along the Riverbanks

River section	Number of large scale discharge outlets	Season	Pollution indicator	Pollution belt exceeding the baseline level 5% over density of the inflow background			Pollution belt exceeding standard over Grade III		
				Length (m)	Width (m)	Area (m^2)	Length (m)	Width (m)	Area ($m^{2)}$
Wanzhou section	9	Normal	Permanganate index	12300	100	1230000	300	10	3000
			Total nitrogen	7600	70	532000	/	/	
			Total phosphorus	14100	110	1551000	900	15	13500
		Dry	Permanganate index	12600	110	1134000	300	5	1500
			Total nitrogen	1200	45	54000	/	/	/
			Total phosphorus	7200	45	324000	250	10	2500
Zhongxian section	3	Normal	Permanganate index	3950	105	414750	150	5	750
			Total nitrogen	3950	80	316000	/	/	/
			Total phosphorus	2990	80	239200	2990	80	239200
		Dry	Permanganate index	1200	40	48000	/	/	/
			Total nitrogen	/	/	/	/	/	/
			Total phosphorus	/	/	/	/	/	/
Fuling section	6	Normal	Permanganate index	/	/	/	/	/	/
			Total nitrogen	/	/	/	/	/	/
			Total phosphorus	2900	20	58000	2900	20	58000
		Dry	Permanganate index	/	/	/	/	/	/
			Total nitrogen	1600	45	72000	/	/	/
			Total phosphorus	4500	120	540000	/	/	/

5.5 Comparison Analysis between Clear Water and Muddy Water

In 2003, the analysis results of the comparison between clear water samples and muddy water sample indicated that the contents of seven measured indicators (permanganate index, total phosphorus, mercury, As, lead, copper and cadmium if found) in muddy water samples were obviously higher than those in clear water samples, in which the difference of total phosphorous, permanganate index, copper and lead etc. was even more outstanding. And the differences between clear water samples and muddy water samples in the main stream of the Yangtze River were bigger than that in the tributaries. The concentration of monitored indicators in muddy water samples differed obviously with the change of the water period, having some relations with the existing of water seasons. However, the content in clear water sample was rather low and stable without obvious relation with water seasons.

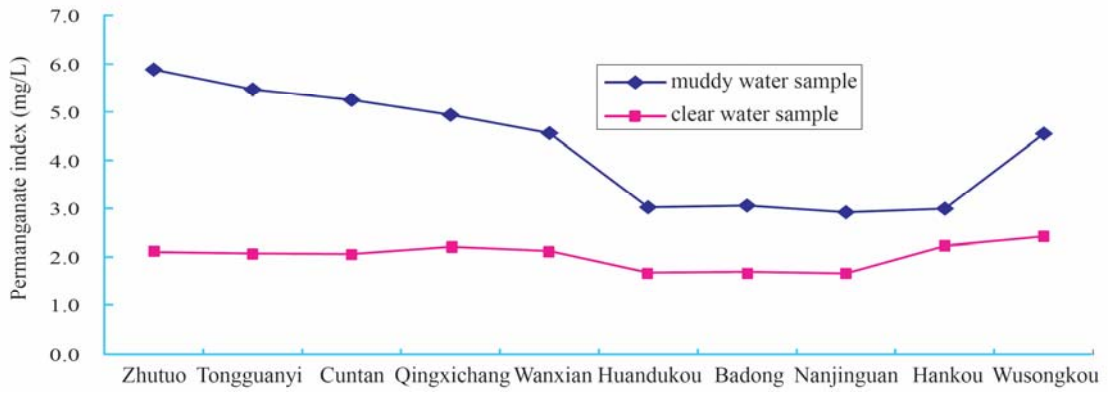


Figure 5-7 Variation Trend of Annual Average Value of Permanganate Index along the Course in Mainstream of the Yangtze River in 2003

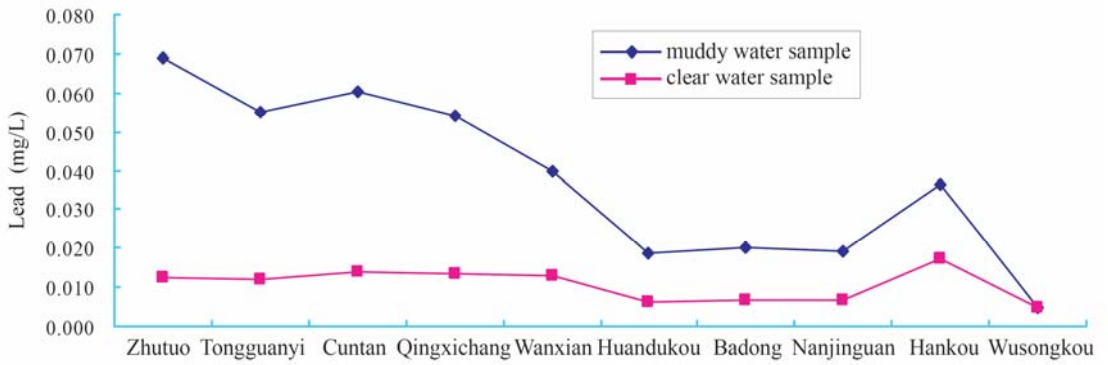


Figure 5-8 Variation Trend of Annual Average Value of Lead along the Course in Mainstream of the Yangtze River in 2003

Chapter 6 Environmental Quality in Construction Area

6.1 Hydrology and Meteorology

6.1.1 Characteristics of hydrology

In 2003, the statistical results from Huanglingmiao Hydrometric Station showed that the average flux in the whole year was 13,000m^3/s. The maximum flux was 48,300 m^3/s on September 4. The minimum flux was 2,820 m^3/s on February 8.The annual average runoff was 4.094 × $10^{11}m^3$. The runoff modulus was 1.30 × 10^{-2} $m^3/s \cdot km^2$. The runoff depth was 408.3mm. The average sand transmission rate was 2.81 t/s. The average sand content was 0.216 kg/m^3. The section's average maximum sand content was 0.875 kg/m^3 on September 6. The section's average minimum sand content was 0.003 kg/m^3 on December 28.

Table 6-1 Monthly Statistics of Flux in Huanglingmiao Hydrometric Station in 2003

Unit: m^3/s

Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average	4300	3430	3930	5600	9520	14900	32600	22400	30900	14100	7450	5850
Max.	4910	4080	4400	8740	16400	34600	45000	28300	48300	23900	10400	7660
Min.	3840	2820	3410	3690	5610	3500	19100	18000	18000	7220	5390	4230

Table 6-2 Monthly Statistics of Sand Content in Huanglingmiao Hydrometric Station in 2003

Unit: kg/m^3

Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average	0.016	0.014	0.009	0.077	0.118	0.164	0.436	0.112	0.382	0.055	0.01	0.005
Max.	0.021	0.019	0.026	0.139	0.274	0.741	0.769	0.183	0.875	0.135	0.014	0.007
Min.	0.012	0.011	0.007	0.026	0.026	0.02	0.1	0.063	0.116	0.007	0.007	0.003

6.1.2 Characteristics of climate

In 2003, characteristics of climate in the Three Gorges reservoir dam area were much precipitation in spring and less in rainy season. Annual average temperature was a little lower than normal, but the extremely highest temperature created historical record. Thunderstorms and strong tempest disasters were frequent.

● Precipitation

Precipitation in the construction area was 1,212.8mm, 4.3% more than the average in the past years and distributed unevenly in different months. In February, April and November, the precipitation was 50% more than normal. Precipitation in May, August and December was also obviously more than normal. But in June and July, though belonging to rainy season, and January, September and October, the precipitation was quite less than normal. The number of rainy days in the whole year (precipitation ≥0.1mm) was 163, 1 day more than the average for years. The daily maximum precipitation was 78.5mm on August 3.

● Temperature

The average monthly temperature in the construction area was 16.6℃, 0.6℃ lower than the average for years. The average temperature in January and September was a little higher than normal, but the average temperature in other months was a little lower than normal. The temperature in mid July was obviously lower than normal years. The number of days with temperature higher than 37℃ was two days less than the average number for years. The days with highest temperature mainly occurred from late July to early August. From July 28 to August 2, the highest temperature exceeded 37℃. The highest temperature from August 6 to August 8 was 36℃. From May to September, the number of thunderstorms days was 21,obviously less than normal years, particularly in July.

● Wind speed

The average wind speed in the construction area was 1.5 m/s, the same as the average for years. The wind direction in the year was normally NNW with an occurrence frequency of 22%. Three times of strong wind appeared respectively on March 26 (8 scale), June 3 (10 scale) and August 24 (9 scale).

Table 6-3 Statistics of Meteorological Elements in the Three Gorges Dam Area in 2003

Month		Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Temperature	Temperature (℃)	6.5	7.6	10.8	16.5	20.6	24.8	26.4	26.8	23.4	17.3	11.9	6.9	16.6
	Difference from historic average (℃)	0.9	-0.4	-0.6	-1.2	-1.5	-0.3	-1.1	-0.3	0.1	-0.4	-0.7	-1.2	-0.6
Precipitation	Precipitation (mm)	9.6	53.3	57.2	140.5	190.9	135.8	171.1	264.4	60.7	36.6	65.4	27.3	1212.8
	Difference from historic average (%)	-60.8	79.5	4.6	87.6	39.1	-13.3	-23.5	42	-40.8	-66.8	51.4	40.0	4.3
Wind speed	Average (m/s)	1.5	1.7	1.8	1.8	1.3	1.4	1.3	1.4	1.3	1.6	1.6	1.8	1.5
	Max. (m/s)	7.1	6.6	13.4	8.6	8.8	10.9	6.5	9.3	5.8	6.1	6.6	7.2	10.9
	Min. (m/s)	11.5	11.0	18.9	15.1	13.6	25.7	11.1	18.0	11.3	10.5	11.3	12.3	25.7

6.2 Air Quality

Assessment on environmental air quality in construction area (working/residential area and construction site) was conducted according to the Environmental Air Quality Standard (GB3095-1996).

In 2003, the annual average concentration of SO_2 in the construction area was 0.019 mg/m^3, and that of NO_2 was 0.022 mg/m^3, all reached the standard for Grade I. Except on the only 2 days SO_2 was on Grade III in the construction area, and the daily average concentration of SO_2 reached or was better than the standard for Grade II. The daily average concentration of NO_2 reached the standard for Grade I as a whole.

The annual average concentration of TSP was 0.219 mg/m^3 in the construction area, reaching the standard for Grade III. The daily average concentration of TSP in working and residential

areas all reached or was better than the standard for Grade III. The proportions of daily average TSP concentration in the construction area reaching the standards for Grade I, Grade II and Grade III and exceeding Grade III were 9.3%, 60.5%, 24.8% and 5.4% respectively.

Compared with 2002, the environmental air quality in the construction area was improved as a whole in 2003. The annual average concentration of SO_2 was a little higher and the annual average concentration of NO_2 and TSP dropped a little. The main pollutant in the environmental air in the construction area was still TSP.

6.3 Water Quality

According to the Water Quality Standard for Surface Water Environment (GB3838-2002), 13 indicators of pH, dissolved oxygen, ammonia nitrogen, COD, permanganate index, BOD_5, volatile phenol, cyanide, arsenic, hexad chromium, copper, lead and cadmium, were selected for assessment on the water quality in the construction area. Anion detergent was added for the assessment on the water quality of the near bank water area.

In 2003, the overall water quality in the main stream of the Yangtze River and along the bank in the construction area was pretty good, reaching or being better than the standard for Grade III. Compared with the first half of 2002, the total hardness and total alkalinity parameters in the water body of the mainstream of the Yangtze River were relatively stable with conductivity a little higher and oxidation reduction potential (ORP) dropping a little. Permanganate index, total phosphorus and heavy metal etc. also decreased in certain degrees.

Table 6-4 Water Quality in Sections of Mainstream of the River in Construction Area in 2003

Name of sections	1st Quarter	2nd Quarter	3rd Quarter	4thQuarter	Whole Year
Taipingxi	I	II	II	I	II
Dongyuemiao	I	I	III	I	II
Letianxi	I	I	III	I	II

Table 6-5 Water Quality Along the Bank of The River in Construction Area in 2003

Monitoring points		1st Quarter	2nd Quarter	3rd Quarter	4thQuarter	Whole Year
Left Bank (30m away from the bank)	Navigation route in upstream	I	II	II	I	II
	Navigation route in downstream	I	II	II	I	II
Right Bank (30m away from the bank)	Laomaoping Town	I	I			
	River mouth of Maopingxi	II	II			
	Fuba			II	II	

Note: After July, monitoring points at Laomaoping Town and river mouth of Maopingxi on the right bank were deleted and Fuba monitoring point was added.

6.4 Noise

The average values of environmental noise in working and residential area were 60.6dB(A) and 53.8dB(A) respectively at daytime and night, all reaching the Environmental Noise Standard in Urban Area (GB 3096-93) for Grade III. The equivalent sound levels of noise at daytime and night in the construction area all met the requirement of the threshold of 90 dB(A) set by the national Design Norms for Noise Control in Industrial Enterprises (GBJ87-85) for production workshops and operation site. Noise at the sensitive points outside the boundary attained the threshold set by the Noise Threshold for Boundary of Construction Site (GB12523-90).

Compared with 2002, the average values of environmental noise in working and residential area at daytime and night increased by 4.9dB(A) and 3.4dB(A) respectively. The average values of environmental noise in the construction site at daytime and night increased by 2.4dB(A) and 0.6dB(A) respectively. The annual average value of traffic noise in the construction site dropped by 2.0dB(A) to 73.9dB(A).

Chapter 7 Status of Public Health in the Reservoir Area

7.1 Basic Situation

The monitoring scale and items in 2003 were the same as that in 2002, including Chongqing, Wanzhou District , Fengdu County of Chongqing and Yichang of Hubei Province. The total number of people monitored was 490,632. The gender ratio of male and female was 1.02:1.

In 2003, there were altogether 314 medical institutions at various levels in the monitoring points, 60 less than that in 2002, mainly caused by the emigration of people from the Three Gorges reservoir area. The total number of public health workers of various types at different levels was 4,307, 97 less than that in 2002. There were 3,716 hospital beds in the medical institutions, 370 more than that in 2002.

7.2 Statistics of Lives

7.2.1 Birth and death

In 2003, 3,766 people were born within the monitoring range, among which 1,971 were males and 1,795 were females. The birth rate was 7.68‰, a light increase compared with 2002. 2,918 people died with a mortality rate of 594.74/100 thousand. Among them 1,603 were males with a mortality rate of 647.80/100 thousand and 1,315 were females with a mortality rate of 541.78/100 thousand. 54 babies including 28 male babies and 26 female babies died. The mortality rate of babies was 14.34‰, decreased by 1.51‰ compared with 2002, close to the baby mortality rate in the whole country.

7.2.2 Analysis of death cause

According to the classification standard for ICD-9 diseases, the first five diseases causing people’s death were ranked as follows: the circulatory system diseases (28.8%), malignant tumor (22.8%), respiratory system diseases (20.2%), damnification and poisoning (12.3%) and digestive system diseases (3.2%). The death cases caused by the above five types of diseases accounted for 87.2% of the total deaths, indicating that these five types of diseases were the major causes for the death of people in the Three Gorges reservoir area. Among the top ten causes of death, the percentages of death causes of circulatory system diseases, damnification and poisoning, unidentified diseases and urinary diseases decreased a little, while those of malignant tumor, respiratory system diseases, digestive system diseases, endocrine system diseases, nervous system diseases and baby diseases increased a little.

7.3 Monitoring of Diseases

7.3.1 Monitoring of infectious diseases

In 2003, 2,890 cases of infectious diseases were reported from different monitoring points with

1 death case. The total morbidity rate was 589.04/100 thousand with mortality rate at 0.2/100 thousand and fatality rate at 0.035%. Among them, 1,802 cases in 12 types of category B infectious disease were reported with 1 death case. The morbidity rate was 367.28/100 thousand with mortality rate at 0.2/100 thousand and fatality rate at 0.055%. There was no report of category A infectious disease. 1,088 cases in 5 types of category C were reported with morbidity rate at 221.75/100 thousand. Morbidity rates of infectious disease in Categories A and B decreased by 9.2%, while that in category C increased by 25.2%.

In 2003, morbidity of the first five infectious diseases in category B was basically the same as in 2002. The order of them was: pulmonary tuberculosis (145.73/100 thousand), virus hepatitis (100.28/100thousand), dysentery (60.33/100 thousand), gonorrhea (37.50/100 thousand) and measles (14.88/100 thousand).

In 2003, there were reports of incidence of infectious diseases every month from the monitoring sites. 168-201 cases of category B infectious diseases were found each month from April to October. The peak morbidity rate was in August, but no so obvious, indicating that the incidence of infectious diseases was scattered and there was no outbreak of epidemics. Two peak periods for incidence of category C infectious diseases appeared in May and September. The major cause was the outbreak of urticaria and conjunctivitis epidemics in these two months.

7.3.2 Monitoring of endemic diseases

In 2003, the monitoring points in Chongqing, Wanzhou and Yichang conducted sampling inspection of endemic diseases and monitoring of iodine salt among junior and middle school students according to the requirements of the Iodine-Deficient Disease Monitoring Program of the Ministry of Public Health. The results of the monitoring conducted at the monitoring points in Chongqing urban area and Wanzhou showed that the rate of iodine-deficient goiter among children at the age of 8-10 were 11.9% and 7.5% respectively. Compared with the situation of 2002, morbidity of children goiter was kept at a lower level. At monitoring points, the average coverage of iodine salt was 97.0%, the acceptance rate of iodine salt was 98.6% and the edible rate of iodine salt was 95.7%. Compared with normal years, all the above three indexes were raised, indicating that the interference measures on iodine salt popularization were well performed.

7.4 Monitoring of Biological Media

In 2003, the deratization campaign carried out for the cleanup of the reservoir made the density of indoor and outdoor mice dropped to 1.3% and 3.4% respectively before water storage of the reservoir started in April, obviously lower than those of 2002. By September after water storage, the density of indoor mice dropped further to 1.0%, while that of the outdoor mice rose up to 3.7%. This situation should be given further attention.

In indoor areas, the brown mice were the superior kind, accounting for 57.1%. The small mice ranked the second, accounting for 34.7%. Besides there were also the small insectivora occasionally invading from outdoors. In the field, the small insectivora (mostly short-tail shrews) were the dominant kind, accounting for 66.7%. The black strip rats and the brown mice ranked as the second, accounting for 14.6% and 13.0% respectively. Small mice and Rattus flavipectus were at a lower rate, less than 5% of the total. As the host animals for epidemic hemorrhagic fever and

leptospirosis, the percentage of black strip rats remained at a low level though a little higher than 2002.

In 2003, all monitoring points collected kidney and lung samples of rat-type animals according to provisions to monitor infection of epidemic hemorrhagic fever and leptospirosis. Leptospirosis tests were made on 242 kidney samples. The results showed that only one sample tested at Yichang monitoring point was positive and all the others were negative. The positive rate was 0.4%. The epidemic hemorrhagic fever test on 14 rat lung samples all showed negative response.

In 2003, the results of monitoring on mosquitoes were similar to those of 2002. The density of mosquito in the livestock sty was higher than that in human living room. The density of mosquito in the livestock sty was 148.11/room.manhour in 2003, higherthan 135.77/room.manhour in 2002. This was mainly because of the obvious increase of the total density of mosquito at Yichang monitoring point. The density of mosquito in human living room was 43.09/ room.manhour, a little higher than 41.98/ room.manhour in 2002.

The peak period for the density of mosquito in human living room was the first ten days of June in Chongqing urban area and the first ten days of July in Fengdu, Wanzhou and Yichang. The peak period for the density of mosquito in livestock sty was the first ten days of June in Chongqing urban area and the first ten days of July in Fengdu and Wanzhou too.

According to analysis on species of the mosquitoes, the armiger's subalbatus were the dominant kind both in human living room and in the livestock sty, accounting for 55.3% and 56.4% respectively. The culicine mosquitoes ranked the second in human living room, accounting for 23.9%, the same level of 2002; Anopheles hyrcanus ranked the second in livestock sty, accounting for 15.0%.

Chapter 8 Monitoring and Researches of Eco-environmental Experimental Stations

8.1 Wanzhou Eco-Environmental Experimental Station

In 2003, Wanzhou Eco-Environmental Experimental Station continued conducting experimental observation on compound cultivation of grain, economic crops and fruits on ridges in slope field and experimental observation on hedgerow technology in slope land. The station also made investigation on the resources in Wuqiao falling belt of Wanzhou District.

8.1.1 Experiment on compound cultivation of grains, economic crops and fruits on ridges in slope farmlands

In 2003, three modes of cultivation were tested and observed, including compound cultivation of grain, economic crops and fruits on ridges, compound cultivation of grain, economic crops and fruits on flat lands, and compound cultivation of grain and economic crops on flat lands. The results showed that compared with compound cultivation of grain, economic crops and fruits on flat lands and compound cultivation of grain and economic crops on flat lands, compound cultivation of grain, economic crops and fruits on ridges could increase water content of soils and different layers of soils with less lapse rate of soil moisture content after rainy days and obvious water conservation and increasing efficiency. With the mode of compound cultivation of grain, economic crops and fruits on ridges, content of various kinds of nourishment in the soils was obviously higher than the other two modes and increased compared with 2002, and the growth rates of organic substances, total nitrogen, total phosphorus, total kalium, available nitrogen, available phosphorus and available kalium were 25.6%, 24.8%, 3.4%, 1.8%, 14.9%, 11.4% and 13.2% respectively with outstanding efficiency of soil fertilization, effectively reducing soil erosion and surface runoff, showing contribution of vegetable cover to conservation of soil and water.

Results of comparison between furrow soil and ridge soil in the mode of compound cultivation of grain, economic crops and fruits on ridges showed that various kinds of nourishment of furrow soil had reached or exceeded the level of ridge soil. Nourishment of furrow soil and ridge soil was both higher than 2002 with growth rate of the former higher than the latter. Among ridge soil and furrow soil, grains smaller than 0.02mm accounted for 65.8% and 46.2% respectively.

8.1.2 Experiment on hedgerow mode in slope fields

In 2003, comparison tests and observation on hedgerow mode in slope fields were made through establishing mode sub-areas respectively in 2 standard runoff observation fields at the slope of 25°, sub-area in mode of shaddock-king grass hedgerow agricultural technology and sub-area in mode of all-crop flat cultivation along the slope.

The results of comparison showed that the mode of shaddock-king grass hedgerow mode could make the soil containing more water than the mode of all-crop flat cultivation along the slope.

After 2 years' cultivation, water conserving and storing capacity of the soil was enhanced and soil moisture content obviously increased with gentle diminishing at a lower lapse rate, and larger changing rates of water content of different soil layers; the soil physical-chemical property was obviously improved; soil fertility was obviously heightened and higher than 2002; the growth rates of organic substances, total nitrogen, total phosphorus, total kalium, available nitrogen, available phosphorus and available kalium were 8.8%, 7.1%, 0.6%, 0.2%, 0.3%, 3.1% and 6.7% respectively. Nourishment was higher on the bottom of the hedgerows than between them, but the whole nourishment was higher than that in 2002 with the growth rate on the bottom of the hedgerows higher than between them. Nourishment content of soil under all-crop flat cultivation mode dropped a little because of serious soil and water losses.

8.1.3 Investigation on the resources in Wuqiao falling belt of Wanzhou District

According to the operation plan of the Three Gorges reservoir water level from 145m to 175m, Wuqiao falling belt in Wanzhou District covers a total area of 1,250.55 hectares. Based on the different types of land-use, the area of cultivation is 707.60 hectares; the area of township and rural residential spots and that occupied by industrial enterprises and mines is 206.64 hectares, the area of landscape is 129.57 hectares, water area is 86.71 hectares, forest area is 69.82 hectares, unused area is 46.20 hectares, traffic used area is 2.06 hectares and the area of grazing grass is just 1.97 hectares, accounting for 56.5%, 16.5%, 10.4%, 6.9%, 5.6%, 3.7%, 0.2% and 0.2% respectively.

8.2 Zigui Eco-Environmental Experimental Station

In 2003, Zigui Eco-Environmental Experimental Station continued the monitoring and research on soil erosion in the front of the Three Gorges reservoir area and pilot tests of ecological agriculture in mountain areas of low hills (altitude < 600m), semi-high hills (altitude from 600m to 900m) and high hills (altitude ⩾900m).

8.2.1 Monitoring of water and soil losses

Results of continuous monitoring on the typical runoff fields in the whole year of 2003 showed that: all the grass coverage, straw coverage and hedgerow technologies had function of water and soil conservation; contour-buried membrane leaking-proof wall had certain capacity of water conservation, but would cause serious soil erosion on bare land. Under shift cultivation mode between bare-land navel orange garden and grass (perennial ryegrass) - grass (Amaranthus hypochondriacus), rainy season caused bare land and artificial cultivation measures could cause a large amount of water and soil losses. Year round cultivation of Alfafa and flower-generated oil plants accompanied with contour-buried hedgerow technology and mode of navel orange garden interplanted with trifolium repens covered with the straws could bring about better ecological benefits, increasing fertility of the land and protecting water and soil.

Ecological adaptation analysis on the regional navel orange industry showed that it was very important for increasing output of navel orange to change local climate through artificial measures.

8.2.2 Experiment demonstration of upland ecological agriculture

In 2003, this experiment station conducted 5 experiment projects on upland ecological agricultural technologies. They were: high, middle and low altitude stereo-agricultural mode demonstration; high and low altitude soil fertilization technology experiment; high altitude soil maturation technology experiment, Houttuynia cordata Thuhb potash fertilizer test and a complete system of pollution-free navel orange cultivation technologies. The results showed that it would have outstanding economic benefit to develop ecological agriculture in line with local conditions of land at different altitudes in the reservoir area. Compared with current mode of agricultural cultivation, all the following modes could raise economic efficiency, increase output of the land and bring about more economic benefits: cultivating corn, potato and vegetable in high mountain land, cultivating rice and vegetable in middle mountain land and cultivating navel orange interplanted with vegetable and mellow. Using farmyard manure in cultivation of corn, broad bean and wheat was beneficial to land fertilization and maturation, increasing output and enhancing capability of the land in high mountain area; Interplanting navel orange garden with trifolium repens could obviously increase unit productivity of the navel orange and improve the quality. For the upland soil short of phosphorus and potash, using more potash and organic fertilizers could obviously upgrade the output and quality of Houttuynia cordata Thuhb.

8.3 Xiaogang Eco-Environmental Monitoring Station

In 2003, Xiaogang Eco-Environmental Monitoring Station conducted continuous observation on ground water dynamics and soil gleization indicators under different levels along the route between Xiaogang and Shi Dock, and the water balance regarding precipitation and evaporation within Xiaogang Station. The station also gave emphasis to the analysis on the influence of water storage of the reservoir to the water level of the Yangtze River and underground water level in the light of water storage, power generation and navigation opening in the second stage of the Three Gorges project.

8.3.1 Monitoring of groundwater dynamics

Neighboring the Yangtze River to the south and the Jing River, a branch of Han River, to the east, the area of Hong Lake is located in the downward area of the four lakes area in Jiang-Han plain with low and flat terrain. The altitude ranges between 22.0m and 25.0m, with relative altitude difference less than 2.0m and slope less than 5%. The surface water within this area is discharged into the Yangtze River through the Xintan estuary gate on the mainly west-to-east main trunk of the four lakes. In addition to the water generated locally, this area also receives water from mid and up stream areas of the four lakes. With water flow impeded, the water level of the groundwater in this area is rather high. The ground water includes mainly the pore water in the Fourth type of unconsolidated rock (phreatic water and pressure water) and deep crack water.

In 2003, the annual average of groundwater level in all observation wells ranged between 21.45m and 22.57m. The annual variation degree of the groundwater level ranged between 0.76m and 2.07m.

The analysis on correlation between pressure water/phreatic water and the water level dynamics of the Yangtze River indicated that the pressure water and phrealic water had very obvious

correlation with the water level of the Yangtze River. In the period of storing water in the Three Gorges reservoir, the water level dynamics of the Yangtze River observed from the side of Honghu Lake showed that the water level of the Yangtze River was gradually dropping after the water storage started, from 27.87m, the peak value before storage, to the valley of 23.95m, and returned gradually by the end of the month. The monthly average water level was 25.72m, 1.96m lower than that in June 2002. During water storage, the level of pressure water also dropped a little with monthly average water level obviously lower than 2002.

8.3.2 Monitoring of soil gleization indicators

In 2003, the monitoring of soil gleization indicators was continued for groundwater sections with different gleization levels from Xiaogang Farm to Shi Dock. The indicators were the same as 2002. The results showed that the gleization indicators were obviously different in winter and summer. The three indicators, the contents of total reducing materials, activated reducing materials and Fe^{2+}, had larger degree of change in winter than in summer. No matter degleization or reducing gleization, changes were violent in surface layer while slowly in core soil layer. So the core soil layer became the soil section layer reflecting the status and degree of soil gleization.

Compared with 2002, the measured value of gleization in 2003 (such as the total amount of reducing materials) was obviously less, especially in winter.

8.4 Terrestrial Plant Monitoring and Experimental Station

In 2003, main works of the terrestrial plant monitoring and experimental station included meteorological element monitoring, sampling belt setting up for biodiversity monitoring, ecological research on *Adiantum reniforme var. Sinense* and *Myricaria laxiflora*, and the conservation of rare and endangered plants using ex-situ approach.

8.4.1 Meteorological monitoring

In 2003, the annual mean temperature in Longmen River area was 10.4℃, while the extremely highest was 32.8℃ and the extremely howest was -12.1℃. The frost-free period was 186 days. The average temperature was 20.7℃ in July and 0.0℃ in January. For most months, the monthly mean temperature varied little compared with those in seven year from 1997 to 2003, but the mean temperature in May (13.9℃)was obviously lower than the average value (15.2℃) in the same period of the 7 years, and the mean temperature in August (20.6℃) was obvious higher than the average value (19.6℃) in the same period of the 7 years. The annual precipitation was 1,476.9mm, 79.8mm higher than the mean value for 7 years. Thehighest precipitation occurred in July, reaching up to 348.5mm. There was little difference in monthly precipitation compared with the average in 7 years while the monthly precipitation in April, May, July and September increased significantly compared with the average for 7 years by 47.0mm, 52.7mm, 83.8mm and 44.3mm respectively.

8.4.2 Biodiversity monitoring

In October 2003, the station completed the setting-up and investigation of the fixed sampling belt for monitoring in Yunyang. This sampling belt was located at Nanxi Town of Chongqing Municipality's Yunyang County (on the north bank of the Yangtze River and geographically located at 31°04'N and 108°51'E, with altitude ranging from 290m to 1,040m). Serious influence

of human activities for a long period had completely destroyed the primeval vegetation. The land at low altitude was mainly cultivated with fruit trees. The natural vegetation was composed only of the deteriorated shkub-grassland scatter in some parts. In the area at altitude over 700m there were some *Pinus massoniana* and *Cunninghamia lanceolata*, which were the main forest resources in this area mainly composed of aerial seeded and man-planted forests added with some secondary natural forests.

Yunyang fixed sampling belt for monitoring is composed of 9 fixed monitoring quadrats varying with altitude gradient varied continuously. The species in the sampling belt was rather less. More than 54 species of higher plants in total were found in the investigation. The species were mainly from families of *Gramineae*, *Rosaceae*, *Cyperaceae* and *Compositae* etc. The whole monitoring sampling belt was composed of 6 vegetational froms including *Pinus massoniana* forests, *Cotinus coggygria scrub*, *Cupressus funnebris* young forests, *Coriaria sinica* scrab, *Heteropogon contortus* herbosa and *Imperata cylindrical var. major* herbosa.

8.4.3 Ex-situ conservation of rare and endangered plants

By the end of 2003, a total of 35 rare and endangered plant species in the reservoir area had been conserved using ex-situ approach, accounting for 75% of the rare and endangered plants (47 species or varieties in total) in the reservoir area, already exceeding the target preset. Most of them were in good condition and at least 15 stems of more than 50% of the species were reserved. The number of reserved stems of some species that need particular conservation such as *Myricaria laxiflora* exceeded 500 and the reserved stems of *Adiantum reniforme var. sinense* exceeded 250, meeting the need for long term reservation.

In the process of ex-situ conservation of rare and endangered plants in 2003, more efforts were given to the protection of those plants already under conservation and long term monitoring of their growth. Through breeding, number of some rare and endangered plants increased, such as *Myricaria laxiflora* and *Adiantum reniforme var. Sinense* etc. At the same time, an important evergreen broad-leaf forestation species - *Castanopsis fargesii* was introduced into the reservoir area.

8.5 Estuary Eco-Environmental Monitoring Station

In 2003, the station continued its monitoring and research on the water salinity dynamics in the border section between land and sea as well as the water eco-environmental monitoring in estuary area.

8.5.1 Water salinity dynamics

Three monitoring sections in Yinyang Town, Daxing Town and Xinglongsha High-quality Seed Farm were set up at the border of land and sea, about 4, 22 and 35 km away from the river mouths. Three monitoring points were established for each section, about 200, 500 and 1,000m away from the Dam of the Yangtze River, mainly for monitoring water quality of the main stream of Yangtze north tributary, water quality inside the water gates near the sections, soil electronic conductivity, negative pressure of the soil, groundwater level and the groundwater electronic conductivity.

The monitoring results showed that soil moisture dynamics and soil salinity dynamics were two

factors of the soil water salinity dynamics, among which the groundwater dynamics was the most dynamic and most direct factor affecting soil water salinity dynamics. The monitoring section in Yinyang Town was located at littoral plain, so the burial depth of groundwater was rather less but the salt content of soil was rather high. Precipitation, evaporation and burial depth of groundwater were the most important factors affecting soil water content. In recent years, the burial depth of groundwater showed a tendency of gradual reduction, because the negative pressure of soil was in consistence with the changing pattern of the burial depth of ground water. The soil negative pressure has the lowest value in winter and spring when the water content of soil is the highest. The biggest soil negative pressure occurs in summer and autumn when the soil water content is the lowest. Particularly, the maximum soil negative pressure was measured in August and September. Precipitation and evaporation as well as their relative value decide the speed and direction of moisture movement. In certain degree, the level of groundwater mineralization decides the salt content of soil. Precipitation, evaporation and groundwater mineralization became the most important factors affecting the salt content of soil. In view of the changing pattern of salt content of soil between different years, the salt content of soil showed a overall tendency of decreasing, a status of natural eluviation of salt. There is a close hydraulic relationship between in-land river water and groundwater, with in-land river water supplementing or draining groundwater. So, the electronic conductivity between them is very close.

The change of soil negative pressure in Daxing Section was in consistence with time like the change of groundwater burial depth, mainly along with the change of seasons. The dynamic change of soil salt content was relatively steady. The degree of dynamics was relatively less. The effect of precipitation, evaporation and change of groundwater burial depth was no so obvious as in Yinyang Section, but the overall changing tendency was still rather obvious. It appeared that the change of soil salt content lagged behind the change of groundwater mineralization in certain degree. Electronic conductivity of the Yangtze River water changed along with the change of seasons in rather a large degree, while the electronic conductivity of the groundwater change along with the change of seasons in a lower degree and slowly, reflecting that the effect of the Yangtze River water to the groundwater was lagging behind.

8.5.2 Non-biological environment

● Hydrological factors

Within the marine area investigated, the water temperature ranged from 18.25 to 22.03 , with an average of 20.70 . By the large, the distribution pattern of water temperature was as follows: The temperature of water was higher inside the Yangtze River estuary and near the coast and higher off the coast. The salinity within the Yangtze River mouth was 3.00-5.47, while the salinity outside the river mouth ranged between 10.82 and 34.32, with an average of 28.83. The seawater near the coast was muddy with low transparency (mainly because of the effect of the muddy river water), while the seawater off the coast was clear with higher transparency.

● Water Chemical factors

The average monitored values of 6 indicators including dissolved oxygen, pH, phosphate, nitrate, ammonia nitrogen and total nitrogen were lower than those of 2002, but the averages of the other 3 indicators including COD, silicate, nitrite and total phosphorus were higher than those of 2002.

● Sedimentation factors

The Yangtze River carried a large amount of muddy and sand out of the estuary to the sea. Content of the soliquoid took obvious declivity. In 2003, the annual highest content of soliquid was not found inside the estuary but outside the estuary near the mouth and the northwest of the monitoring area out of the estuary, far lower than the usual monitored level. In the whole monitoring area, the content of soliquid ranged between 0.7 and 747.5 mg/L with an average of 51.0 mg/L. The distribution of ignition loss of soliquoid was quite consistent with that of the soliquid, lower near the estuary and higher in the pelagic sea, lower on surface and higher on bottom layer. The ignition loss of soliquoid ranged between 0.1 and 41.5 mg/L, with an average of 4.6 mg/L, also lower than 2002 obviously.

8.5.3 Biological environment

● Chlorophyll a and primary productivity

In 2003, the content of chlorophyll a and primary productivity were all significantly higher than 2002. The content of surface chlorophyll a ranged between 0.471-13.956 mg/m^3, with an average of 2.010 mg/m^3, changing by a big margin. The primary productivity in the ocean area was 35.361 and 999.389 mgC/m^2·d, with an average of 259.001 mgC/m^2·d. Affected by the runoff of the Yangtze River, in water area in the west of 122°15′ E, the content of soliquid was much higher and the water quality was muddy with transparency lower than 1.0m, and less than 0.5m at the mouth and inside the river course. The primary productivity of these water areas was rather lower.

●Phytoplankton

A total of 95 species of phytoplankton were collected and examined during the monitoring and investigation, including 75 species of diatom and 17 species of inoflagellate, 1 species of blue algae, one species of green algae and one species of gold algae. Among offshore law salt species, Skeletonema costatum was dominant in quantity. The number of phytoplankton in the investigation area was 1.0×10^4 - 54665.68×10^4/m^3, without significant change, with an average of 3037.11 $\times10^4$/m^3. In the middle of the investigation area, Skeletonema costatum formed a large concentration area. The domination of Skeletonema costatum was over 99%. Moreover, a small sized concentration area was also formed by the Skeletonema costatum at the mouth of the estuary.

● Zooplankton

A total of 88 species (classes) of zooplankton (including some bottom dwelling organism and their synchoropaedia) were monitored, investigated, collected and identified, including 30 species of copepod, 12 species of Tubularla crocea, 8 species of synchoropaedia, 6 species of shrimp and 1 species of Cumacea. According to analysis of historical data, the density of zooplankton in the investigation area showed a tendency of decrease from year to year. But in this investigation, the density of individual zooplankton saw a little increase. The overall average density of zooplankton was 150/m^3. The largest density of zooplankton was 982/m^3 . The distributions of different populations were different in geographical location and density, with different populations of zooplankton dominating different geographical locations.

● Benthos

In the sampling investigation and analysis appraisal, there were a total of 132 species of benthos,

including 34 species of mollusk, accounting for 25.8%; 17 species of carapace, accounting for 12.9%; 66 species of polychaete, accounting for 50.0%; 5 species of echinoderm, accounting for 3.8% and 10 species of others, accounting for 7.6%. In composition of species, polychaeta had the highest percentage, belonging to dominant one. The average of total biomass in the sample was 23.13 g/m^2. Among them, the average biomass of mollusk was the highest, reaching up to 9.73 g/m^2, and then the average biomass of the others inorder were 7.88 g/m^2 for polychaeta, 3.42 g/m^2 for carapace and 1.8 g/m^2 for echinoderm. On the other hand, there appeared a large amount of pollution tolerance species, causing increase of the total density of benthos, which means that part of the water near estuary of the Yangtze River was polluted in certain degree.

- **Fishery plankton**

In the investigation, 109 spawns and fry fishes were caught in total, including 24, all of which were floating spawns, belonging to 3 families and 4 species. The fry fish totaled 85 tails, belonging to 8 families and 9 species, except 1 fresh water species. In vertical trawl sampling, 24 spawns and 4 tails of fry fish were caught in total. Among spawns, the number of species of Sciaenidae was the largest. In horizontal trawl net sampling, no spawns were caught but 81 tails of fry fish in total, most of which were Engraulidae.

8.5.4 Fishery resources

In the investigation of fishery resources, a total of 61 species of biological resources were obtained, including 39,552 tails, weighing 3,544,262g, with average weight of each individual at 89.6g. Among these, there were 34 species of fish, 15 species of shrimp, 6 species of crab, 3 species of antispdix, 1 species of jellyfish, 1 species of cowfish and 1 species of pomfret. Number of fish species investigated this year was less than before. Except invertebrate whose species were a little more than 2002, the number of fish species was just 53% of that of 1998.

Compared with the autumn of 2002, the dominance of cutlass fish decreased and dominance of Cyanea capillata Linnaeus increased sharply, which distribution had expanded to the whole areas from a few stations in the north.

8.6 Peculiar Fish Experimental Station

In 2003, the major targets of peculiar fish experiment were *Procypris rabaudi* and *Sinilabeo rendahli*. The repeated experiments on artificial propagation of *Ancherythroculter nigrocauds* and *Megalobrama Pellegrini* in the same time, and information sere further collected on biology and artificial propagation of other peculiar fish. 20 times of habitat investigation were conducted in the whole year. The scope included mainstreams of the Yangtze River, the Laixi River, the Longxi River, the Chishui River, the Tang River, the Jialing River and the Mudong River etc. Through the investigation, information about distribution and catch amount of peculiar fish was obtained and data about *Ancherythroculter nigrocauda* and *Magalobrama pellegrini* were supplemented.

8.6.1 Biological characters of Procypris rabaudi

In 2003, the station collected data about *Megalobrama pellegrini*, *Rhinogobio cylindricus*, *Rhinogobio ventralis Sauvage* and *Procypris rabaudi* etc. were collected, and special research was conducted on biological characters of the *Procypris rabaudi*. *Procypris rabaudi* belongs to *Cyprinidae* family and *Procypris* genus, a fish species with a larger body and high economic value

specially distributing in the upstream of the Yangtze River. As the results of investigation showed, the major distribution spots of *Procypris rabaudi* included Luzhou section, Hejiang section, Mudong section of the Yangtze River, down stream of the Chishui River, down stream of the Jialing River and first level branch of the Yangtze River near Hejiang. The results of investigation showed that the *Procypris rabaudi* was composed of 9 age groups, from 0 to 8 years old. Compared with the data of 1970's, the mature ones with larger bodies (over 4 years old) decreased obviously. Procypris rabaudi become sexually mature at 2 years old, but some of their sexual glands would not be mature even by 5 years old. The propagation season is from March to May each year. Among the propagation group, Procypris rabaudi at the age of 2 or 3 account for 60% and the ratio between the male and female is 1:1.08. *Procypris rabaudi* is a kind of typical omnivore fish. The major foods include fresh water conchocelia, Gastropoda, aquatic insect, aquatic growth and algae etc. The habitats of *Procypris rabaudi* include river section with rocky geology, rock fissures and deep pond etc. The fry fish often appear in groups in meanders of large rivers, down stream of river branches and estuary etc. in spring and autumn seasons.

8.6.2 Experiment on artificial propagation

In 2003, the Peculiar Fish Experimental Station made dozens of times of experiments on artificial propagation, all adopting medical inducing method.

In the 4 times of artificial propagation experiments on *Ancherythroculter nigrocauda*, inducing rate reached 100%, average fecundation rate reached 89.5% and average birth rate reached 70.4%. In the 7 times of artificial propagation experiments on *Megalobrama pellegrini*, average inducing rate reached 91.1%, average fecundation rate reached 84.0% and average birth rate reached 67.7%. The data about early growing of *Megalobrama pellegrini* was supplemented. In the 4 times of artificial propagation experiments, primary success was achieved one time. No success was made in the 4 times of artificial propagation experiments on *Sinilabeo rendahli*. In addition to above, artificial propagation experiments were also conducted on major economic fishes in upper reaches of the Yangtze River such as *Leiocassis crassilabris, Mystus macropterus*,*Spinibarbus sinensis, Coreius heterodon and Pelteobagrus vachellii* etc. These experiments were significant for protection of the fishery resources in the upper reaches of the Yangtze River. The 5 times of artificial propagation experiment on *Spinibarbus sinensis* improved its birth pattern, among which 3 times of success were made on reducing, with reducing rate ranging from 42.9% to 75.0%, fecundation rate from 47.7% to 83.3% and birth rate from 50.0% to 72.0%.

8.6.3 Experiment on artificial raising and training

In 2003, artificial raising and training experiments were continued on *Ancherythroculter nigrocauda, Megalobrama pellegrini, Procypris rabaudi, Sinilabeo rendahli, Coreius guichenoti, Rhinogobio ventralis Sauvage, Rhinogobio cylindricus*, increasing parent fish reservation of *Ancherythroculter nigrocauda, Megalobrama pellegrini, Procypris rabaudi* and *Sinilabeo rendahli*. The results of experiment showed that for artificial raising and training, the *Procypris rabaudi* should be injected with narcosis at the first time when it was caught, otherwise the survival rate in raising and training could not be high, no matter the wild fish was injured or not. It was rather easier to raise and train *Sinilabeo rendahli.*

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