Bulletin on the Ecological and Environmental Monitoring Results of the Three Gorges Project

2005

State Environmental Protection Administration

May 2005

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Summary

2004 is the first year when the Three Gorges Project entered Phase III Construction period. The indicator of each construction project exceeds the annual target and the progress of the huge project meets the set objectives.

The Three Gorges Reservoir area enjoyed rapid social and economic development in 2004. The total production output of the reservoir area increased by 13.1% in comparable price compared with that of 2003 and the industrial structure was under further improvement. Each economic sector of the reservoir area enjoyed steady fast growth with continuous rising of living standard. In addition, such work as resettlement of local residents, restructuring of resettled enterprises and environmental protection was conducted smoothly and the basic situation of public health was normal.

In 2004, the overall situation of natural ecological environment of the Three Gorges Reservoir area was basically the same as that of 2003. The climate was a little bit warmer with average precipitation. During the wet season, there was not any large scale and severe flood disasters. The amount of the fish fry of the "Four major home fishes" in the river flow continuously decline with relatively big cut down of colia mystus and eel fry. The overall water quality of major fishery waters was good. Due to the continuous agricultural restructuring, the arable land area and the total sown area were on continuous reduction. As a result, the proportion of commercial crops increasingly rose and that of grain crops on continuous drop. However, there was certain rise of slight earthquakes.

In 2004, water quality of the main and tributary rivers of the Three Gorges Reservoir area was dominated by Grade III standard. There were some algal bloom phenomena in return water areas in spring and summer. As a whole, the environmental quality of the construction area and resettlement area was quite good.

In 2004, a total of 246.63 million tons of industrial wastewater from 51 major industrial sources was directly discharged into the Three Rivers (the Yangtze River, Jialing River and Wujiang River) with major pollutants being COD, NH_3-N and cyanide. The total amount of wastewater from urban sewage draining outlets and sewage treatment plants outlets of the 26 administrative districts (counties) of the reservoir area reached 498, 516,300 tons with total phosphorus, BOD_5 and COD as major pollutants. Total amount of urban garbage reached 2.0008 million tons. 529,700 tons of oil containing wastewater from ships and boats were discharged into the waters, up by 25.8% compared with that of 2003. 94.9 percent of them had been treated. Cargo ships and passenger ships were the main polluting ships. There was an increase of the application amount of both fertilizers and pesticides in the reservoir area.

Chapter 1 Progress of the Three Gorges Project

2004 is the first year when the Three Gorges Project entered Phase III Construction period. The indicator of each construction project exceeded the annual target and the progress of the huge project met the set objectives.

In 2004, a total of 6.9044 million m^3 of earth and rock were excavated in the construction of the right bank project; 135,800 m^3 of earth and rock were filled out; 2.9122 million m^3 of concrete were poured; and over 40,000 tons of metal structure, machinery and electric components were buried and installed on site. And over 30,000 m^3 of cement were grouted by way of consolidation, curtain surrounding or seam connecting methods. Five new power generation sets were put into operation. The total amount of power generated by the Three Gorges Power Plant on the left river bank reached 39.14 billion kW/h, more than the objective of annual plan. During the concrete construction period, strict measures were taken to prevent cracks by temperature control and eliminate difficult problems. In installing generation sets, the authority had furthered the quality control and launched the campaign of "obtaining stable operation in the first 100 days". It had established the mechanism of "people oriented, prevention first, enhancing supervision and continuous improvement". As a result, there were remarkable progresses in both the project quality and production safety.

In 2004, the comprehensive benefits of the Three Gorges Project such as flood resistance, power generation and water transportation emerged. The main stream of the Yangtze River occurred with the big flow of 60,500 m^3 on September 8. The Three Gorges Project played its role in reducing the flood peak for the first time and alleviated the pressure on flood fighting in the downstream. A total of 11 power generation sets were put into operation by the end of 2004 with accumulated power of 47.7 billion kW/h. This had played a key role in alleviating the power shortage of Eastern and Central China as well as Guangdong Province. After one year of trial operation, the double line 5-stage-ship lock has passed the examination and approval and been ready for formal navigation. Because the navigation conditions of the sections of the Yangtze River have been greatly improved after impoundment, a total of 43 million tons of goods have passed the ship lock, exceeding the historical record of 18 million tons that have passed the ship lock of the Gezhouba Dam.

Chapter 2 Economic and Social Development

2.1 Population, Society and Economy

By the end of 2004, the population of the Three Gorges Reservoir area totaled 19.9874 million, up by 0.7% compared with that of 2003. Among them, 14.0038 million were farmers. And 5.9836 million were urban and township residents, accounting for 29.9% of the total population, with an increase of 1.1 percentage points.

The total production outcome of the reservoir area in 2004 was 187.733 billion yuan RMB, an increase of 13.1% in comparable price against that of 2003. Among them, the total production output of Chongqing region was 171.605 billion yuan and 16.128 billion yuan for the reservoir area in Hubei Province, up by 13.7% and 7.5% respectively against that of 2003. The primary industry of the reservoir area realized added value of 23.891 billion yuan, up by 5.2%; the secondary industry realized added value of 91.92 billion yuan, up by 15.6% and the tertiary industry with added value of 71.922 billion yuan, up by 12.4% compared with that of 2003. Industrial restructuring was on continuous pace. As a result, the proportion of the added value of the primary, secondary and tertiary industries against the total production output was adjusted from 12.8:48.5:38.7 to 12.7:49.0:38.3.

Table 2-1 Major statistic indicators of economic and social development indexes of the Three Gorges Reservoir area in 2004

Indexes	Amount	Increase (%)
Total grain output (10,000 t)	656.51	3.3
Oil crop yield (10,000 t)	22.94	7.9
Tobacco yield (10,000 t)	3.92	-6.0
Meat output (10,000 t)	116.02	3.8
Aquatic products (10,000 t)	13.55	1.3
Financial revenue in local budget (100 million yuan)	88.13	22.9
Fixed assets investment (100 million yuan)	1227.30	27.0
Total sales volume of consumer goods (100 million yuan)	776.69	15.7
Average urban disposable income (yuan)	8554	10.1
Average net income of rural residents (yuan)	2469	15.3
Balance held on savings deposit (100 million yuan)	1637.55	15.9

In 2004, the production of each industry of the reservoir area was on steady fast growth. The added value of the industries realized 66.219 billion yuan, up by 18.4% compared with that of 2003 in comparable price. The construction industry realized the added value of 25.701 billion yuan, rose by 9.5% against 2003. The total amount of cargo shipment reached 319.59 million tons with an increase of 9.0%. A total of 621.96 million passenger times were completed in 2004 with an increase of 18.7%. In addition, postal and telecommunication services obtained 8035.16 million yuan revenue with an increase of 20.5%.

In 2004, the budgeted educational expenditure of the reservoir area reached 2.636 billion yuan, up by 14.2% against that of 2003. Public health expenditure was 662 million yuan with an increase of 9.2%. There were 467,600 professionals in the region, up by 0.7% against 2003. There were 491 full-time teachers per 10,000 middle and primary school students, 5 more than that of 2003. TV broadcasting coverage was 96.7%, same as that of the previous year.

2.2 Migration Resettlement

The migration resettlement work was smooth in 2004 with a total of 131,191 rural and urban residents resettled and 3.3624 million m^3 of various buildings constructed. In addition, 206 industrial and mining enterprises had been relocated.

● **Rural areas**

35,244 rural residents had been resettled and 36,379 people were assigned with their livelihood. 3200 mu land were developed, 6 new ponds and 6 channels had been built. 88 rural roads were built with total length of 278.25 km. Moreover, 780,500 m^2 buildings were constructed, among them, 768,600 m^2 were resettlement residential houses. The migrant farmers had planted 16.8398 million m^2 of farmland on contract basis, constructed 629,100 m^2 of residential buildings, built 1060 km road, placed 1.0595 million meter of water-supplying pipes and 911,200 m of communication lines.

● **Cities**

A total of 80,804 urban residents had been relocated. 14,000 m^2 of land had been leveled. 11.99 km of new road was built and 85,300 m of communication line had been placed. In the order of 97,000 m^2 urban area had been planted with grasses and trees. 1.7303 million m^2 of urban buildings had been constructed，1.4605 million m^2 of which were residential buildings.

● **Towns**

A total of 15,143 township residents were removed. In the order of 393,100 m^2 of buildings were constructed. Among them, 316,100 m^2 were residential buildings.

● **Industrial and mining enterprises**

206 industrial and mining enterprises had finished their resettlement work.

● **Special facilities**

A road of 54.15 km was rebuilt. Some big or medium sized bridges with a total length of 505.47 m were rebuilt. In addition, 13 ports, 126 wharfs, 7 hydro-power stations, 30 pumping stations, 3 power transmission and transforming stations and 1 post office were newly built. In the order of 696,800 m power transmission lines, 366,000 m communication lines and 387,000 m broadcasting and TV cables had been laid.

● **Environmental protection**

A total of 11.8483 million yuan had been invested in environmental protection work in the resettlement areas.

● **Counterpart assistance**

2004 is the year when the reservoir area have obtained most counterpart assistance with 4.079 billion yuan capital introduced (Among them, 3.835 billion yuan for economic cooperation projects and 244 million yuan for social welfare projects). This is twice the average annual attracted investment of the past 12 years. There were 209 new economic cooperation projects. Three schools were built with the help of the “Hope Project”. 1,632 people received training and 53 local officials attended exchange programs. The Three Gorges Reservoir area had received 173 visiting delegations with 2,490 person times.

By the end of 2004, the Counterpart Assistance Program had introduced 20.174 billion yuan in accumulation (Among them, 18.057 billion yuan for economic cooperation projects and 2.117 billion yuan for social welfare programs). There were over 2700 economic cooperation projects in the region and a total of 764 “Hope schools” were built. A total of 13,000 person times of migrant labour were arranged, more than 7,000 person times training were carried out. 462 person times of carders attended exchange program.

Chapter 3 State of the Natural Ecological Environment

3.1 Climate

The air temperature of the Three Gorges Reservoir area in 2004 was continuously higher than the average with precipitation close to normal years. The annual average temperature (AT) of the central and eastern part was evidently higher than that of usual level. While the annual air temperature of the western part was similar to normal level. In winter and spring, the air temperature of the region was obviously higher than the average level but slightly lower in summer and autumn. The average annual precipitation was above the average in the western part, same as usual in the central part but lower than the average in the eastern part of the reservoir area. Precipitation occurred more than the average level in winter and autumn, lower than the average in spring and same as usual in summer. During the wet season, there were not any large-scale and serious flood disasters. The annual average number of foggy days and average evaporation of the Three Gorges Reservoir area were less than the normal level. The annual average wind speed was slightly less than the average level with small or no change of wind speed at each typical weather station. Major climate disasters include storms, floods and its secondary geological disasters such as landslides and mud-rock flows, droughts, strong winds, hails, strong convective currents and heavy fogs.

Table 3-1 Monitoring results of meteorological items of each weather station of the Three Gorges Reservoir area in 2004

Station name	AT (℃)	RH (%)	P (mm)	E (mm)	AWS (m/s)	NHS (h)	NFD (d)	NT (d)
Chongqing	18.4	78	1188.4	669.6	1.3	981.3	33	36
Changshou	17.6	83	1365.4	1083.0	1.2	1101.3	46	32
Fuling	18.2	77	1269.5	663.8	0.6	1073.2	74	37
Wangzhou	18.5	75	1314.9	697.3	0.7	1073.2	8	28
Fengjie	18.2	72	1153.3	819.4	1.5	1421.6	9	26
Wushan	18.7	66	1074.3	1456.7	0.6	1430.4	6	28
Badong	17.5	69	1094.6	1624.5	1.8	1505.0	29	34
Zigui	18.1	74	868.1	1437.1	0.9	1416.7	1	19
Bahekou	17.3	73	897.3	1331.9	1.7	1357.0	0	28
Yichang	17.8	73	950.7	1457.1	1.2	1264.7	15	38

Note: RH stands for relative humidity; P for precipitation; E for evaporation; AWS for average wind speed; NHS for number of hours with sunshine; NFD for number of foggy days; NT for number of thunder storms.

The annual average precipitation of the Three Gorges Reservoir area was 1142.1 mm in 2004, similar to normal level. The maximum precipitation occurred in Changshou, which was 1365.4 mm. The minimum precipitation was in Zigui with 868.1 mm. Compared with normal years, precipitation in regions west to Wangzhou was 10%～20% more than that of normal years. The precipitation from Fengjie to Badong remained at normal level. But the rainfall of Zigui and its east was 10%～20% less than the average level of normal years. The precipitation of the reservoir area was above-average in 2003/2004 winter, below-average in the spring, normal in summer and slightly higher in the autumn. The annual precipitation presented double peaks with one in May and the other in September, 190 mm and 176 mm respectively, which were 25% and 35% more than the average level of normal years. The special distribution of precipitation of the reservoir area at each weather station was not even in each season. In winter and spring, most areas to the west of the Three Gorges Reservoir had above-average precipitation with storms and floods in some of the area, while the areas to the east of the dam had drought in winter and spring. In summer and autumn, there were frequent strong convective currents in part of the reservoir areas with continual storms and floods. However, there were also other areas suffering from heat wave and drought in summer and stage drought in autumn.

The pH value of the precipitation in the reservoir area was 4.77 in 2004 with slight drop in rainfall acidity compared with that of 2003. Rainfall acidity was the biggest in the autumn, followed by winter, spring and summer.

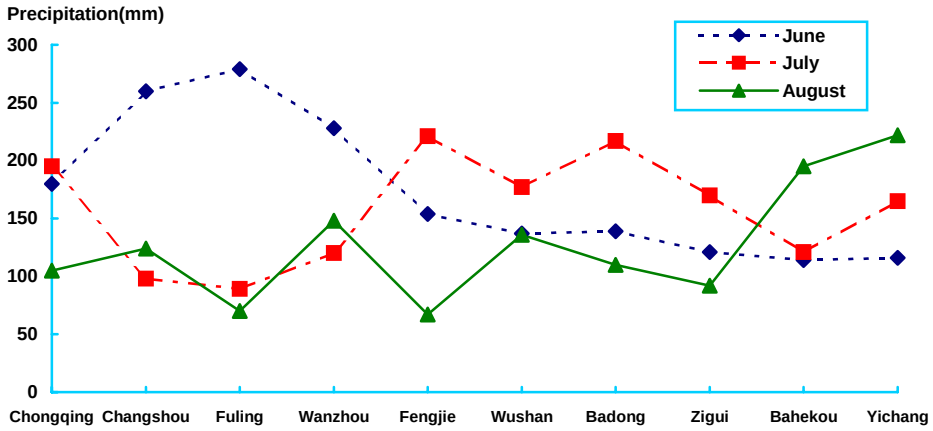


Figure 3-1 Spatial distribution curve of the precipitation of the Three Gorges Reservoir area in June, July and August of 2004

The annual average temperature of the Three Gorges Reservoir area in 2004 was 18.1℃, same as in 2003 but 0.6℃ higher than the historical average level. The annual average temperature in eastern reservoir area had an evident rise, 0.1～1.0℃ higher than the historical average at the same period. Among them, the biggest increase of annual average temperature occurred in Yichang, which was 1.0℃. The annual average temperature change in the western part was slightly higher than the average level of the past years. In winter and spring, the average temperature was evidently higher than the historical average by 1.2℃ and 1.5℃ respectively. In summer and autumn, the average temperature had a little drop by 0.3℃ and 0.1℃ compared with the historical average in the same period. In time distribution, the maximum monthly temperature of the reservoir area was in July with 27.8℃, the minimum one in January with 7.2℃. The annual temperature gap was 20.6℃. When Yichang was used as control area, it was indicated that the temperature of the Three Gorges reservoir area was 0.4℃ up in winter and 0.5℃ down in other three seasons after the impoundment. The change trend of temperature of the entire Three Gorges Reservoir area in 2004 was the same as that of the background region (Hubei, Sichuan and Chongqing) with fluctuations falling into the normal change range. On the whole, the impoundment did not impose obvious impact on the temperature of the reservoir area.

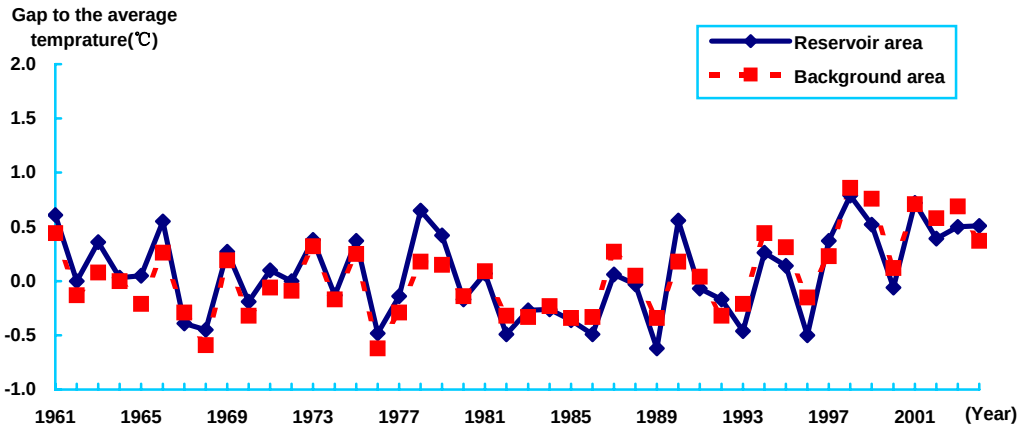


Figure 3-2 Yearly change of the gap to annual average temperature of the Three Gorges Reservoir area and that of the background region

The wind of the reservoir area in 2004 was not strong with the average wind speed being 1.1m/s, down by 0.2m/s compared with the normal level. Both the seasonal and monthly changes of the annual average wind speed of each weather station were not big. However, there used to be gale at the speed≥17.0m/s in the reservoir area subject to strong convective currents.

The annual average number of foggy days of the reservoir area in 2004 was 24, 5 days less than in 2003 and 13 days less than the historical average. There were more foggy days in the western part than in the eastern part. And more foggy days occurred in autumn and winter than in spring and summer. But the number of foggy days in all four seasons was smaller than the historical average. Except for Fuling and Zigui where experienced 1.7 and 0.7 more foggy days than normal level, other weather stations monitored 4 ~ 27 less foggy days than the historical average. The annual foggy days of Wanzhou and Fengjie were less than 50% of the historical average. The biggest reduction occurred in Wanzhou, which was 44.6 days less than the historical average.

The annual average relative humidity of the reservoir area in 2004 was 74%, down by 2 percentage points than the historical average. It increased from the east to the west. Compared with normal years, Wanzhou had 6% decline in relative humidity, while other regions basically kept the same. The relative humidity was the maximum in autumn and minimum in spring with seasonal change bigger than that of 2003.

The annual average evaporation of the reservoir area in 2004 was 1100.9 mm, about 10% less than the historical average. The regional distribution of the evaporation was big in the east and small in the west. From Wushan to the west except Changshou being normal, most of the region had 30% ~ 40% less evaporation compared with the historical average. To the east except Yichang with 10% rise, most of eastern region had normal evaporation level. The evaporation of each season of Fuling, Wanzhou and Fengjie was 20% ~ 40% less than the historical average. The monthly average evaporation of the reservoir area in June, July and August ranged from 115 mm to 168 mm, down by 10% ~ 20% compared with the historical average.

Major climate disasters of the reservoir area in 2004 were storms and floods as well as secondary geological disasters resulting from floods such as landslide and mud-rock flow, drought, gale, hail, strong convective current and heavy fog.

Storms and floods mainly occurred in summer and autumn with the scale of regional or local. All weather stations affiliated to Chongqing Municipality recorded at least 131 storms from May to September. The disasters such as floods, landslide and mud-rock flow triggered by those storms had caused several billion yuan direct economic losses. For example, the first strong storm at regional scale along Chongqing section of the Yangtze River on 29^{th} ~ 31^{st} of May affected 5.667 million people in 21 districts (counties) with direct economic losses of 548 million yuan. Another strong regional storm hit the same area on 4^{th} ~ 6^{th} of September with the biggest intensity since 1982, affecting 23 districts (counties) with 82 dead and the direct economic losses of 2.123 billion yuan. The areas under the administration of Yichang City Government, which was in the eastern part of the Three Gorges Reservoir area, recorded 29 storms from May to August. They led to rapid rise of river flow, flooded farmland, and frequent landslides and mud-rock flows. According to Land Resources Bureau of Yichang, the geological disasters resulting from strong regional precipitation during May ~ July totaled 23 with direct economic losses of 18.84 million yuan.

Drought disasters mainly happened in late winter, spring, summer and autumn. The droughts in late winter and spring usually covered large area with relatively longer period. Yichang prefecture, which located in the eastern part of the reservoir area, experienced the worst continuous drought from January to April (winter and spring) in the history, leading to severe lack of impoundment in ponds and reservoirs, grim situation for the prevention of forest fires and serious impacts on spring sowing. Summer drought mainly occurred in Chongqing Municipality west to the Dam, lasting from July 22 to August 12. According to local statistics, 35 districts (counties) under the jurisdiction of Chongqing Municipal Government were subject to spring and summer drought with direct economic losses of 789 million yuan, 645 million yuan of which came from agriculture. Autumn drought happened in Yichang east to the Dam, lasting from late September to early November with both grain and commercial crops subject to adverse impacts.

Gales and hails often occurred in spring and early autumn. Chongqing suffered from at least 17

gale or hail attacks in February and from April to September with direct economic losses of 420 million yuan. Meanwhile, Yichang experienced at least 11 gales and hails with direct economic losses of 130 million yuan.

Heavy fogs mainly occurred in winter, 8 of them had significant impacts. The heavy fog during December 11 ~ 12 lasted quite long with wide coverage, making the visibility of some regions down to dozens of meters and bringing to the closure of airport and highways as well as shutting down of navigation route. In addition, a very big traffic accident occurred at No.239 provincial highway in E'zhou City due to a heavy fog, leading to 5 dead and 24 injured.

3.2 Terrestrial Plants

Researchers carried out analysis on plant species of the Three Gorges Reservoir area in 2004. They did not find any new plant species, indicating that plant species remain at the amount of 2003. There were 6,088 vascular plants in the reservoir area, which belong to 208 families and 1,428 genuses. Among them, 400 were pteridophyte belonging to 38 families and 100 genuses; 88 were gymnosperm belonging to 9 families and 30 genuses; 5,600 were angiosperm that belonged to 161 families and 1,298 genuses.

At present, there are 51 precious, rare and endangered plant species in the reservoir area, accounting for 13.1% of the total (388 species). Among them, 8 are endangered, 19 rare and 24 close to be endangered. Those rare and endangered plant species that live under 400 m above the sea level are mainly Magnolia, Machilus, Adiantum reniformevar sinense and wild soybean.

3.3 Terrestrial Animals

There were 561 terrestrial vertebrates in the Three Gorges reservoir area, including 103 species of beats, 390 species of birds, 36 species of reptiles and 32 species of amphibious animals. Among them, nine are Grade I national protected animals and 64 species are Grade II national protected animals.

During winter monitoring of water birds, *Egretta alba* were found at Pengxi River flowing across Yunyang and Kai County. This is the first time *Egretta alb* were found at the Yangtze River and its major tributary waters since such monitoring activities were carried out in 1999. In addition, the breeding places of such Class II animals under Special State Protection as *Acipiter soloensis* and *Ketupa flavipes* were found in the reservoir area under the jurisdiction of Hubei Government. The investigations found that there were some changes in community population and distribution of mandarin ducks (Class II animal under special State protection). Investigators had observed mandarin ducks at such places as the upstream of the tailwater of Meixi River in Fengjie County, Daning River of Wushan County and the section of the Yangtze River from Wushan Port-Zigui Maoping Port with increased community population.

3.4 Fishery Resources and Environment

3.4.1 Fishery resources

The total fishing amount of the Three Gorges Reservoir area, waters downstream the huge Dam, Dongting Lake, Poang Lake and estuary area in 2004 was 63,000 tons, 10% down compared with that of 2003. The fish fry flow of the “Four major home fishes” at Jianli Cross-section downstream the Dam continuously declined. There was a relatively dramatic reduction of the output of coilia mystus and eel fry in estuary area.

- **Reservoir area**

The total fishery catch of the Three Gorges Reservoir in 2004 was 2,369 tons, 20% down compared with that of 2003. If we calculated the catch of individual species in the light of species composition in the reservoir area,491 tons were large mouth bronze gudgeon, 429 tons were bronze gudgeon, 294 tons were *pelteobagrus fulvidraco*，210 tons were carp, 207 tons catfish, 108 tons grass carp and 92 tons silver carp.

The monitoring results showed that the six species including large mouth bronze gudgeon, bronze gudgeon, *pelteobagrus fulvidraco*, carp, catfish and grass carp accounted for 73% of the total

fishery catch and were major commercial species of the reservoir area. However the size of catfish, large mouth bronze gudgeon and bronze gudgeon was still relatively small and their age was rather young. Among them, 92% of catfish were only one-year old.

● Waters downstream the Dam

The total fishery catch of the waters downstream the Three Gorges Dam in 2004 was 2,100 tons, a reduction of 14% compared with that of 2003. Among them, the capture of bronze gudgeon was 796 tons, catfish 551 tons, carp 184 tons, *pelteobagrus fulvidraco* 122 tons and the "Four major home fishes" 101 tons.

The catch monitoring results showed that bronze gudgeon, catfish and carp accounted for 73% of the total catch, which were still the commercial fish species in the waters downstream the huge Dam. However, the size of caught bronze gudgeon and catfish was smaller than the normal standard. Among the caught catfish, 70% were only one-year old.

● Spawning sites of the "Four major home fishes"

The fish fry runoff of the "Four major home fishes" at the Sanzhou Section in Jianli County in May ~ June of 2004 continuously decline to 339 million, down by 16.5% compared with that of 2003. This was only 13% of the baseline figure before the impoundment (1997～2002). In May of that year, there were only 37 million fry, only 11.6% of the minimum level of the historical same period (318 million fry in 2000) before the impoundment.

● Dongting Lake

The total catch of Dongting Lake was 26,000 tons in 2004, a reduction of 13% compared with that of 2003, 13,000 tons of which coming from the eastern part of Dongting Lake, 8,000 tons from the southern Dongting Lake, 5,000 tons from the western Dongting Lake, accounting for 49%, 31% and 20% of the total respectively.

There were 45 spawning sites for carp and crucian with total area of 277 km^2, 13 of them in the eastern part of Dongting Lake with an area of 139 km^2; 26 in southern part of Dongting Lake with an area of 63 km^2, 6 of them in the western part of the Lake with an area of 75 km^2. The population of carp spawning communities were 175,000 weighing 296 tons, down by 10.7% and 16.1% respectively compared with that of last year. A total of 5.035 billion eggs were produced, similar to that of 2003. The population of egg-laying crucian carps was 378,000 weighing 110 tons, up by 39.5% and 8.9% respectively compared with that of 2003. A total of 4.198 billion eggs were produced, an increase of 10.3% compared with that of 2003.

There were 34 feeding sites in this Lake with a total area of 676 km^2. 13 of which were in eastern part of the Dongting Lake with an area of 108 km^2, 16 in southern part of the Dongting Lake with an area of 108 km^2, and 5 in eastern part of the Dongting Lake with an area of 164 km^2. The species of fish in those feeding sites were mainly carp, crucian, catfish, *pelteobagrus fulvidraco*, the "Four major home fishes", bighead and bream. The fish population in the Lake is 5.763 billion, 13% down compared with that of 2003.

● Poyang Lake

The total fish catch was 32,000 tons in Poyang Lake in 2004. There were 33 spawning sites for carps and crucians in the lake with an area of 230 km^2, down by 47% compared with that of 2003. A total of 3.58 billion eggs were produced, a decrease of 27% compared with that of 2003.

The area where fish could seek feed was 430 km^2 in the Lake, a reduction of 7% compared with that of 2003. It was mainly distributed in the central and southern part of the Lake. The type of fish in the Lake were mainly black carp, grass carp, silver carp, bighead, carp, crucian, catfish and mandarin fish.

● Estuary area

The total catch of coilia mystus during the fishing season of 2004 was 748.36 tons. And the average catch of every ship during the fishing season was 3311.31 kg with the output of 30481.46 yuan, down by 40.5%, 34.1% and 29.2% respectively compared with that of 2003. The total fish

resources was 795.79 tons with the instantaneous resource amount at the end of fishing season being 47.43 tons, down by 40.1% and 33.2% respectively compared with that of 2003. The average length of coilia mystus during the fishing season was 155 mm with average body weight of 14.44 g, up by 5.4% and 3.4% respectively compared with that of 2003.

During the fishing season, the total catch of parent Chinese turtle crabs was 1826.69 kg. And the average catch of every ship during the fishing season was 68.16 kg, down by 45.5% compared with that of 2003. The total fish resource was 47.47 tons with instantaneous resources of 42.64 tons at the end of the fishing season. The average shell length of the parent crabs during the fishing season was 62 mm with 67 mm in average width and 145.1 g in average weight, down by 1.4%, 4.7% and 13.7% respectively compared with that of 2003.

The total catch of eel fry during the fishing season was 5101.25 kg, a reduction by 42.7% compared with that of 2003. The average index of eel fry of every ship had an evident decline compared with that of the previous year. And the average output of each ship in the whole season was 70308.1 yuan, down by 25.7% compared with that of 2003.

3.4.2 Fishery environment

The authority organized the monitoring work on 17 water quality items of 7 major fishery waters (Yibin, Banan, Wanzhou, Jingzhou, Yueyang, Lake outlet and estuary) in the mainstream of the Yangtze River, Dongting Lake, Poyang Lake and estuary Area and carried out water quality assessment in line with the “Fishery Water Quality Standards (GB11607-89)” in 2004. The findings indicated that the overall water quality of major fishery waters of the Yangtze River Basin was good in 2004 and could basically meet the requirements for the growth and egg-laying of fishes. However, some waters were subject to pollution at some degree and major pollutants were petroleum, copper, non-ionic ammonia and volatile phenol.

In Guagongshan water area of Yibin, the concentration of copper exceeded water quality standard by 100% during the egg-laying, fattening and winter periods. In Xiaziliang water area of Banan, pollutants such as petroleum, volatile phenols, zinc and copper also exceeded water quality standard at different degree. Among them, the concentration of petroleum in 66.7% samples went beyond relevant standard in fattening period and in 100% samples over winter. The concentration of volatile phenol in 33.3% samples went beyond the standard in winter. The level of zinc of 100% samples exceeded the standard during both the egg-laying period and fattening period. The copper concentrations of 100% sample went beyond the standard during the spawning period. However, all monitoring items of the water area in Shaiwangba of Wanzhou did not go beyond the standards.

In Guanyinsi water area of Jingzhou, the concentration of petroleum of 66.7% samples went beyond the standard during fish fattening period and lead concentration of 16.7% samples went beyond the standard during winter.

In Chenglingji water area of Yueyang, all monitoring items did not go beyond relevant standards. In water area of Lake outlet, petroleum concentration of 33.3% samples in egg-laying period and 100% samples in winter went beyond the standard. The concentration of non-ionic ammonia of 100% samples in fattening period and 33.3% in winter went beyond the standard.

All monitoring items of the egg-laying grounds of the “Four major home fishes” in Jianli monitoring site did exceed the standard during May and June. Each monitoring item of spawning sites of Chinese sturgeon in water area of Yichang did not exceed the standard in November.

The pollutants in fishery waters of Dongting Lake were copper and non-ionic ammonia. The concentration of copper of 18.2% samples in egg-laying period, of 18.2% samples in fattening period and 9.1% samples in winter went beyond the standard. And the non-ionic ammonia level of 18.2% samples went beyond the standard during egg-laying period.

The pollutants in fishery waters of Poyang Lake were copper and non-ionic ammonia, too. The concentration of copper of 100% samples went beyond the standard during both the egg-laying, fattening and winter periods. The non-ionic concentration of 100% samples went beyond the standard during the fattening period.

The pollutant of fishery waters in estuary area of the Yangtze River was volatile phenol and its concentration of 50% of the samples went beyond the standard during the fish season of coilia mystus.

3.5 Endemic Fish Species and Rare Aquatic Animals

3.5.1 Endemic fish species in the upper reaches of the Yangtze River

In 2004, samples of 100 species (sub-species) of fishes were collected in the upper reaches of Yangtze River (referring to the middle and lower reaches of Jinsha River, Hejiang section of Yangtze River and Xishui River, Wanzhou section of Yangtze River, Wujiang River), including 24 endemic fishes dominated by large mouth bronze gudgeon, *Rhinogobio ventralis, Rhinogobio cylindricus* and *Schizothorax wangchiachii* in terms of quantity. The middle and lower reaches of Jinsha River boasts 18 endemic species, the most diversified in all the river sections monitored. The diversity of endemic fish species diminished gradually down the mainstream of Yangtze River to only three species to the Wanzhou section.

According to the fish eggs collected, inferences had been made regarding the spawning sites of large mouth bronze gudgeon and *Leptobotia elongata*, two endemic species of fish with great quantity and extensive distribution: the spawning beds of large mouth bronze gudgeon in the middle and lower reaches of Jinsha River were mainly distributed in the river section between Jinanqiao and Shudi; the spawning sites of *Leptobotia elongata* were scattered in many places, among which those in the river section between Jinjiangqiao and Yupao River mouth as well as the Long River section were relatively larger.

3.5.2 Rare and precious fish species

The spawning sites of Chinese sturgeon remained in the river section between Gezhou Dam and Miaozui and was concentrated in the floodgate area of the Dam, the upper reaches of the river center area and the deep bed area of the river's left bank between Yichang Shipyard and the supply service wharf in Miaozui, totaling about 3 km. The Chinese sturgeons in this area laid their eggs on November 11, 2004, which is the latest over recent years. The spawning occurred in a large scale, and, compared with the previous year, it lasted longer. The breeding population of Chinese sturgeon mainly inhabited in the river section between Gezhou Dam base and Yanzhi Dam, about 2km's long and no less than 10m's deep in the water. The findings of Micro-satellite DNA mark study indicated that currently 90% of young Chinese sturgeons in the Yangtze River were the offspring from natural reproduction, which demonstrated that population from natural reproduction remained dominant in the Chinese sturgeon communities and the amount of artificial breeding was only supplementary.

The phenomena of egg-eating fish hunting for Chinese sturgeon eggs lasted until November 19. There were 9 species of such fish, namely large mouth bronze gudgeon, bronze gudgeon, *Pelteobagrus vachelli*, *Rhinogobio ventralis, Rhinogobio cylindricus, Leptobotia elongata, Leiocassis crassilabris, Gobiobotia filifer* and *Leiocassis longirostris.* Among these large mouth bronze gudgeons caught, 81.8% of them ate fish eggs, the highest among the fish species; the percentage of egg-eating for *Pelteobagrus vachelli* was the second, up to 76.2%. According to observation, bronze gudgeon devoured Chinese sturgeon fries occasionally.

In 2004, there was no record of accidental catching of *Psephurus gladius*, Chinese sturgeon, *Acipenser dabryanus* and *Myxocyprinus asiaticus* in the middle and lower reaches of Jinsha River. Seven cods were caught accidentally in Luzhou city in November, all being cultivated from other waters. Among the seven, three were raised temporarily. Three *Myxocyprinus asiaticus* caught accidentally in Luzhou River section were 115 cm, 120 cm and 123 cm in length and 17 kg, 33 kg and 20 kg in weight respectively. One of the three fishes was dead, and two others were returned to the Yangtze River. In Wujiang River, one *Myxocyprinus asiaticus,* 126 cm in length and 20.8 kg in weight, was accidentally caught and was then returned to the River. In the lower reaches of Wujiang River, no case of accidental catching of rare fishes had occurred. In the Wanzhou river section, one *Myxocyprinus asiaticus* weighing around 1kg was caught accidentally and was raised temporarily. In the Yichang river section, no *Psephurus gladius* and *Acipenser dabryanus* were found, neither was there any case of accidental catching of *Myxocyprinus asiaticu*. 17 parent Chinese sturgeon were caught for artificial breeding or ultrasonic tracking studies.

3.6 Agricultural Ecology

Surveys were conducted in 181 towns and villages of 19 counties (cities) in the Three Gorges Reservoir area, the same as that of the previous year.

3.6.1 Ecological environment of the farmland

The survey results showed that ecological environment in farmlands within the reservoir area in 2004 changed remarkably. With the impoundment of the reservoir reaching the height of 139 m and the adjustment of agricultural structure, the reservoir area quickened the pace to transform slope farmland and convert the arable land for forestry and grassland. The area of cultivated land and planting area of farm crops continued to diminish, and agricultural production kept its priority on grain crops but with lower proportion. In contrast, the percentage of commercial crops kept on rising.

In 2004, the total area of arable land in the reservoir area was 199,210 ha, 4.7% less than the previous year. The multiple cropping index was 238.0, 1.4 percentage points lower than that of the previous year. The total agricultural planting area was 502,900 ha, down by 5.4% compared with that of 2003. Among the total planting area, 359,200 ha were for grain crops and 143,710 ha for economic crops, taking up 71.4% and 28.6% of the total respectively. Compared with the previous year, the planting area of grain crops, mainly that of flatland in river valleys and cultivated land on mild slopes, continued on the decrease, whereas the areas of such economic forests as woodlands, orchards and tea gardens increased to some extent.

As to the farming system, paddy fields were dominated by two-crop system, accounting for 60.0% of the total, down by 1.3 percentage points than that of the previous year. Dry land mainly practiced the three-crop system, accounting for 56.0% of the total, 9 percentage points down compared with that of 2003.

3.6.2 Rural energy

In 2004, the energy structure in countryside of the Three Gorges Reservoir area was improved to some extent. Energies for rural households were still mainly derived from direct combustion of firewood and straw while the energy percentage from small hydropower stations and marsh gas generation kept on rising. Among all kinds of rural energy, straw constituted the largest proportion at around 39.5%, followed by firewood, small coal pits, small hydropower stations and marsh gas, accounting for 36.9%, 16.4%, 1.7% and 5.5% respectively. Compared with the previous year, energies derived from the direct combustion of stalks, small hydropower stations and marsh gas increased by 2.2, 0.5 and 2.1 percentage points respectively while those from direct combustion of firewood and small coal pits decreased by 3.7 and 1.1 percentage points.

In 2004, the development of marsh gas energy-generation and utilization in rural families of the reservoir area was accelerated. There were 1.357 million households using marsh gas energy in the area. 80,531 methane ponds were set up with annual capacity of 29.955 million m^3 methane gas. The three figures were up by 25.1%, 4.9% and 3.5% respectively compared with that of 2003. The underlying reasons for rapid expansion of methane utilization were that the Central Government stepped up its efforts in eco-environmental improvement in the Three Gorges Reservoir area, especially in the development of eco-homes and extensive application and further popularization of high-efficiency eco-agricultural technologies based on marsh gas utilization.

3.6.3 Plant diseases and insect pests of crops

The total farmland area affected by plant diseases and insect pests in 2004 had a remarkable drop compared with that of 2003. The actual losses were alleviated, and the area involved in prevention and control of plant diseases and insect pests increased. There was no outbreak or great imperil of certain plant diseases or insect pests, and no new plant disease or insect pest was observed.

The total area suffering from plant diseases and insect pests was 699,130 ha·times, 426,610 ha·times of which were affected by insect pests mainly caused by paddy stem borer, and 272,510 ha·times by plant diseases dominated by *Piricularia oryzae*. In 2004, the total area affected by plant

diseases and insect pests, the area subject to insect pests and that of plant diseases fell by 1.7, 1.5 and 1.9 percentage points respectively compared with that of 2003.

The area involved in the prevention and control of plant diseases and insect pests reached 598,610 ha·times, among them, 365,320 ha·times were for the prevention and control of insect pests and 233,290 ha·times for the prevention and control of plant diseases, an increase of 3.0% and 3.1% respectively in comparison with that of the previous year. The actual loss of grain production amounted to 40,064 tons, 0.7% less than the previous year, while 137,865 tons potential grain losses were averted, 0.8% higher than that of 2003.

Table 3-2 Statistics on the occurrences of major plant diseases and insect pests in the Three Gorges Reservoir area

Types of plant diseases and insect pests	Area affected (100 ha·times)	Area for prevention and control (100 ha·times)	Control rate (%)	Losses recovered (t)	Actual losses (t)	Degree
Paddy stem borer	1143.9	938.2	82.02	28113.0	16161.0	Heavier than medium
Nilaparvata lugens	1585.3	1188.2	74.95	37899.0	833.8	Medium
Piricularia oryzae	251.7	396.4	157.47	30076.0	13294.0	Slight
Rice sheath blight	1454.6	1032.4	70.97	13244.0	599.1	Medium
Corn northern and southern leaf blight	29.6	3.9	13.06	29.0	234.0	Slight
Gibberella zeae	664.1	775.8	116.82	4335.7	614.9	Slight
Osmotin Harpinea	245.6	203.9	83.01	7841.0	4461.0	Slight
Corn sheath blight	420.8	395.4	93.96	7124.0	3283.0	Heavier than medium
Orange spider	1195.6	1052.6	88.04	9205.1	584.1	Medium

3.7 Geological Disasters

3.7.1 Earthquakes

In 2004, 1,062 earthquakes measuring at $M_L \geqslant 0.0$ occurred from the head to the middle areas of the Three Gorges Reservoir area (108°20′-112°00′ E, 29°55′-31°45′ N). Among these earthquakes, 625 quakes measuring at $0.0 \leqslant M_L < 0.9$, 378 ones at $1.0 \leqslant M_L < 1.9$, 56 ones at $2.0 \leqslant M_L < 2.9$ and three at $3.0 \leqslant M_L < 3.9$. The largest earthquake, which measured at $M_L = 3.8$, occurred in Yesanguan, Badong County (about 50 km away from the bank of the reservoir) at 11:14, September 13, 2004.

According to the results of GPS observation, crust deformation measurement and mobile gravity observation, there was obvious crust deformation response in the reservoir area after impoundment, and the regional tectonic stress field was undergoing adjustment. During 2004, micro-earthquake activities intensified in the Three Gorges Reservoir area, and eight earthquakes measuring over $M_L = 2.5$ hit the region between Badong County and Zigui County.

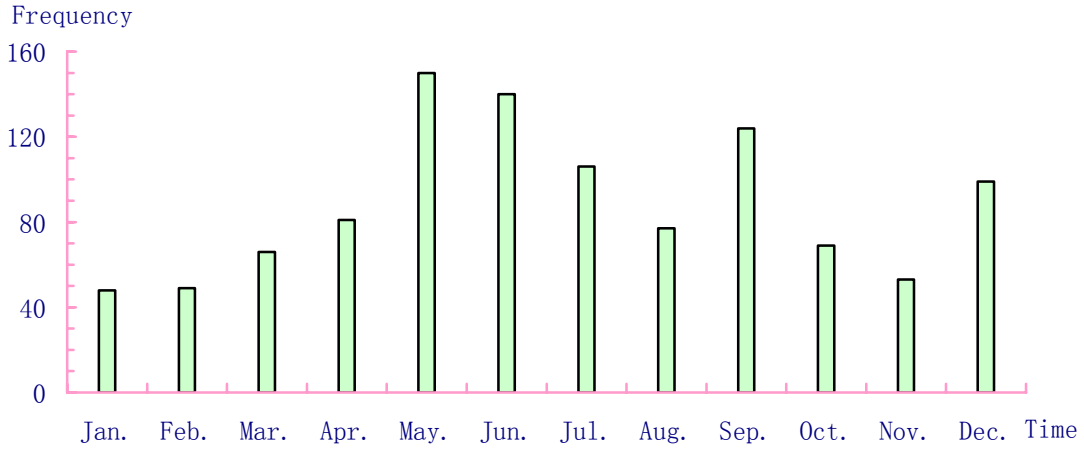


Figure 3-3 Earthquake frequency from the head to middle of the Three Gorges Reservoir area in 2004

3.7.2 Collapses, landslides and mud-rock flows

● Monitoring and early warning

During 2004, professional monitoring of serious landslides and reservoir banks in 129 sites (sections) were conducted. A Grade III GPS monitoring network composed of 1,337 sites covering the whole reservoir area was established, and Local Area Networks (LAN) for 20 districts (counties) of the reservoir area were completed. Apart from the 1,216 landslide monitoring and preventing sites identified by phase II planning having finished the construction and put into operation, 1,939 other landslide monitoring and preventing sites identified in phase III planning were launched ahead of schedule, making the total number of such sites across the reservoir area to 3,155, which had greatly expanded the area where landslides could be prevented or monitored by the masses with enhanced capacity. As a result, a monitoring and early-warning system composed of a professional monitoring system, a mass monitoring and preventing system and an information system was initially established and played its due role. During 2004, 9 dangerous situations of landslides or collapses were predicted in the reservoir area of Hubei Province. 52 such dangerous situations were predicted in the reservoir area of Chongqing Municipality, which had effectively safeguarded the life and property of 9,757 people. At 2:00 am, June 14, 2004, Maliushu Slope in No. 9 production team, Xiushan Village, Nantuo Town of Fuling District glided towards the Yangtze River abruptly, sinking to a depth of 782 mm on average with horizontal move of 450 mm, causing the collapses of three houses and serious deformation of nine. Thanks to timely early warning and evacuation, the life of 45 local residents and properties amounting to 800,000 yuan were protected. On June 14, 2004, a new crack (with a length of 13.55m and a width of 2cm to 5cm) appeared in the landslide groups located in Group No. 3 and No. 4, Beishan Village, Zhonggulou neighborhood office in Wanzhou District. The adjacent packaging factory also saw a new crack (10m long and 2 cm to 3cm wide), and the slope was at a risk of collapse. However, the disaster prevention plan was initiated in time, and efforts were made to mitigate the danger, thus eliminating the potential threat to the lives and properties of 688 people.

● Prevention and control projects

Initiated in July 2001, the Geological Disaster Prevention and Control Project (phase II) of the Three Gorges Reservoir area lasted for two and a half years. By the end of 2003, all the tasks concerning prevention and control had completed according to plan. The project passed the initial check and acceptance by national authority in 2004.

During the second phase of this project, various prevention and control programs were completed including 158 collapse and landslide control programs (including 44 in Hubei Province and 114 in Chongqing Municipality), bank collapse control programs of 59 sections (22 in Hubei

Province and 37 in Chongqing Municipality), 130 control programs on excavated high slopes (34 in Badong County, Hubei Province, 96 in Wushan County and Fengjie County of Chongqing Municipality), 803 deep-foundation treatment programs (178 in Badong County, Hubei Province and 625 in Wushan County and Fengjie County, Chongqing Municipality) as well as some resettlement projects.

The implementation of the Geological Disaster Prevention and Control Project (phase II) ensured the timely impoundment and power generation of the Three Gorges Reservoir, enhanced the geological safety of the resettlement area and improved the environment for human settlement in the reservoir area. After one year's water storage, the control projects basically realized its prevention and control objective and yielded remarkable social and economic benefits.

Chapter 4 State of Pollution Sources Discharge

4.1 Investigation and Monitoring on Key Industrial Wastewater Pollution Sources

In 2004, industrial wastewater directly discharged into the Yangtze River, Jialing River and Wujiang River (hereafter referred to as the Three Rivers) from 51 key industrial pollution sources in the reservoir area amounted to 246.63 million tons. Among them, the industrial wastewater from main downtown areas in Chongqing Municipality (including Banan District, Dadukou District, Jiulongpo District, Nan'an District, Yuzhong District, Yubei District, Jiangbei District, Shapingba District and Beibei District) constituted the largest proportion of 126.688 million tons, taking up 51.4% of the total. The volume of industrial wastewater from Changshou District, Fuling District and Jiangjin City was also relatively large, 34.2997 million tons, 34.0587 million tons and 29.7202 million tons respectively, accounting for 13.9%, 13.8% and 12.1% of the total respectively.

Pollutants from 51 key industrial sources totaled 25,939.04 tons, including 24,279.93 tons of COD (chemical oxygen demand) accounting for 93.6%; 1,451.50 tons of ammonia nitrogen, taking up 5.6%. The rest of the pollutants were petroleum, cyanide, volatile phenol, Arsenic, hexavalent Chromium and Lead, amounting to 183.75 tons, 17,079.30 kg, 3,102.30 kg, 2,465.82 kg, 1,114.17 kg and 94.94 kg respectively.

COD, ammonia nitrogen and cyanide were major pollutants in industrial wastewater, and their respective equivalent standard pollution load ratio was 60.6%, 24.2% and 8.5% and the accumulated one was 93.3%. Major downtown areas, Fuling District, Changshou District and Shizhu County (Xituo Town) of Chongqing Municipality were major wastewater discharge areas with the equivalent standard pollution load ratio being 38.4%, 22.8%, 15.6% and 11.7% respectively and the accumulated number standing at 88.5%. The major wastewater discharge industries were chemical industry, food industry, industries related to production and supply of electric power, steam and hot water and mechanical industry with the equivalent standard pollution load ratio being 32.9%, 26.3%, 19.5% and 6.9% respectively, and the accumulated number being 85.6%.

Table 4-1 Wastewater from 51 key industrial sources directly discharged into the Three Rivers in the Three Gorges Reservoir area during 2004

District/County	Wastewater volume (10,000 t)	COD (t)	Petroleum (t)	Ammonia Nitrogen (t)	Hexavalent Chromium (kg)	Lead (kg)	Arsenic (kg)	Volatile Phenol (kg)	Cyanide (kg)
Jiangjin city	2972.02	794.40	—	—	—	—	—	—	—
Main downtown areas	12668.80	9358.22	153.45	178.31	458.25	84.94	2459.26	2869.00	11639.30
Changshou	3429.97	5614.01	26.96	43.34	637.72	—	—	231.00	—
Fengdu	1.10	16.92	—	0.22	—	—	—	—	—
Kaixian	611.00	433.33	—	117.00	—	—	—	—	3900.00
Fengjie	20.99	4.91	—	—	—	—	6.56	—	—
Fuling	3405.87	6217.99	3.34	449.05	7.50	10.00	—	2.30	—
Shizhu (Xituo Town)	2.21	400.00	—	650.00	—	—	—	—	—
Wanzhou	1078.86	1016.08	—	9.56	10.70	—	—	—	—
Wushan	6.26	4.38	—	—	—	—	—	—	—
Wuxi	3.90	—	—	—	—	—	—	—	—
Wulong	187.92	227.38	—	—	—	—	—	—	—
Xingshan	68.10	—	—	—	—	—	—	—	210.00
Zhouxian	2.00	10.45	—	4.02	—	—	—	—	—
Zigui	204.00	181.85	—	—	—	—	—	—	1330.00
Total	24663.00	24279.93	183.75	1451.50	1114.17	94.94	2465.82	3102.30	17079.30

4.2 Investigation and Monitoring of Urban Sewage

In 2004, a total of 498.5163 million tons of sewage from 26 districts (counties) in the reservoir area was discharged directly into the Three Rivers through urban sewage outlets and the outlets of sewage treatment plants. Among them, the discharge volume of main downtown areas of Chongqing Municipality topped the list at 306.8854 million tons, taking up 61.6% of the total. Wanzhou District and Fuling District ranked the second and third respectively with the discharged volume at 44.2643 million tons and 28.8646 million tons, accounting for 8.9% and 5.8% of the total.

Total phosphorus (TP), BOD_5 (biochemical oxygen demand) and COD were major pollutants in urban sewage, their equivalent standard pollution load was 47.1%, 26.9% and 16.3% respectively, and the aggregated one was 90.3%. The main downtown area, Wanzhou District and Fuling District of Chongqing Municipality were the main sewage discharging areas with the equivalent standard pollution load standing at 72.0%, 11.5% and 4.4% respectively, totaling to 87.9%.

Table 4-2 Urban sewage directly discharged to the Three Rivers in the Three Gorges Reservoir area in 2004

District/County	Discharge volume (10,000 t)	COD (t)	BOD_5 (t)	Ammonia nitrogen (t)	TP (t)	Volatile phenol (t)	Petroleum (t)
Jiangjin City	375.66	470.95	237.98	100.29	9.97	0.16	0.47
Main downtown areas	30688.54	72325.80	37196.10	5166.00	1033.20	13.05	39.06
Changshou	1749.30	3331.97	1390.82	292.59	45.94	0.07	0.21
Fuling	2886.46	4783.33	2604.96	679.52	45.86	0.38	1.18
Wulong	579.33	973.30	431.94	84.57	9.67	0.02	0.07
Fengdu	697.00	1022.58	492.54	121.43	20.27	0.05	0.14
Shizhu (Xituo Town)	84.86	251.06	79.62	28.70	2.07	0.03	0.08
Zhongxian	951.59	325.30	177.15	53.04	7.67	0.05	0.16
Wanzhou	4426.43	8624.00	3418.00	1277.34	204.77	2.43	7.16
Kaixian	1470.95	1204.80	495.68	57.38	4.91	0.05	0.13
Yunyang	769.42	286.45	143.95	76.92	9.38	0.06	0.18
Fengjie	1067.00	543.50	347.21	49.25	11.20	0.04	0.12
Wushan	853.15	1472.20	757.10	105.20	21.00	0.30	0.80
Wuxi	328.14	600.43	238.95	26.09	2.20	0.02	0.06
Badong	582.72	738.50	303.84	35.17	3.01	0.03	0.08
Xingshan	452.60	353.90	145.60	16.87	1.44	0.01	0.04
Zigui	622.33	436.40	179.56	20.80	1.78	0.02	0.05
Yiling	1266.15	1902.75	782.84	90.60	7.77	0.07	0.21
Total	49851.63	99647.22	49423.84	8281.76	1442.11	16.84	50.20

4.3 Investigation on Urban Garbage

In 2004, the reservoir area generated up to 2.0008 million tons of urban garbage, among which 1.5341 million tons were landfilled and 466,700 tons were released. The urban garbage from the main downtown areas of Chongqing Municipality constituted the largest proportion of 1.168 million tons, taking up 58.4% of the total. The second and third position was taken by Wanzhou District and Fuling District with 146,000 tons and 113,100 tons respectively, accounting for 7.3% and 5.7% of the total respectively.

Table 4-3 Urban garbage in the Three Gorges Reservoir area in 2004

Unit：10,000 t

District/County	Total Amount	Landfill Amount	Discharged Volume	District/County	Total Amount	Landfill Amount	Discharged Volume
Jiangjin City	1.21	1.10	0.11	Kaixian	5.59	4.74	0.85
Main Downtown Areas	116.80	81.76	35.04	Yunyang	4.38	3.72	0.66
Changshou	9.12	7.54	1.58	Fengjie	6.20	5.40	0.80
Fuling	11.31	9.85	1.46	Wushan	4.38	4.38	0.00
Wulong	2.74	2.37	0.37	Wuxi	1.77	1.03	0.74
Fengdu	5.58	5.48	0.10	Badong	2.74	2.40	0.34
Shizhu	0.27	0.19	0.08	Xingshan	1.46	1.00	0.46
Zhongxian	5.47	4.48	0.99	Zigui	2.38	2.19	0.19
Wanzhou	14.60	12.78	1.82	Yiling	4.08	3.00	1.08

4.4 Monitoring of Pesticides and Chemical Fertilizers

In 2004, investigation results on the utilization of pesticides and chemical fertilizers in 181 towns and villages of 19 counties in the reservoir area showed that the application of chemical fertilizers remained at a high level and was still on the rise. Both the total application amount and per unit application amount of pesticides increased at relatively large margin.

4.4.1 Chemical fertilizers

In 2004, calculated by the percentages of nitrogen, phosphorus, and potash contained respectively in the three kinds of fertilizers, up to 112,000 tons chemical fertilizers were applied in the reservoir area, 75,700 tons of which were nitrogen fertilizer, 25,700 tons were phosphorus fertilizer and 10,600 tons potash fertilizer. The total application of chemical fertilizers increased by 1.6% compared with that of the previous year, but a reduction of 2.8% in the application of nitrogen fertilizer. The application of potash fertilizers and phosphorus fertilizers rose by 16.8% and 2.9% respectively. A total of 562.2 kg fertilizers were applied in every hectare, up by 6.6% compared with that of the previous year.

The fertilizers applied in the reservoir area were dominated by nitrogen fertilizers. The ratio among consumed nitrogen fertilizer, phosphorus fertilizer and potash fertilizer was 1:0.33:0.14, witnessing certain degree of improvement than in 2003. This indicated that fertilizer application ratio was developing in an appropriate way.

4.4.2 Pesticides

In 2004, 649.66 tons pesticide equivalents were applied in the reservoir area including 325.24 tons of organic phosphorus pesticides, 155.72 tons of organic nitrogen pesticides, 53.89 tons of trifluorocypermethrin pesticides, 39.81 tons of herbicides and 75.00 tons of others. Compared with that of the previous year, the application of pesticide equivalents increased by 0.7%, organic phosphorus pesticides and other pesticides dropped by 18.5% and 17.7% respectively, and the application amount of organic nitrogen, trifluorocypermethrin pesticides and herbicides rose by 90.5%, 29.0% and 26.3% respectively. The application of pesticide equivalents per hectare was 3.26 kg, up by 5.5% compared with that of 2003.

Though the application of organic phosphorus pesticides dropped sharply in the reservoir area, it still constituted half of the total, indicating that the application of high-toxicity pesticides remained popular in the reservoir area.

4.5 Monitoring of Mobile Pollution Sources

There were nearly 130 shipping companies and more than 9,300 registered shipping vessels in the reservoir area in 2004, a certain degree of drop compared with that of the same period of 2003. The major underlying reason for the drop was the reduction of the amount of small ships and

non-mechanically propelled boats while the number of cargo ships, motor ships and big ships causing oil pollutions increased. Of all the shipping vessels, 6,079 ones had oil pollution, 52 of which were cruise ships, 1,870 were passenger ships, 2,830 were cargo ships, 381 tugboats and 946 other types.

4.5.1 Ship transportation

In 2004, the lock of Gezhouba Dam operated for a total of 15,323 times passing through a total of 75,313 ship-times, which transported 1.53 million person-times and 30.42 million tons of cargo, 157%, 153%, 160% and 179% of the same period of 2003 respectively. The permanent ship lock of the Three Gorges Dam had operated for 8,719 times with 75,056 ships passing through bearing the passenger load of 1.73 million person-times and cargo load of 34.31 million tons, which was 199%, 215%, 160% and 249% of the same period of 2003 respectively. In Chongqing Municipality, Fuling District and Wanzhou District of the Three Gorges Reservoir area, large and medium-sized ports saw a passenger flow of 11.45 million person-times, 2.0% less than that of the same period of 2003 and a cargo flow of 31.38 million tons, up by 36.4% compared with that of the previous year.

4.5.2 Oil-containing wastewater from shipping vessels

Estimated from the monitoring results oil-polluted water from 430 ships in the reservoir area, a total of 529,700 tons of oil-containing wastewater were discharged by ships in the reservoir area in 2004, up by 25.8% than that of the previous year. Among them, 502,700 tons were treated with the treatment rate of 94.9%. A total of 451,300 tons discharged wastewater met the standard with the up-to-standard rate of 90.0%. Of all kinds of shipping vessels, the oil-containing wastewater discharged by cruise ships, passenger ships, cargo ships, tugboats and other ships were 9,900 tons, 179,300 tons, 212,300 tons, 97,600 tons and 30,600 tons respectively, accounting for 1.9%, 33.8%, 40.1%, 18.4% and 5.8% of the total respectively.

Among the oil-polluted wastewater, 44.0 tons were contaminated by petroleum, down by 33.3% compared with that of the previous year. Cargo ships and passenger ships were major polluters and discharged 33.94 tons and 8.73 tons of petroleum-containing wastewater respectively, taking up 77.1% and 19.8% of the total. The amount of petroleum-containing wastewater discharged from tugboats, cruise ships and other ships was 0.52 ton, 0.78 ton and 0.03 ton respectively, accounting for 1.8%, 1.2% and 0.1% of the total respectively.

4.5.3 Domestic wastewater from ships

According to the number of passengers, ship crew, their daily water consumption amount as well as pollutant discharge coefficient, it was calculated that 1.898 million tons of domestic wastewater was discharged by ships in the reservoir area in 2004, up by 46.0% compared with that of the previous year. However, only 18,000 tons of such wastewater received treatment with treatment rate of 0.9% and discharge up-to-standard rate of 0.9%. The expansion of ship size, the increase of ships and ship crew that generate pollution, the rise of per capita water consumption as well as absence of domestic wastewater treatment equipment on most ships were the main reason why there was an increase in the discharge of domestic wastewater from ships and a low treatment rate.

A total of 478.0 tons of domestic sewage pollutants were discharged by all shipping vessels in the reservoir area. Among them, 268.0 tons were BOD_5 and 210.0 tons were suspended particles, taking up 56.1% and 43.9% of the total respectively.

4.5.4 Garbage from ships

In 2004, seven garbage collection sites were set up in some ports of the Three Gorges Reservoir area, equipped with six collection ships (one of them is capable of collecting oil-polluted water as well). A total of 4,940 tons of garbage was collected throughout the year, up by 14.9% compared with that of 2003. In addition, 242 tons of oil-polluted water was collected.

4.5.5 Ship pollution accidents

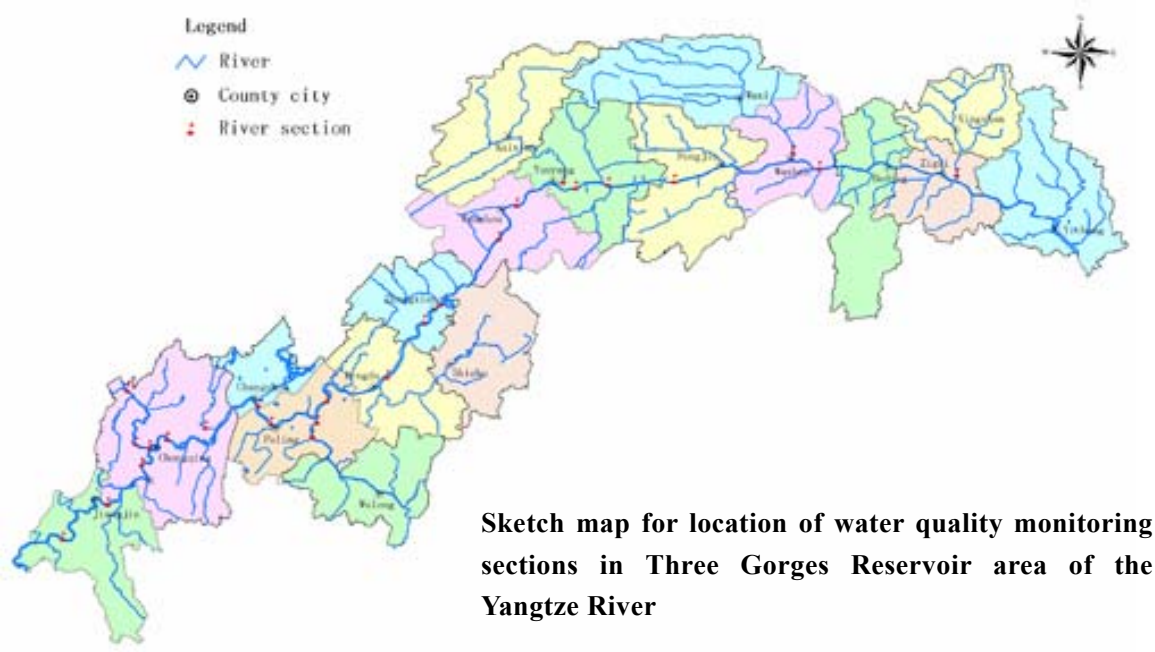
In 2004, the Three Gorges Reservoir area saw 16 pollution accidents including three general pollution accidents and 13 traffic-related pollution accidents, less than that of the previous year. Among those accidents, three were severe accidents, six were big ones, five were general ones and two were minor ones, accounting for 18.8%, 37.5%, 31.2% and 12.5% of the total respectively.

Table 4-4 Discharge of oil-containing wastewater from shipping vessels in the Three Gorges Reservoir area

Ships		Oil-containing wastewater						Petroleum	
Type	Amount	Discharge amount (10,000 t)	Percent (%)	Disposed amount (10,000 t)	Treatment rate (%)	Up-to-standard discharge amount (10,000 t)	Up-to-standard rate (%)	Discharge amount (t)	Percent (%)
Cruise ship	52	0.99	1.9	0.99	100.0	0.99	100.0	0.03	0.1
Passenger ship	1870	17.93	33.8	17.21	96.0	15.32	89.0	8.73	19.8
Cargo ship	2830	21.23	40.1	19.53	92.0	17.77	91.0	33.94	77.1
Tugboat	381	9.76	18.4	9.66	99.0	8.60	89.0	0.78	1.8
Other ship	946	3.06	5.8	2.88	94.1	2.45	85.1	0.52	1.2
Total	6079	52.97	100.0	50.27	94.9	45.13	90.0	44.00	100.0

Chapter 5 Status of Water Environmental Quality

In 2004, the monitoring of water quality of mainstream and tributaries of the Yangtze River, early-warning monitoring for water blooms during sensitive period as well as monitoring of pollution belts in riverbanks constituted all components of water environmental quality monitoring work in the Three Gorges Reservoir area. The assessment and testing method of water quality were conducted in accordance with the "Environment Quality Standards for Surface Water (GB3838-2002)", whereas the assessment of nutrition status of water body was carried out according to the "Technical Regulations on the Assessment Method and Classification for Eutrophication of Lakes (Reservoirs)", which is formulated by China National Environmental Monitoring Center.



Sketch map for location of water quality monitoring sections in Three Gorges Reservoir area of the Yangtze River

5.1 Monitoring of Water Quality of the Mainstreams of the Yangtze River in the Reservoir Area

16 monitoring sections were set up in the mainstream of the Yangtze River in the reservoir area, and six water quality monitoring activities were conducted during the three water periods, ie, dry period (Februrary), level water period (May) and high water period (August). Three vertical lines in the left, middle and right side of each monitoring section were set to collect water samples at the depth of 0.5m under the water surface for analysis. Water quality assessment included 15 items such as pH value, disolved oxygen, permanganate index, BOD_5, ammonia nitrogen, petroleum, volatile phenol, total phosphorus, COD, cyanide, mercury, lead, cadmium, arsenic and hexavalent chromium.

5.1.1 Annual water quality monitoring in the reservoir area

In 2004, water quality of the sections in mainstream of the Yangtze River of the reservoir area met or was superior to Grade III water quality standard. No sections meeting Grade I water quality standard were observed, and sections of water quality meeting Grades II and III standards accounted for 6.3% and 93.7% of the total samples respectively.

During dry period: no section meeting Grade Ⅰ water quality standard was observed in the mainstream of the reservoir, and the number of sections of water quality meeting the Grade II and III standards took up 50.0% respectively.

During level water period: no sections with Grade I water quality were observed, and the number of sections meeting Grade II and III water quality standards took up 37.5% and 62.5% respectively.

During high water period: there were no sections meeting Grade I and II water quality standards and the water quality of each section monitored met Grade III standard.

Table 5-1 Assessment result of water quality of the mainstreams of the Yangtze River in Three Gorges Reservoir Area in 2004

Section	Location	Dry period	Level water period	High water period	Whole year
Zhutuo	Yongchuan City	III	III	III	III
Tongguanyi	Jiangjin City	III	III	III	III
Wanglongmen	Yuzhong District	II	III	III	III
Cuntan	Jiangbei District	II	III	III	III
Huangcaoxia	Changshou District	II	III	III	II
Yazuishi	Fuling District	II	II	III	III
Qingxichang	Fuling District	III	II	III	III
Mishiquan	Fengdu County	III	III	III	III
Jiutiaohe	Zhongxian County	III	III	III	III
Lian'erqi	Zhongxian County	III	III	III	III
Tongziyuan	Wanzhou District	II	II	III	III
Shaiwangba	Wanzhou District	II	II	III	III
Xiayansi	Yunyang County	III	III	III	III
Yanmatou	Yunyang County	III	III	III	III
Baidicheng	Fengjie County	II	II	III	III
Peishi	Wushan County	II	II	III	III

5.1.2 Year-on-year water quality variations

There was no obvious change in water quality of the mainstreams of the Yangtze River in the reservoir area compared with the previous year. The water quality of most sections of the river still met Grade III water quality standard, and the number of sections meeting Grade II water quality standard declined by 13.7 percentage points.

Table 5-2 Year-on-year comparison of the water quality of the mainstreams of the Yangtze River in the Three Gorges Reservoir Area

Water periods	Dry period		Level water period		High water period		Whole year	
Year	2003	2004	2003	2004	2003	2004	2003	2004
Number of total sections monitored	15	16	15	16	15	16	15	16
Percentage of sections meeting Grades I~ II water quality standards (%)	33.3	50.0	33.3	37.5	20.0	0.0	20.0	6.3
Percentage of sections meeting Grade III water quality standard (%)	53.3	50.0	66.7	62.5	80.0	100.0	80.0	93.7
Percentage of sections meeting or being better than Grade III water quality standard (%)	86.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0

5.2 Monitoring of Water Quality of Tributaries of the Yangtze River in the Reservoir Area

A total of 9 monitoring sections were set up in 6 tributaries of the Yangtze River in the reservoir area, including 2 sections under national water quality monitoring program (Daxigou section in Jialing River and Maliuzui section in Wujiang River) and 7 others (Beibei and Linjiangmen section in Jialing River, Wulong section of Wujiang River, Yulin River mouth, Xiaojiang River mouth, Daning River mouth and Xiangxi River mouth). Three vertical lines and three monitoring spots were set up in each of the three sections of Daxigou, Maliuzui and Linjiangmen, while three vertical lines and six monitoring spots were set up in each of the two sections Beibei and Wulong.

For the setions of Yulin River mouth, Xiaojiang River mouth, Daning River mouth and Xiangxi River mouth, two vertical lines and two monitoring spots on each line were set up. One monitoring work of water quality was carried out in each month to all the river sections, totaling 12 times throughout the whole year of 2004.

5.2.1 Water quality of sections under national monitoring program

The water quality monitoring work of river sections under national monitoring program included 23 basic items (excluding total nitrogen) in accordance with the "Environmental Quality Standards for Surface Water (GB3838-2002)".

The assessment results indicated that in 2004, the water quality of Maliuzui section of Wujiang River fell into Grade V standard, while water quality of Daxigou section of Jialing River was inferior to Grade V standard. Fecal coliform bacteria were the only pollutant and generally exceeded the standard. Comparing the water quality in twelve months of the year, we could see that in the Maliuzui section of Wujiang River, water quality was Grade IV in January and February, Grade V from May to October, worse than Grade V in March, April, November and December. The annual average water quality of this section was of Grade V The Daxigou section of Jialing River met Grade V water quality standard in each month of the whole year. Generally speaking, the water quality of Wujiang River was better than that of Jialing River.

Table 5-3 Water quality of the national river monitoring sections in the Yangtze River tributaries of the Three Gorges Reservoir areas in each month of 2004

Section \ Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Daxigou section	Water quality[1]	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V	Worse than Grade V
	Water quality[2]	III	II	III	III	III	II	III	III	II	III	III	II	III
Maliuzui section	Water quality[1]	IV	IV	Worse than Grade V	Worse than Grade V	V	V	V	V	V	V	Worse than Grade V	Worse than Grade V	V
	Water quality[2]	III	III	III	III	II	II	II	II	III	III	II	II	II

***Note**: Water quality[1]: Each of the 23 basic items was included in the assessment.*

Water quality[2]: 22 items were included in the assessment, excluding fecal coliform bacteria.

5.2.2 Water quality of ordinary sections

For ordinary sections, water quality assessment included 11 items such as pH value, dissolved oxygen, BOD_5, ammonia nitrogen, permanganate index, arsenic, hexavalent chromium, copper, cadmium, lead and petroleum.

The assessment results showed that the water quality of the sections of the Yangtze River tributaries in the Three Gorges Reservoir area was good. One section met Grade II water quality standard; 5 sections met Grade III water quality standard and one met Grade IV water quality

standard, taking up 14.3%, 71.4% and 14.3% of the total respectively. Among all these sections, the Xiangxi River mouth section met Grade II water quality standard, and the water quality of five sections at Linjiangmen, Yulin River mouth, Wulong, Xiaojiang River mouth and Daning River mouth met Grade III standard. Beibei section of Jialing River only met Grade IV water standard due to the concentration of petroleum exceeding the standard.

5.3 Early Warning Monitoring of Water Blooms in Sensitive Period in the Reservoir Area

5.3.1 Nutrition status of the water bodies

In the first ten days of June 2004, early warning monitoring was conducted to some Class I tributaries of the Yangtze River in the reservoir area upon the coming of sensitive period of water bloom. 24 monitoring sections were established in 12 Class I tributaries with one section in the middle and one section at the end of each tributary. The assessment of nutrition status of the water body included 5 items including chlorophyll a, total phosphorus , total nitrogen, transparency and permanganate index. The results indicated the followings.

During the first ten days of June 2004, over 50% of Class I tributaries of the reservoir area were in a state of eutrophication. Among the 24 sections, 14 were under eutrophication, accounting for 58.3% of the total, the rest 10 were under intermediate eutrophication, taking up 41.7% of the total. Among the eutrophicated sections, 12 were under light eutrophication and were distributed mainly in Longhe River of Fengdu County, Ruxi River and Huangjin River of Zhongxian County, Baolong River in Wushan County, Modao Brook, Changtan River and Daxi River in Yunyang County. Two sections in Zhuxi River of Wanzhou County were under moderate eutrophication. The sections under intermediate nutrition were mainly distributed in Quxi River of Fengdu County, Daning River and Shennü Brook in Wushan County and Tangxi River, Modao Brook and Changtan River in Yunyang County.

5.3.2 Occurrence of water bloom

In the spring and summer of 2004, many water blooms at different degree occurred in some Class I tributaries (including reservoir bends) of the Yangtze River in the reservoir area. The occurrences were relatively concentrated in a certain period of time with rather fixed covering area.

Water blooms happened in Xiangxi River in the late February, the mid March, early April and early June, which lasted for 5 days, one month and ten days respectively, and the river sections affected mainly ranging from over 2 km upstream of the Gorge to the inflow river mouth with a length of about 20 km. The water was turbid and resembled the color of soy sauce or with a tint of chartreuse. The dominant algae were *Cyclotella sp*. and *Asterionellopsis sp*..

Water blooms occurred at Daning River in late March to early April, late May, early June and late June, which lasted for about ten days. The range of water bloom in Shennü Brook were concentrated in the river section from Bawu Gorge to Daning River mouth, Shuanglong-Yinwotan-longmen river section and the section from Maduhe river to river mouth with a length of nearly 25 km. The water body appeared the color of light chartreuse, chartreuse or light soy sauce color and smelled quite fishy. *Cyclotella sp*, *Asterionellopsis sp*, *Peridinium*, *Pandorina* and *Microcystis* were the dominant algae.

The water blooms in both Shennü Brook and Baolong River occurred from the late May to early June and late June, each lasting for about ten days. The occurrence in Shennü Brook ranged from Daoche Dam to No. 6 navigation mark, about 1.5 km long. There were red threadlike things in water body with dominating algae being *Pyrrophyta*, *Cyclotella sp*. and *Pandorina*. The water bloom in Baolong River involved the river section between Hongyan River and Putao Dam with a length of about 2.5 km. The water body appeared chartreuse in color with fishy smell. The dominated alga was *Microcystis*.

In early March, Fenghuangshan Reservoir bend in the front of the Dam had water blooms lasting for one week or so. The water body looked like soy sauce and the dominant algae were *Asterionellopsis sp*. and *Peridinium*.

5.4 Monitoring of Pollution Belts in Riverbanks

In 2004, one monitoring activity was conducted to the pollution belt near the sewage outlet of Yunyang Sewage Treatment Plant during level water period (the last ten days of October) and dry period (the last ten days of December) respectively. One section was set up 150m upstream from the sewage outlet as the inflow control section. Another five sections with varied intervals were identified 500 m downstream of the waters near the riverbank. Six vertical lines with varied intervals were set up in each section for sample collection in line with the diffusing pattern of the pollutants, and three vertical sampling points in each vertical line were identified for collecting water samples from the depth of 0.5m, 5m and 10m beneath the water surface for analysis. During the monitoring process, such items as water depth, flow speed, flow and the distance to the bank were also measured. The water quality monitoring items included permanganate index (COD_{Mn}), ammonia nitrogen (NH_3-N) and total phosphorus (TP).

5.4.1 Hydrological conditions

After impoundment of the Three Gorges Reservoir, the water surface gradient of the Yangtze River had mitigated, leading to very low velocity of water flow. During the level water period, the maximum velocity of surface water flow was 20cm/s with the average of only 6cm/s. In the dry period, the velocity near the bank was generally less than 2cm/s. The sharp decrease of flow velocity was not conducive to the dilution and diffusion of pollutants and made it easy to form high-concentration pollution belts near the sewage outlets.

5.4.2 Range of the pollution belts

The range of the polluted areas of the river varied due to different loads of COD, NH_3-N and TP as well as different velocity of water flow. The monitoring results indicated that there were both pollution belts of which the monitoring items were in excess of that of the background level and pollution belts of which the water quality could not meet Grade II standard in the sections downstream of the sewage outlets of Yunyang County.

● Level water period

The pollution belt with COD_{Mn} exceeding the level of the control section was over 320m long and 60 ~100m wide. The TP pollution belt with the concentration of TP more than the level of the control section was over 320m in length and 60~150m in width. The TP pollution belt failing to meet the Grade II water quality standard was nearly 250m in length and 20~80m in width. The NH_3-N pollution belt with its concentration exceeding that of the background level was approximately 300m long and 30~80m wide. And The NH_3-N pollution belt with its concentration failing to meet Grade II water quality standard was around 160m in length and 20~80m in width.

● Dry period

The permanganate index pollution belt with the COD_{Mn} in excess to the control section was around 50m long and 10~40m wide. The TP and ammonia nitrogen pollution belts with the TP and NH_3-N level exceeding that of the control section were more than 320m in length and 40~150m in width. The TP pollution belt with TP level failing to meet Grade Ⅱ water quality standard was nearly 150m long and 40~60m wide. Both the length and width of the pollution belt with the concentration of ammonia nitrogen failing to meet national standard were about 10 m.

Table 5-4 Range of pollution area of each water quality monitoring item in level water period

Section	Distance to the sewage outlets (m)	Width of pollution belts over the control level (m)			Width of pollution belts whose level failing to meet Grade Ⅱ water quality standard (m)		
		COD_{Mn}	TP	NH_3-N	COD_{Mn}	TP	NH_3-N
1	10	60	60	60	—	66	60
2	50	80	80	80	—	80	80
3	150	100	100	30	—	20	20
4	240	70	120	80	—	20	—
5	320	70	150	—	—	—	—

Table 5-5 Range of pollution area of each water quality monitoring item in dry period

Section	Distance to the sewage outlets (m)	Width of pollution belts over the control level (m)			Width of pollution belts whose level failing to meet Grade Ⅱ water quality standard (m)		
		COD_{Mn}	TP	NH_3-N	COD_{Mn}	TP	NH_3-N
1	5	10	40	40	—	40	10
2	50	40	50	50	—	50	—
3	150	—	110	110	—	60	—
4	240	—	150	150	—	—	—
5	320	—	150	150	—	—	—

Chapter 6 Environmental Quality in Construction Area

6.1 Hydrological and Meteorological Conditions

6.1.1 Hydrological characteristics

In 2004, actual statistics from Huanglingmiao Hydrological Station in the downstream of the Three Gorges Pivotal Project indicated that the annual average flow was 13,000m^3/s with the maximum of 60,900m^3/s on September 9 and the minimum of 3,560m^3/s on January 30 and February 1. The annual average sediment discharge rate was 2.01 t/s, and the average sand concentration was 0.155 kg/m^3. The maximum average sand concentration in the monitored section was 1.82 kg/m^3 occurring on September 9, and the minimum was 0.001 kg/m^3 on December 26. Compared with the previous year, the annual average sediment discharge rate and average sand concentration dropped to some extents.

Table 6-1 Monthly statistics of water flow of Huanglingmiao Hydrological Station in 2004

Unit: m^3/s

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average	4520	4310	5420	7120	11700	20600	22900	20000	28200	15900	9730	6100
Maximum	5360	5430	7430	11000	18700	31100	36000	26300	60900	23000	12900	9690
Minimum	3560	3560	4060	5120	6950	11300	17100	14900	16900	10600	7360	4740

Table 6-2 Monthly statistics of sand concentration of Huanglingmiao Hydrological Station in 2004

Unit: kg/m^3

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average	0.002	0.003	0.004	0.005	0.007	0.044	0.153	0.100	0.606	0.038	0.006	0.002
Maximum	0.003	0.004	0.007	0.007	0.012	0.076	0.387	0.180	1.820	0.070	0.011	0.004
Minimum	0.002	0.002	0.003	0.004	0.004	0.012	0.029	0.029	0.043	0.011	0.004	0.001

6.1.2 Meteorological characteristics

In 2004, the climate in the Three Gorges Reservoir area was characterized by mild weather with less rainfall and higher-than-normal temperature. The temperature of most months of the year turned out to be normal. The rainfall in spring and autumn was less than historical average, and the rainfall in summer was a bit less than the historical average.

● Precipitation

The annual precipitation in the construction area totaled 885.8mm, 25.6% less than the historical average. The annual precipitation was quite uneven in the twelve months. To be specific, the rainfall in March, April and October decreased by more than 50%; July also saw obvious decline in precipitation. However, January experienced relatively more rainfall, and only one rainstorm hit the area in August throughout the whole year. A total of 131 days experienced rainfall with the maximum daily precipitation of 53.6mm on August 21. The longest period of rainy days was ten consecutive days occurring in July while the longest period without any precipitation lasted for 17 consecutive days in February.

● Temperature

The annual average temperature in the construction area was 17.3℃, 0.1℃ higher than the historical average. The highest temperature reached 40.3℃ on July 27, and the lowest temperature was -2.1℃ on January 27. There were 28 days experiencing thunderstorms in the whole year.

● Wind speed

The annual average wind speed was 1.5m/s with the extreme speed hitting 29.8m/s on July 9. The wind direction changed frequently over the year with the dominant wind direction of NNW, accounting for 20% of the total.

Table 6-3 Statistics of important meteorological elements in the Three Gorges Dam Area in 2004

Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Temperature	Temperature (℃)	5.1	10.1	12.9	19.4	21.7	24.2	27.3	25.9	23.0	17.2	13.4	7.6	17.3
	Difference to the historical average (℃)	-0.8	1.9	1.3	1.9	-0.1	-1.0	-0.2	-1.0	-0.3	-0.5	0.9	-0.3	0.1
Precipitation	Precipitation (mm)	39.0	41.0	18.2	32.7	155.0	114.3	120.8	195.3	85.8	20.5	47.4	15.8	885.8
	Difference to the historical average (%)	77.9	19.2	-67.8	-64.7	4.0	-28.6	-42.4	-0.6	-14.4	-79.5	-1.3	-26.2	-25.6
Wind speed	Average (m/s)	1.5	1.6	1.7	1.6	1.5	1.3	1.2	1.4	1.4	1.5	1.6	1.7	1.5
	Maximum (m/s)	7.0	7.6	8.9	8.6	10.8	8.4	11.9	7.1	6.4	6.5	6.1	5.8	11.9
	Extreme (m/s)	12.3	13.6	14.5	14.2	18.3	14.7	29.8	11.1	11.0	9.7	9.5	10.5	29.8

6.2 Air Quality

The assessment of the ambient air quality of the construction area (including office buildings, residential areas and construction sites) was conducted in accordance with the "Ambient Air Quality Standards (GB3095-1996)".

In 2004, the annual average concentration of SO_2 in the construction area was 0.024 mg/m^3, meeting Grade II national air quality standard. The annual average level of NO_2 was 0.022 mg/m^3, meeting Grade I national air quality standard. The daily average concentration of SO_2 of all the days in 2004 met or was superior to Grade II national air quality standard. In addition, all the daily average concentrations of NO_2 met Grade I air quality standard in 2004.

The annual average concentration of total suspended particles (TSP) in the construction area was 0.323 mg/m^3, inferior to Grade III air quality standard. Among them, all the daily average concentrations of TSP in office and residential areas met or were better than Grade III air quality standard with the exception of only one single day. In the construction area, the percentage of days with the daily average of TSP meeting Grade I air quality standard was 14.8%, that meeting Grade II air quality standard was 38.5%, that meeting Grade III air quality standards was 17.0% and that failing to meet Grade III standard was 29.6% of the total respectively.

The overall ambient air quality in the construction area during 2004 deteriorated to some extent compared with that of the previous year, which was subject to the excavation of the right bank construction projects. The annual average concentration of NO_2 remained unchanged; the annual average of SO_2 increased a bit, and the annual average level of the TSP rose by 47.5%. TSP remained as the dominant pollutant in ambient air of the construction area.

6.3 Water Quality

According to the "Environmental Quality Standards for Surface Water (GB3838-2002)", 13 items such as pH value, dissolved oxygen, ammonia nitrogen, COD, permanganate index, BOD_5, volatile phenol, cyanide, arsenic, hexavalent chromium, copper, lead and cadmium were included to assess the water quality in the construction area. Anionic surface-active agents were added to the list for the assessment of water quality of waters near or along the bank.

The water quality of all sections in mainstream of the Yangtze River and waters near the bank was good in 2004, all meeting or being superior to Grade II water quality standard. Compared with 2003, the concentration of suspended particles had a further drop while other monitoring indicators were relatively stable.

Table 6-4 Water quality of the mainstream sections of the Yangtze River in the construction area in 2004

Section name	The 1st quarter	The 2nd quarter	The 3rd quarter	The 4th quarter	Whole year
Taipingxi	I	II	II	I	II
Dongyuemiao	II	II	II	I	II
Letianxi	I	I	II	I	II

Table 6-5 Water quality of alongshore water areas of the Yangtze River in the construction area in 2004

Sampling point		The 1st quarter	The 2nd quarter	The 3rd quarter	The 4th quarter	Whole year
Left bank (30m away from the bank)	Upstream navigation channel	II	II	II	I	I
	Downstream navigation channel	II	II	II	I	II
Right bank (30m away from the bank)	Auxiliary dam	I	II	II	I	I

6.4 Noise

The average daytime and nighttime noise of the office and residential areas of the construction area was 58.8 dB and 52.2 dB respectively. The average daytime noise met Grade II standard of the "Standard Environmental Noise of Urban Area (GB3096-93)", while the nighttime noise met Grade III national noise standard. The daytime and nighttime sound equivalent levels of the construction area were in conformity with the requirements for the noise limits of production workshop and operational sites stipulated by the "Design Standards for the Control of Noise of Industrial Enterprises (GBJ87-85)". The noise level at sensitive points outside the boundary was in conformity with the "Requirements of the Noise Limit for the Boundary of Construction Sites (GB12523-90)".

The average daytime and nighttime noise levels of the office and residential areas dropped by 1.8 dB and 1.6 dB respectively compared with that of 2003. The average daytime and nighttime noise levels of the construction sites decreased by 3.6 dB and 4.5 dB respectively. The average traffic noise of the construction sites was reduced by 2.4 dB compared with that of 2003.

Chapter 7 Status of Public Health in the Reservoir Area

7.1 Basic Situation

The monitoring scope and items of 2004 was the same as that of 2003, including the urban area of Chongqing, Wanzhou District and Fengdu County of Chongqing Municipality and Yichang City of Hubei Province. The total population covered by this year's monitoring was 486,894, 3,738 less than that of the previous year with the same gender ratio of 1.02:1 between male and female.

In 2004, the total number of health institutions at all levels within the monitoring areas was 310, down by 4 compared with that of 2003. The total number of hospital beds in these institutions was 3,625, a reduction of 91 beds compared with that of the previous year. The total number of public health workers in these institutions was 4,047, down by 260 people against that of 2003, this was mainly due to the migration of the Three Gorges Reservoir area.

7.2 Life Statistics

7.2.1 Birth and death

There were altogether 4,005 babies born within the monitoring areas in 2004, among which 2,098 were male and 1,907 female. The birth rate was 8.23‰, up by 7.16% over the previous year. The total number of death was 2,767, among them, 1,555 were male and 1,212 female. The mortality rate was 5.68‰, 4.45% lower than that of the previous year. The death rate of Chongqing Municipality had a slight rise while that of Yichang, Wanzhou and Fengdu dropped to different extents, all within the normal range. Infant mortality was 12.48‰, lower than the level of the previous year (14.34‰). The life expectancy of all monitoring sites was higher than the national average (71.4 years old in 2000) with that of Fengdu (72.53 years old) close to the national average.

7.2.2 Analysis of death cause

According to the ICD-9 disease classification standard, a comparison among cause of death, gender and mortality of the top 10 causes of death for different gender indicated that malignant tumor was the No. 1 killer for men while circulatory diseases was the No. 1 killer for women. The order of the top 5 causes of death was the same as that of 2003 as: circulatory diseases (28.51%), malignant tumor (24.07%), respiratory diseases (20.20%), injury and poisoning (11.31%) and digestive diseases (3.61%). The death toll resulting from these 5 diseases accounted for 87.70% of the total and they were major killers for dwellers in the Three Gorges Reservoir area. Compared with 2003, the death percentage of circulatory diseases and injury and poisoning had dropped to some extents while that of malignant tumor and respiratory diseases rose to certain degrees.

7.3 Diseases Monitoring

7.3.1 Infectious Diseases Monitoring

In 2004, a total number of 3,455 cases of infectious diseases were reported from all the monitoring sites with the total morbidity of 709.60 per 100,000 people. No death case was reported. Among them, 2,481 cases of 12 types of Class B infectious diseases were reported with the morbidity of 509.56 in every 100,000 people. 974 cases of 5 types were identified as Class C infectious disease, and the incidence was 200.04 in every 100,000 people. There was no report on the case of Class A infectious disease. Respiratory diseases, blood and sexually transmitted diseases, digestive diseases and natural epidemic focus-based diseases took up 38.21%, 36.12%, 24.78% and 0.09% of the total cases respectively. Compared with that of the previous year, respiratory diseases rose to the top position, blood and sexually transmitted diseases rose to the second and digestive diseases dropped to the third. There were only cases of encephalitis B in the category of natural epidemic focus-based diseases with its percentage having no apparent change compared with that of 2003. Regarding the types of all infectious diseases, whooping cough disappeared while HIV Aids was added to the list. The incidences of 4 Class B infectious diseases of dysentery, typhoid fever, measles and scarlet fever saw certain degree of reduction, while the rest rose to different extents.

Compared with 2003, the top 5 types of Class B infectious diseases were somewhat different. They were viral hepatitis (205.18 in every 100,000), TB (187.93 in every 100,000), gonorrhea (53.81 in every 100,000), dysentery (45.80 in every 100,000) and syphilis (9.24 in every 100,000) respectively. The incidence of Class A and Class B infectious diseases grew by 38.74% in contrast to that of the previous year and reached the peak during the past 5 years. However, the reported incidence of Class C infectious diseases dropped by 9.79%. Among Class B infectious diseases, the incidence of hepatitis B and TB increased remarkably to 173.96/100,000 and 187.93/100,000, up by 142.69% and 28.95% respectively compared with that of 2003.

7.3.2 Endemic Diseases Monitoring

The monitoring results of endemic diseases of 2004 showed that the incidence of hypertrophy of the thyroid gland was the highest in Fengdu (11.88%) among the 4 monitoring sites while Yichang was the lowest of 3.33%. The incidence of hypertrophy of the thyroid gland among children aged 8 to 10 in Chongqing and Wanzhou was 9.89% and 6.88%, both lower than the sample survey results at each monitoring site in the same period last year. At all monitoring sites, the average coverage rate of iodized salt was 97.42% with 92.67% iodized salt products meeting national quality standard. And 89.99% of the local population under monitoring consumed qualified iodized salt. The up-to-standard rate and consumption rate of iodized salt of 2004 decreased by 6.03% and 5.95% respectively compared with that of the previous year. However, 50.55% of the subjects in Fengjie County of Chongqing Municipality showed positive testing results in endemic fluorine poisoning tests, a phenomenon deserving the attention of the local authorities.

7.4 Biological Medium Monitoring

The indoor mouse density was 1.61% in 2004, a little higher than that of 2003, but much lower than the average level of the 5 years before water impoundment (3.94%). The mouse density in spring was higher than that in autumn. The outdoor mouse density was 2.69%, lower than that of the previous year as well as the average level of the 5 years before water impoundment (4.22%). The outdoor mouse density was higher in autumn than in spring. Mouse density had a dramatic reduction after water impoundment into the Three Gorges Reservoir, which was possibly due to the all-round mice killing campaigns in the area before impoundment.

Sewer rat dominated the indoor mouse species, accounting for 55.71% of the total. Small house mouse (Mus musculus) ranked the second and took up 32.86%. In outdoor environment, small beast of insectivore (mainly short-tailed shrew) still dominated all other species and accounted for 65.67% of the total. Sewer rat (18.41%) was the second and black strip rat (7.96%) the third. There were not many small house mice and buff-breasted mouse, each accounting for less than 4%. Black strip rat was the host animal for epidemic haemorrhagic fever virus and leptospirosis, its percentage dropped from 14.35% of 2003 to 7.96% in 2004, continuously maintaining on a low level. Among all monitoring sites, Wanzhou had the highest indoor mouse density of 4.49% while Chongqing City had the lowest density of 0.86%. As for outdoor mouse density, Fengdu was the highest of 7.80% while Chongqing City was the lowest at 1.91%.

In 2004, all monitoring sites carried out relevant tests on lung (469) and kidney (488) samples of mice to identify the infection situation of epidemic haemorrhagic fever virus and leptospirosis. The findings showed that all samples were negative except two showing positive results on leptospirosis in Chongqing and two positives on epidemic haemorrhagic fever virus in Fengdu.

In the year 2004, the adult mosquito density in livestock pen of all monitoring sites was much higher than that of indoor. The overall adult mosquito density in livestock pen was 132.76/(pen•artificial hour), lower than 148.11/(pen•artificial hour) of 2003 or the average level of the 5 years before impoundment [198.57/(pen•artificial hour)]. The overall indoor adult mosquito density was 36.82/(pen•artificial hour), lower than the level of 43.09/(pen•artificial hour) of the previous year or the average level of the 5 years before impoundment [63.97/(pen•artificial hour)]. The change trend of mosquito density of both residential buildings and livestock pens in every ten days from May to September was the same. The adult mosquito density peak was generally in the trend of moving from the head to the tail of the reservoir. The mosquito density in residential buildings was the highest in Chongqing Municipality and lowest in Yichang. On the contrary, the mosquito density in livestock pens was the highest in Yichang and the lowest in Chongqing. The underlying reasons for

the dramatic rise of mosquito density in livestock pens of Yichang in 2004 need further study.

Regarding the composition of mosquito species, Desvoidea obturbans dominated all the species in both residential buildings and livestock pens, accounting for 52.91% and 55.67% of the total number respectively. Similar to the previous year, the No.2 species of mosquito was culex pipiens fatigans, accounting for 23.66% in residential buildings and 17.47% in livestock pens.

7.5 Public Health of the Migration Resettlement Area

In 2004, public health monitoring work was conducted in 15 districts (counties) involving migration resettlement, which were under the administration of Chongqing Municipality. They included Wushan County, Wuxi County, Fengjie County, Yunyang County, Wanzhou District, Kaixian County, Zhongxian County, Shizhu County, Fengdu County, Wulong County, Fuling District, Changshou District, Banan District, Yubei District and Jiangjin City.

7.5.1 Life statistics

The total population in the monitoring area was 2,714,031 (including 1,350,907 in the resettlement area and 1,363,124 in the submerged area) in 2004. Among them, 1,398,424 were male and 1,315,607 female. 553,312 people were aged 0~14 while 243,094 were over 65, accounting for 20.39% and 8.96% of the total respectively.

A total of 22,313 babies were born in 2004 within the monitoring area with the birth rate of 8.22‰, 11,659 of which were male and 10,654 were female. Altogether 12,615 people died with the mortality of 464.81/100,000. Among the dead, 7,137 were male and 5,478 female. The total death in the resettlement area was 5,689 with the mortality of 508.10/100,000. In the submerged area, 6,926 people died with the mortality of 421.12/100,000.

7.5.2 Diseases monitoring

- **Infectious diseases monitoring**

In 2004, there were 10,466 cases of 16 types of Class B infectious diseases at all the monitoring sites with 1 case of death. The incidence of infectious diseases was 385.63/100,000 with mortality of 0.10‰. There were 2,498 cases of 6 types of Class C infectious diseases with the morbidity of 92.04/100,000. There was no outbreak of any epidemic diseases throughout the whole year. There were 5,921 cases of Class B infectious diseases in the resettlement area with morbidity of 438.30/100,000. In addition, 1,275 cases of Class C infectious diseases were reported with morbidity of 94.38/100,000. In the submerged area, 4,545 cases of Class B infectious diseases occurred with morbidity of 333.43/100,000. 1,223 cases of Class C infectious diseases occurred in 2004 with morbidity of 89.22/100,000.

In all kinds of infectious diseases, the order was as the followings: there were 1,397 cases of intestinal infectious disease, accounting for 13.35% with morbidity of 51.47/100,000; 4,086 cases of respiratory infectious diseases accounting for 39.04% with morbidity of 150.55/100,000; 4,927 cases of blood and sexually transmitted diseases accounting for 47.08% with morbidity of 181.54/100,000; 53 cases of insect-borne and natural epidemic focus-based (including 5 cases of haemorrhagic fever, 47 cases of encephalitis B and 1 case of diarrhea) diseases accounting for 0.50% with the incidence of 1.95 in every 100,000; and 3 cases of tetanus in newly-born babies accounting for 0.03% with the incidence of 0.11/100,000.

The monthly incidence of 30~40/100,000 for Class B infectious diseases occurred from May to September and from November to December. In January to April, the monthly morbidity of Class B infectious diseases was 20~30/100,000. For Class C infectious diseases, only March saw the monthly incidence of over 10/100,000 while all other months had monthly morbidity under 10/100,000.

There were 18 occupations reported cases of disease in 2004. The top 5 groups of people in terms of the largest number of cases were: farmer (4,752 cases, accounting for 36.66%), student (2,121 cases, accounting for 16.36%), worker (1,227 cases, accounting for 9.46%), people dealing with housework or unemployed (928 cases, accounting for 7.16%) and children living in scattered

areas (651 cases, accounting for 5.02%).

● Endemic diseases monitoring

The monitoring work of endemic diseases included endemic fluorine poisoning, iodine-deficiency, endemic hypertrophy of the thyroid gland, malaria and paragonimiasis. Three districts (counties) of Wushan, Shizhu and Fuling carried out the investigation of endemic fluorine poisoning with 36,195 people having been tested and 7 were positive, the positive rate was 0.02%. As for iodine-deficiency, 1,161 people in 5 districts (counties) of Fengjie, Wanzhou, Zhongxian, Fengdu and Wulong were tested and 145 were reported positive with the rate of 12.49%. With regards to endemic hypertrophy of the thyroid gland, 37,100 people in 4 districts (counties) of Wushan, Kaixian, Shizhu and Fuling were tested and 59 were reported positive with the rate of 0.16%. As for malaria, 10,164 people from 10 districts (counties) including Wushan, Fengjie, Yunyang, Kaixian, Zhongxian, Wanzhou, Fengdu, Wulong, Fuling and Ba'nan were tested, and 1 was reported positive with the rate of 0.01%. For paragonimiasis, 36,504 people from 2 districts (counties) including Shizhu and Fuling were tested with no positive cases found.

7.5.3 Biological medium monitoring

● Mouse density and plague monitoring

In 2004, mouse density was monitored in 12 districts (counties) such as Wushan, Fengjie, Yunyang, Kaixian, Wanzhou, Zhongxian, Shizhu, Wulong, Fengdu, Fuling, Yubei and Banan. A total of 73,854 rattraps were deployed with 70,621 in function. As a result, 1,365 mice were caught with the mouse density of 1.93%. To be specific, the indoor mouse density was 2.11% while the outdoor density was 1.80%.

Another work was carried out in 8 districts (counties) including Wushan, Fengjie, Yunyang, Kaixian, Wanzhou, Zhongxian, Fengdu and Fuling to monitor the plague situation. As a result, 3,427 live mice were caught, accomplishing 84.41% of the target. Mouse fleas were found in 102 mice. Blood serum tests on plague antibody were carried out on 3,019 mice and all the results showed negative.

● Mosquito density monitoring

The mosquito density of 9 districts (counties) including Wushan, Fengjie, Yunyang, Kaixian, Wanzhou, Zhongxian, Fengdu, Fuling and Yubei was monitored. 112,750 mosquitoes were caught in 4,640 houses or livestock pen/time with the density of 97.20/artificial·hour. In specific, the mosquito density of residential buildings was 47.19/ artificial·hour while that in the livestock pen was 147.21/ artificial hour.

Desvoidea obturbans dominated all the mosquito species, accounting for 77.22% of the total. Culex pipiens fatigans took the second place, taking up 12.49%, followed by *Anopheles sinensis* accounting for 7.45%, *Culex tritaeniorhynchus* accounting for 2.04%, Culex pipiens pallens accounting for 0.23%, *Aedes albopictus* accounting for 0.06% and other mosquitoes accounting for 0.51%. The mosquito density reached its peak in late July at 62.86/artificial·hour in residential buildings and 143.57/ artificial·hour in livestock pens. The mosquito density hit its bottom in early May at 26.38/ artificial hour in residential buildings and 58.22/ artificial hour in livestock pens.

Chapter 8 Environmental Quality of the Migration Resettlement Area

Comprehensive environmental quality monitoring was conducted in 15 districts (counties) of the migration resettlement area in Chongqing Municipality of the Three Gorges Reservoir area. The major components of the monitoring work were water quality, environmental air quality and acoustic environment quality.

8.1 Water Quality Monitoring

Water quality monitoring work includes the monitoring of surface water quality, water quality of both backwater in sensitive areas and drinking water sources. Water quality evaluation standard and testing methods employed were in accordance with the "Environmental Quality Standards for Surface Water (GB3838-2002)". The nutrition evaluation of water bodies complies with the "Technical Regulations on the Assessment Method and Classification Eutrophication of Lakes (Reservoirs)" issued by the China National Environmental Monitoring Center.

8.1.1 Surface water quality

A total of 130 river sections were set up in 47 rivers of 15 districts (counties) to carry out 3 monitoring activities, one in dry period, one in level water period and one in high water period. The assessment covered 20 items such as pH value, dissolved oxygen, permanganate index, COD, BOD_5, ammonia nitrogen, copper, zinc, fluoride, selenium, arsenic, cadmium, mercury, hexavalent chromium, lead, cyanide, volatile phenol, petroleum, anion surfactant and sulfide. The evaluation results were as the followings:

The overall surface water quality in the migration resettlement area was fairly good in 2004. 107 sections met or were superior to Grade III water quality standard, taking up 82.3% of the total. 11 sections met Grade IV water quality standard, 1 met Grade V water quality standard and 11 failed to meet Grade V water quality standard, accounting for 8.5%, 0.8% and 8.5% of the total respectively. Major pollutants were ammonia nitrogen, petroleum and COD.

The water quality in low, level and high water season was all good, with 82.9%, 78.0% and 82.0% of all the sections monitored meeting or superior to Grade III water quality standard respectively. Nevertheless, water quality in level water period was slightly worse than that of other times. The river sections subject to pollution were mainly in the districts of Banan, Changshou and Wanzhou with 85.7%, 63.6% and 61.5% of the sections exceeding national water quality standard.

The surface water quality in the migration resettlement areas in 2004 was better than that of the previous year, with the proportion of river sections meeting or being superior to Grade III water quality standard increased by 21.1 percentage points.

8.1.2 Water quality of backwater in sensitive areas

49 river sections were established in 26 rivers of 8 districts (counties). Monitoring work on water quality of backwater in sensitive areas was conducted once in the early, mid and late March, April and May of 2004 totaling 9 times. The monitoring covered 11 items of water transparency, water temperature, pH value, dissolved oxygen, permanganate index, BOD_5, total nitrogen, ammonia nitrogen, nitrate, chlorophyll a and total phosphorus.

● Water quality

Six items including pH value, dissolved oxygen, permanganate index, BOD_5, ammonia nitrogen, and total phosphorus were employed to assess water quality. The assessment findings were as follows.

The overall surface water quality of the backwater in sensitive areas of the migration resettlement area was quite good in 2004. 43 river sections met or were superior to Grade III water quality standard, taking up 87.8% of the total. One section met Grade IV standard and 5 failed to meet grade V standard, accounting for 2.0% and 10.2% respectively. Major pollutants in the water were ammonia nitrogen and total phosphorus.

As the comparison of the water quality in March, April and May showed, the water quality in March and May was relatively better with 82.8% and 89.6% of river sections meeting or being superior to Grade III water quality standard. In contrast, the water quality in April was a little worse with only 75.6% sections meeting or being superior to Grade III water quality standard. The sections with relatively poor water quality were mainly in Wanzhou District and Wushan County.

The water quality of the backwater in sensitive areas dropped to some extent compared with that of 2003, with the proportion of sections meeting or being superior to Grade III water quality standard decreasing by 8.1 percentage points.

● Nutrition status of the water bodies

Five items including chlorophyll a, total phosphorus, total nitrogen, water transparency and permanganate index were employed to assess the nutrition status of the water body with the assessment results as follows.

The water body of 14 river sections was of eutrophication, accounting for 28.5% of the total. Among them, 11 were of slight to medium eutrophication, 3 of intermediate eutrophication, accounting for 22.4% and 6.1% of the total respectively. Nine sections were of poor nutrition and 26 sections were of medium nutrition, taking up 18.4% and 53.1% respectively. The nutrition status index of the water bodies ranged from 12.86 to 67.97.

8.1.3 Water quality of drinking water sources

A total of 84 monitoring sites were set up in all major centralized drinking water sources of Class I towns in 15 districts (counties), 66 of which were river sections and 18 were in reservoirs that were drinking water sources. County city drinking water source was monitored once a month, totally 12 times throughout the year. The drinking water sources of towns were monitored once in the low water season, once in level and once in high water season, totaling 3 times throughout the whole year. The assessment contents covered 23 basic water environmental items set forth in the "Environmental Quality Standards for Surface Water (GB3838-2002)"(excluding total nitrogen) and the additional 3 items including sulfate, chloride and nitrate (calculated in nitrogen) totaling 26 items. The assessment results were as follows.

In 2004, the water quality of the drinking water sources in the migration resettlement areas was quite satisfactory with the quality of all drinking water sources meeting or being superior to Grade III water quality standard. Compared with the previous year, the proportion of sections meeting the functional requirements for drinking water source rose by 4.1 percentage points. To be specific, the proportion of sections meeting Grade I and III water quality standard rose by 6.0 percentage points and 15.3 percentage points respectively while the proportion of sections meeting Grade II water quality standard dropped by 17.2 percentage points.

8.2 Environmental Air Quality Monitoring

The monitoring of environmental air quality of the migration resettlement areas was mainly composed of the monitoring of urban air quality and precipitation quality.

8.2.1 Air quality

A total of 30 air quality monitoring sites and 31 dust monitoring sites were established in 14 districts (counties) except for Wuxi County. The key monitoring items included SO_2, NO_2, total suspended particles (TSP) and dust. For SO_2, NO_2 and total suspended particles, 24-hour continuous sample collection was carried out for laboratory analysis. Their samples were collected at least 18 hours a day and 3 days a week. As for dust, the monitoring was conducted for a consecutive month with sample collected and analyzed each month. The "Ambient Air Quality standard (GB3095-1996)" was applied in the evaluation of environmental air quality.

The annual average concentration of sulfur dioxide in 2004 was 0.046 mg/m^3, meeting Grade II national air quality standard. The daily average concentration of SO_2 was 0.001 ~ 0.415 mg/m^3 with 1.2% of the total failed to meet national air quality standard. The highest daily average level of SO_2 was 1.77 times higher than the standard value. Among the 14 districts (counties) monitored, the

annual average level of sulfur dioxide of 11 districts (counties) met Grade II national air quality standard, accounting for 78.6% of the total.

The annual average concentration of nitrogen dioxide in 2004 was 0.031 mg/m^3, meeting Grade II national air quality standard. Its daily average level ranged from 0.001 to 0.201 mg/m^3, and 0.2% of the total failed to meet the national daily average standard. The highest daily average concentration of NO_2 was 0.68 times higher than the standard value. The annual average concentration of NO_2 in the air of all the 14 districts (counties) met Grade II national air quality standard.

The annual average concentration of total suspended particles (TSP) in 2004 was 0.167 mg/m^3, meeting Grade II national air quality standard. Its daily average level ranged from 0.004 to 0.610 mg/m^3, 2.9% of the total failed to meet the national daily average standard. The highest daily average level was 1.03 times higher than the standard. Among the 14 districts (counties) monitored, the annual average level of TSP of 13 districts (counties) met Grade II national air quality standard, accounting for 92.9% of the total.

The annual average level of dust was 6.81 ton/km^2·month, 0.59 times higher than the reference standard. The peak amount was 1.33 times higher than the standard value. Among all the 14 districts (counties) monitored, only Wulong County and Fengdu County met relevant national standard, taking up only 14.3% of the total.

8.2.2 Precipitation quality

A total of 18 precipitation quality monitoring sites were set up in 15 districts (counties), among which 2 monitoring sites were set up in Wanzhou District, Fuling District and Jiangjin City respectively while 1 site was set up in each of the rest districts (counties). A monthly monitoring was carried out in Wanzhou District and Fuling District while the monitoring work in other districts (counties) was carried out in January, April, July, August and October when there was precipitation.

732 precipitation samples were collected in all the 18 monitoring sites. Among them, 397 were acid rain samples with the frequency of 54.2%. The amount of acid rain accounted for 47.1% of the total precipitation volume. The pH value of the precipitation tested ranged from 3.37 to 7.95, with an averaging of 4.87. Among all the 15 districts (counties) monitored, the annual average pH value of 9 districts (counties) was under 5.60, accounting for 60.0%.

8.3 Acoustic Environmental Quality Monitoring

The monitoring of acoustic environmental quality in the migration resettlement areas included the monitoring of regional environmental noise, traffic noise and functional area noise. The evaluation work complies with the “Standard of Environmental Noise of Urban Area (GB3096-93)”.

8.3.1 Regional environmental noise

A total of 1,574 monitoring grids were established in the towns of 15 districts (counties), covering 86.06 km^2 of established urban area. The regional environmental noise monitoring was carried out once in May.

Monitoring results showed that the overall regional environmental acoustic quality was under slight pollution with the equivalent sound level of 58.0 dB. Among all the districts (counties) monitored, the equivalent sound level of Kaixian County was the highest at 66.1 dB followed by Wushan County at 63.8 dB. Changshou District was the lowest at 52.8 dB. The source of noises was mainly from social life and domestic noises, accounting for 58.9% of the total. Traffic noise took the second, taking up 25.9%. Among the 1,574 monitoring grids, 1,108 grids met the relevant national noise standard, accounting for 70.4%. The grid noise up-to-standard rate of Grade I, II, III and IV region was 39.0%, 70.5%, 96.4% and 82.0% respectively. In the 15 districts (counties), only 3 enjoyed relatively good acoustic environment, accounting for 20.0% of the total. The up-to-standard rate of grid noise of Changshou Distrcit was the highest of 100%, while that of Kaixian County was the lowest of 25.2%.

8.3.2 Traffic Noise

A total of 187 road sections were set up in 15 districts (counties) for the monitoring of traffic noise, covering a total length of 250.90 km. Traffic noise monitoring was carried out once in May.

Monitoring findings indicated that the overall road traffic acoustic quality was relatively good with average equivalent sound level being 69.1 dB. The average traffic flow was 1,274 vehicle/hour; and the total length of trunk road with equivalent sound level over 70 dB was 96.71 km, accounting for 36.55% of the total. 10 districts (counties) out of the 15 had rather good traffic acoustic environment, taking up 66.7% of the total.

8.3.3 Noise of functional areas

35 monitoring sites were set up in the towns of 15 districts (counties) to monitor the environmental noise functional areas, covering an area of 76.33 km^2. A one-day (24 hours) monitoring was conducted in early June and early November respectively, the noise was monitored once every hour. The findings showed that daytime and nighttime equivalent sound levels of the functional areas was 58.7 dB and 48.8 dB respectively, and the equivalent sound level in both the daytime and nighttime was 58.8 dB, all meeting relevant national noise standard. However, 32.7% of hours during daytime and 44.5% of nighttime hours cannot meet the hourly national noise standard. The equivalent sound level of all regions met relevant national noise standard for both daytime and nighttime with the exception of that (59.7 dB) of Class IV region during nighttime, which was 4.7 dB higher than the standard.

Chapter 9 Ecological Environment Monitoring and Studies

9.1 Ecological Environment Monitoring of Wanzhou Model Zone

Runoff plots trial for the study and monitoring of ecological environment of Wanzhou model zone continued in 2004. The trial carried out comparison observation on soil water content and soil erosion under different modes of land use. Moreover, efforts were made to promote the application of ecological agricultural techniques such as compound farming of grain crops, cash crops and fruit trees on ridges in slope farmland and the establishment of biological fence on steep slopes. As a result, good economic and ecological benefits had obtained.

9.1.1 Trial of compound farming of grain crops, cash crops and fruit trees on ridges of slope cropland

The patterns of compound farming of grain crops, cash crops and fruit trees on ridges of slope farmland (Pattern I), compound farming of grain crops, cash crops and fruit trees on flat farmland (Pattern II) and the planting of grain and cash crops on flat farmland (Pattern III) have been operated for three years. The comparison trial findings showed that Pattern I enjoys the best effects in soil water retention with the highest soil water content, followed by Pattern II and Pattern III. The lapse rate of soil water content and the variation of soil water contents at different soil layers after rainfall was the highest in Pattern III, followed by Pattern II and Pattern I. Under the same land-use mode, the changing rate of soil water content is smaller in spring, autumn and winter as compared with that in summer. Compared with the previous year, soil water retention capability of Pattern I improved with some reduction of the lapse rate of soil water content. Soil water retention capability did not have much change in Pattern II, but had some rise in the pattern of flat cultivation of crops along the slope.

In comparison, Pattern I achieved the best results in reducing soil erosion and run-off with highest concentration of various nutrients in eroded soil. Pattern II had less good results while Pattern III the worst. If we compared with that of 2003, the level of various nutrients of the eroded soil from Pattern I rose to different extent. For example, the concentrations of organic matter, total nitrogen, total phosphorus, total potassium, quick-acting nitrogen, quick-acting phosphorus and quick-acting potassium rose by 9.98%, 11.46%, 10.98%, 5.37%, 8.20%, 22.58% and 13.91% respectively compared with that of 2003.

9.1.2 Trial of the pattern of steep slope with biological fence

Comparison trial was continued to observe the effect of steep slope cropland fenced with shaddock-king grass hedgerows (Fence Pattern) and the pattern of flat cultivation of pure grain crops along the slope (Pure Grain Crops Pattern). The findings indicated that both soil water content and the changing rate of the moisture in different soil layers of the 3-year-long Fence Pattern were higher than the Pure Grain Crops Pattern. The soil under the hedgerows enjoyed the highest soil water content with relatively small change rate (or variations) after rainfall. The water content of the soil up to the hedgerows and down to the hedgerows was similar and had relatively big variations after rainfall. Compared with the previous year, the post-rain lapse rate of soil water content of the Fence Pattern decreased while its water retention capability improved. However, there was no significant change in both the post-rain lapse rate of soil water content and water retention capability for the pattern of flat cultivation of pure grain crops along the slope.

Compared with Pure Grain Crops Pattern, Fence Pattern was more effective in preventing soil erosion and surface runoff with higher concentrations of various nutrients in eroded soil. The concentration of such items as organic matter, total nitrogen, total phosphorus, total potassium, quick-acting nitrogen, quick-acting phosphorus and quick-acting potassium were all higher than that of previous year, rising by 14.20%, 15.96%, 17.07%, 2.67%, 16.33%, 26.43% and 6.88% respectively.

9.2 Ecological Environment Monitoring of Zigui Model Zone

Zigui Ecological Environment Experimental Station continued the monitoring and study on soil erosion and soil fertility of arid slope cropland in Zigui area at the head of the Three Gorges Reservoir in 2004. It also further promoted the demonstration project of comprehensive technical trial of pollution-free navel oranges.

9.2.1 Soil and water erosion monitoring

The monitoring results on soil and water erosion of arid-slope orchard plot and forage grass-grain cropland plot under different water conservation measures showed that high natural biological fence like orchard and forage grass-grain crop fence could not only conserve water and soil, but also effectively reduce the loss of nitrogen in the runoff. Compared with intercrop pattern of wheat-peanut planting, high biological fence like orchard could reduce soil erosion modulus by 90.8% and reduce the loss of nitrogen by 81.7%. And a comparison between forage grass-grain crop fence and wheat-peanut pattern found that the former could reduce soil erosion modulus by 89.8%~91.2% and nitrogen loss by 47.7%～53.4%.

The coverage of vegetation may reduce soil erosion to some extent, but it was not the absolute factor. Different soil disturbance under different management measures would also impose evident impacts on soil erosion. Ploughing and low vegetation coupled with rainfall were the fundamental cause for heavy soil erosion.

9.2.2 Soil fertility monitoring

Straw mulching and white clover vegetation applied in orchard proved to be effective to enhance soil fertility. Compared with wheat-peanut intercrop pattern, the two techniques enabled the content of organic matter to increase by 44.7% and 26.3% respectively, total nitrogen by 24.0% and 26.0%, but no evident change in toal phosphorus and total potassium in the surface soil layer (0~20cm) of the orchard. There was no significant increase in nutrient contents under orchard-biological fence pattern. Compared with wheat-peanut farming pattern on arid slope cropland, the pattern of wheat-peanut-Chinese toon biological fence had increased content of organic matter, total nitrogen, total phosphorus and total potassium by 1.5%, 51.7%, 12.8% and 12.6% respectively. Alfalfa pattern and the ryegrass-amaranth pattern had a poor growth and unsatisfactory soil improving effect due to their poor resistance to drought.

9.2.3 Demonstration of comprehensive culture technique for pollution-free navel orange

The comprehensive culture technique for pollution-free navel orange was further promoted in 2004. Major technical measures of this technique included water-saving irrigation, the application of organic fertilizers, grass vegetation, hanging lamps, applying predator mites to control harmful mites and hanging bottles on tree crown.

A total of 1,000 mu (15mu= 1 hectare) of land applied water-saving irrigation technique, 530 mu for sprinkler irrigation, 100 mu for drip irrigation and 370 mu for low-micro sprinkler irrigation. The organic fertilizer demonstration projects applied a total of 500 tons of organic biological fertilizers. In grass vegetation demonstration projects, such techniques of planting and growing grasses on orchard were employed. Such grass species as bahiagrass, white clover and ageratum conyzoides were planted between lines in orchards. In the lamp hanging demonstration projects, 80 resonant frequency killing lamps were installed with one lamp per 30 mu of land, covering an effective area of 2,400 mu. In the mite control demonstration project, 14,400 bags of predator mites were distributed among the region.

9.3 Groundwater Table and Soil Gleization Monitoring

The monitoring on groundwater table from Xiaogang to Shimatou around the “four lakes” at the middle reaches and the observation on gleization indicators of soil at different gleization degree continued in 2004.

9.3.1 Groundwater table monitoring

The groundwater monitoring section consisted of 10 long-term observation boreholes in 5 groups. The distances from the 5 groups of borehole marked with the code of A, B, C, D and E to the Yangtze River bank was 1.5 km, 3.0 km, 5.0 km, 8.5 km and 13.0 km respectively. The depth of boreholes of confined water was about 35m while that for phreatic water observation was 5m~7m deep.

The average annual groundwater level of all observation boreholes ranged from 21.12 m to 22.33m in 2004 with fluctuations of 0.83m~2.50m within the year. The phreatic surface changed from 20.63m to 23.14m with maximum fluctuation margin of 2.51m. And the water table of confined groundwater varied from 20.73m to 23.49m with the maximum change margin of 2.76m. Be it confined or phreatic water, the highest groundwater table mostly occurred in August and the lowest in February. Compared with past few years, the annual average groundwater tables of both the confined and phreatic water had some decrease in general and the decline of phreatic water level was rather evident. The drop of groundwater level would impose certain influence on soil gleization.

Table 9-1 Water table of each observation borehole in 2004

Unit: m

Borehole	Confined water table					Phreatic surface				
	A	B	C	D	E	A	B	C	D	E
Annual average	22.27	21.45	21.86	21.45	21.90	22.04	22.33	22.15	21.96	21.89
Maximum	23.49	22.3	22.85	22.02	22.36	23.13	23.14	22.8	22.59	22.48
Minimum	21.04	20.73	20.99	20.73	21.53	20.63	21.46	21.41	21.4	21.54
Change margin	2.45	1.57	1.86	1.29	0.83	2.50	1.68	1.39	1.19	0.94

Table 9-2 Annual average water table of each borehole during 2001-2004

Unit: m

Borehole / Year	Confined water table					Phreatic surface				
	A	B	C	D	E	A	B	C	D	E
2001	22.38	21.73	21.78	21.41	21.76	22.53	22.60	22.26	22.02	21.74
2002	22.53	21.76	21.93	21.45	21.90	22.45	22.64	22.33	22.17	21.88
2003	22.51	21.72	21.83	21.45	21.95	22.04	22.57	22.25	22.00	21.94
2004	22.27	21.45	21.86	21.45	21.90	22.04	22.33	22.15	21.96	21.89

9.3.2 Soil gleization indicators monitoring

Indicators of soil gleization at soil sections affected by different degrees of gleization were monitored continually in 2004 from the groundwater observation sections from Xiaogang Farm to Shimatou. The monitoring work was carried out once in winter and once in summer. Indicator parameters monitored included oxidation reduction potential, total amount of reduction materials, active reduction materials and ferrous iron, etc.

Monitoring results indicated that compared with the previous year, all gleization indicators were obviously lower, particularly in winter. In view of the overall soil sections, it was found that all the gleization indicators had evident seasonal variations. The amount of total reduction materials, the concentration of active reduction materials and ferrous iron were bigger in summer than that in winter and the order of content spacial distribution in soil sections from big to small was: surface layer > subsurface layer > subsoil layer. However, pH and Eh values showed a reserve order. In view of different layers of a soil section, seasonal change of indicators was big in surface layer and small in subsoil layer. The change margin of soil gleization indicators of different layers and sections was bigger in summer than in winter.

9.4 Special Monitoring on Terrestrial Plant Community

A special monitoring was undertaken in 2004 in order to accumulate vegetation baseline information during initial impoundment period of the Three Gorges Reservoir, analyze the status of plant communities and give objective assessment on the conditions of terrestrial eco-system of the reservoir area. The main activities of this special monitoring included data collection, identifying investigation samples and quadrat of plant community, collecting field samples and conducting site visits to the eastern and central parts of the reservoir area.

9.4.1 Identifying fixed monitoring sample plots

The investigation of plant communities of the reservoir area was carried out by identifying and setting up fixed monitoring sample plots and quadrats. Sample plots were selected according to different community types (biome), taking account of the representativeness of their geographical location, administrative jurisdiction and natural environment. In 2004, a total of 193 fixed sample plots with a total area of 4.18 ha were identified in 12 counties (cities) in the reservoir area and 377 quadrats were set up, collecting over 1,500 botanical samples and 193 soil samples. The sample plots could be divided into two groups by geographical location, 83 to the south of the Yangtze River and 110 to the north. When classified according to their altitude, 76 were in low altitude areas, 43 in middle altitude and 74 in high altitude.

9.4.2 Investigation on vegetation type

In 2004, 69 vegetation types were investigated including 41 forest types, 15 shrub types and 13 herbosa types.

● Forest

The distribution area of natural vegetation of the reservoir area, especially forests, has been narrow and small due to strong influence of long-term human activities, most of which were secondary forest. The zonal vegetation of evergreen broad-leaved forest only remained in a few areas. Forest vegetation concentrated in Shizhu County and Wulong County, which were to the south of the Yangtze River while natural forests (excluding Chinese red pine and cypress, etc.) to the north of the Yangtze River were mainly distributed in mountainous areas, such as Longmenhe Forest Farm of Xingshan County, Baiguo Forest Farm of Wuxi County and Dalaoling Forest Farm of Yichang, which were near Shennongjia forest zone.

The low altitude areas below 600 meters were mainly reclaimed farmlands and orchards with few forests due to relatively high density of population. Most forests were distributed in steep mountainous areas above 1,000 meters. Areas at middle altitudes of 600 ~ 1,000 meters were transitional belts where forest coverage gradually increased while farmland decreased from low to high altitudes.

● Shrubs and grasses

Most of shrubs and grasses in the reservoir area were degraded secondary ones. Vitex negundo, cotinus coggygria and coriaria intermedia were most common bush types covering the majority of the reservoir area and were distributed in a wide range of altitudes. The most common grass species were heteropogon, imperta cylindrica and arthraxon, etc., most of which were pioneer communities evolved on the degraded heathland.

9.5 Ecological Environment Monitoring of Estuary Area

In 2004, monitoring on river mouth eco-environment continued to focus on the monitoring on the change trends of water and salt concentration at land-sea interface and the comprehensive monitoring on biological and non-biological environment of river mouth waters.

9.5.1 Water and salt concentration trend

Three monitoring sections were established at the land-sea interface at the northern tributary

estuary of the Yangtze River in 2004, which located at Yinyang Town, Daxing Town and Xinglongsha Seed Multiplication Farm of Qidong City, Jiangsu Province. The distance of the three sections to the northern tributary estuary was 4 km, 22 km and 35 km respectively. Three monitoring sites (from south to north) were placed at each section with their distance to the Yangtze River bank being 200 m, 500 m and 1,000 m respectively. Major monitoring items included soil conductivity, soil negative pressure, groundwater table and groundwater conductivity of the tributary estuary areas.

The water table of Yinyang section has risen by 15cm in spring and declined by about 10 cm in autumn and winter compared with the historical average of previous years. But the change of water table was smoother in comparison with that of past record. Soil water content was closely related to water table and varied with different seasons. Groundwater conductivity has gradually decreased since the power plant was established in 1997. However, the river water conductivity and groundwater conductivity both increased in 2004 compared with that of 2003 and the increasing margin was particularly obvious in autumn and winter.

The dynamic change of water table at Daxing section was in line with the change of water level of the Yangtze River. Compared with past record, the groundwater table did not change much in spring but had a sharp drop in autumn and winter. The groundwater conductivity has decreased by 0.8 mS/cm as compared with the historical average. The dynamic change of groundwater conductivity of full section was similar to that of the water of the Yangtze River. The farther the location of groundwater from the Yangtze River bank, the lower the groundwater conductivity was. This reflected evident influence of river mineralization on groundwater mineralization. The change pattern of the salt concentration of inland river water was similar to that of the Yangtze River. The average conductivity of 2004 has dropped somewhat compared with the historical average, but increased a little bit as compared with that of 2003. The soil conductivity also kept increasing in 2004.

The groundwater table of Xinglongsha section was a little higher in spring compared with that of the same period of the previous year, and also 10 cm higher than the historical average. Groundwater conductivity had some reduction compared with historical average since the establishment of the power plant, but was higher than the conductivity of 2003. The mineralization of inland river water was similar to that of the previous years. In 2004, the water conductivity of the Yangtze River was higher than that of inland river water. The conductivity of both the Yangtze River and inland river water had substantial fluctuations. However, the fluctuation of soil conductivity was relatively small.

Along the Yangtze River, the conductivity of the sections of the Yangtze River, inland rivers and groundwater varied as they were subject to different tidal influence. The monitoring results of Yinyang section (downstream) and Daxing section (upstream) showed that the change of the conductivity of the Yangtze River, inland river water, groundwater and soil presented similar pattern in line with the distance from the section to the estuary, that is, the nearer it was to the estuary, the higher the monitored value was. However, the changing margin of these monitored elements was different. The conductivity fluctuation of the Yangtze River was bigger than that of inland river water, and that of groundwater bigger than that of soil.

9.5.2 Non-biological environment of waters

- **Hydrographic elements**

The monitoring results of each season showed that the temperature of sea waters under investigation was from 7.96℃ to 28.50℃ with the maximum in August. In spring the average temperature of the Yangtze River estuary and its adjacent sea waters was 20.86℃ on surface and 18.46℃ in the bottom. The average water temperature did not change much in autumn compared with that of 2003. The minimum value of salinity was below 3 and the maximum being 34.49. The salinity showed the trend as being low at the estuary and adjacent sea waters, high in offshore waters; low on the surface and high at the bottom. However, there were some variations at different seasons and marine waters.

● Hydrochemical items

In 2004, the average values of the eight monitored indicators of the investigated marine waters were all bigger than that of the previous year. These 8 indicators included pH value, dissolved oxygen, COD, phosphate, silicate, nitrate, total nitrogen and total phosphorus. The average value of NH_3-N was slightly lower than that of 2003 while the average concentration of nitrite did not have any change.

● Deposition items

The concentration of suspended matter in the investigated sea waters in the autumn of 2004 was between 1.7~320.6mg/L with the average of 17.8 mg/l, lower than that of the previous year. The concentration of suspended matter gradually decreased from the inland side of the Yangtze River estuary to the coastal side, and was higher at the bottom than in the surface layer. On the inland side of the estuary, the average concentration of suspended matter was 65.6 mg/l, forming a high-concentration area of suspended matter in the marine waters southeast to the mouth of the Yangtze River. But on the whole, whether on the inland side or coastal side, the concentration of suspended matter had an obvious reduction compared with that of 2003.

9.5.3 Biological environment of the waters

● Chlorophyll a

The concentration of chlorophyll a at the estuary of the Yangtze River in the spring, summer, autumn and winter of 2004 was 1.74±2.71 mg/L, 0.74±0.76 mg/L, 0.53±0.26mg/L and 0.44±0.18mg/L respectively.

● Phytoplankton

A total of 92 kinds of phytoplankton were collected and identified during the survey in 2004. Among them, 64 were *diatom*, 25 were *dinophyta*, 2 were *chlorophyta* and 1 was *chrysophyta*. *Skeletonema costarum* dominated all phytoplanktons and there were also a great deal of *ditylum brightwellii* and *nitzschia pungens*. Compared with 2001, there were 29 new species or subspecies of phytoplankton.

The amount of phytoplanktons in the investigated sea waters was $1.75\times10^4/m^3$ ～ $1.11\times10^9/m^3$ with big regional difference and the average of $5.34\times10^7/m^3$.

● Zooplankton

A total of 123 kinds of zooplanktons were collected at the Yangtze River estuary in 2004. Maximum zooplankton density of the area was $725.3/m^3$ and the minimum $107.5/m^3$. The density of copepoda, jelly fish and arrow worms had some increase compared with that of the previous year.

● Benthos

Investigation and analysis identified 215 species or subspecies of benthos, including 112 species of hairy organisms, 54 species of mollusks, 27 species of crustaceans, 7 species of echinoderm and 15 other species. Hairy organisms dominated all benthos, followed by mollusks. There were relatively fewer species of crustacean and echinoderms. The overall density of benthos in the water was $19,543/m^2$ in maximum and $6,253/m^2$ in minimum. Among all the benthos, hairy organisms had highest density, reaching $12,000/m^2$ in May and $15,640/m^2$ in November. The density of mollusks ranked the second, which was over $1,000/m^2$.

Compared with the same period of previous years, the total species and total average biomass of benthos did not have any significant change in spring but showed some decline in autumn.

● Ichthyic plankton

Biological investigation at the Yangtze River estuary had obtained 734 samples of 44 species of ichthyic planktons in 2004. The dominant species were lion fish, lizard fish, taperail anchovy,

engraulis japonicus and *anchoviella commersonii*.

● **Fishery resources**

The fishery resources investigation in 2004 identified 83 species of biological resources, including 52 fish species and 31 invertebrate species. The dominant fish species included *setipinna taty*, *harpodon nehereus*,tapertail anchovy, hairtail and *Psenopsis anomala* while the dominant species of invertebrate were *crangon affinis*, *palaemon gravieri*, *palaemon carincauda*, sanderia, jelly fish, *charybdis bimaculata* and portunus.

Compared with past years, both the species and amount of fishery resources have declined and only accounted for half of previous years' record in spring and two thirds of that in autumn. In spring the estuary and adjacent sea waters were filled with jelly fish, mostly sanderia of little economic value. The stock of economic fish species and invertebrates has dumped to a record low. In autumn this year, the dominant species underwent some change and the dominant fishery species in past years, i.e. cyanea capillata Linnaeus, did not appear.

9.6 Study on Endemic Fish Species

In 2004, study on special fish species was conducted to observe the early stage growth of such fish species as *Procypris rabaudi*, *Sinilabeo rendahli* and *Ancherythroculter nigrocauda*. Meanwhile, a series of experiments were conducted. The experiment and trial focused on the artificial propagation of *Procypris rabaudi* and *Sinilabeo rendahli*, the duplication of artificial propagation on *Ancherythroculter nigrocauda* and the continuous accumulation of the information about artificial propagation of other endemic fish species.

9.6.1 Study on early stage growth

On the second day when the fry of *Procypris rabaudi* was born, the swim bladder I appeared and inflated. It was found that melanin appeared in its eyes. The fry was 8.9 ± 0.4 mm long on the third day of its birth and 33.3±0.9 mm on its 56th day, with average daily growth of 0.45 mm. On the fourth day of its birth, the fry's intestine was developed and the fry began to take food. On the 27th day of its birth, the fin was fully developed and the fry reached to its juvenile stage.

The total length of *Ancherythroculter nigrocauda* fry was 4.04 ± 0.09 mm. It began taking food on the fourth day of its birth. The growth of the fry slowed down as the time for initial food serving was postponed. On the 30th day, the squama appeared on its body. As all the fins reached full growth with just abdominal creases remained, the fry grew into the advanced fry stage.

9.6.2 Experiment of artificial propagation

A total of 31 artificial propagation experiments were conducted on 12 endemic fish species through drug fecundation and artificial insemination in 2004. Drug fecundation was successful for such species as *Procypris rabaudi*, *Sinilabeo rendahli*, *Ancherythroculter nigrocauda*, *Onychostoma sima*, S*pinibarbus sinensis*, *Leiocassis longirostris* and *Culter alburnus*. And the fry of *Procypris rabaudi*, *Sinilabeo rendahli*, *Ancherythroculter nigrocauda*, *Onychostoma sima* and *Spinibarbus sinensis* were raised. The successful artificial propagation of *Sinilabeo rendahli* was the first time in China.

Seven artificial propagation experiments were carried out on P*rocypris rabaudi*, four of which were successful. The total fecundation rate was not high and the total amount of fry was not many. Over 60,000 P*rocypris rabaudi* fry were produced during the whole year and about 18,000 juvenile fishes were raised apart from those used for observation and study. All the three artificial propagation experiments on S*inilabeo rendahli* were successful, obtaining over 1.08 million fry. Apart from those used for study and for sale, about 1,000 were raised to young fishes. Artificial propagation experiment on A*ncherythroculter nigrocauda* was repeated once, breeding 50,000 fry with the average fry fecundation rate of 33.33%.

Host organization:

Department of Reservoir Management, the General Office of the State Council Three Gorges Project Construction Committee

Chief compiling organization:

China National Environmental Monitoring Center

Compiling members:

Hubei Provincial Office for Assisting Three Gorges Construction
Hubei Provincial Statistics Bureau
Chongqing Municipal Statistics Bureau
Chongqing Municipal Environmental Monitoring Center
Geological Hazards Monitoring Center of Three Gorges Reservoir, Ministry of Land and Resources
Environmental Protection Center of the Ministry of Communications
Water Conservation Committee of the Yangtze River
Office of the Fishery Resources Management Committee of the Yangtze River
Agriculture Ecological and Environmental Protection Station of Hubei Province
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Chinese Center for Disease Control and Prevention
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Institute of Botany, Chinese Academy of Sciences
National Climate Center
Institute of Earthquake Science, China Seismological Bureau
Department of Financial Planning, the General Office of the State Council Three Gorges Project Construction Committee
China Three Gorges Project Corporation

Approval organization:

State Environmental Protection Administration
General Office of the State Council Three Gorges Project Construction Committee

Release organization:

State Environmental Protection Administration

Translation:

Department of International Cooperation, State Environmental Protection Administration