Chapter 2
Regional Evolution of Dalian Lake

2.1 Regional Wetland Type

As same as the forest, grassland, desert and ocean, the wetland is an important integral part of global ecological environment and an ecological system with particular hydrologic, soil and biological features. Generally the wetland refers to the natural transitional zone from water to land. The word of "wetland" was firstly mentioned by U.S. Fish and Wildlife Service in the publications titled by *No.* 39 *Notice* in 1956. In which the wetland was defined as the lowland covered by the intermittent or the permanent shallow water layer. Such definition satisfies with the needs of wetland administrators and wetland scientists finitely, and thence it is still adopted and used frequently by wetland scientists and wetland administrators nowadays. In 1979, Zoltai, in a discussion meeting of Canadian National Wetland Working Party, defined the wetland into the one as follows, *i.e.*: "the land, where the wet soil dominates and the aquatic plants grow, but the water level approaches to or exceeds mineral soil in the majority days in the unfrozen seasons". The definition made by the Canadian for the word of "wetland" limits the hydrologic conditions and wet soil conditions more concretely. Upon years' investigation, the wetland scientists of U.S. Fish and Wildlife Service defined the wetland as the one as follows, *i.e.*: "the wetland is a transitional zone of the terrestrial system and the aquatic system; on these lands, the water level is normally on or approaches to the earth's surface, or is covered by the shallow water".

In view of the connotation of the wetland, it comprises three features as follows, *i.e.*:

1. The dominant aquatic plants grow on the land periodically at least;
2. The watertight aqueous soil in the matrix dominates;
3. The non-soil matrix is sometimes saturated by water or covered by shallow water in growth season.

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For the definition of the wetland, it is usually adopted the definition in Ramsar Wetland Convention currently, *i.e.*: "the wetland refers to the natural, artificial, permanent or temporary marsh, peat land or water area, whichever it is static, flows, fresh water, brackish water, or salt water, including the water area with the water depth not more than 6 m in the low tide". In this book the lake wetland definition in the Ramsar Wetland Convention is adopted.

The main factors affecting the wetland functions include the hydrologic factor (rainfall inflow process, climate before and after rainfall) and the hydrodynamic force factor (movement status and dwelling time of water flow in wetland), and the other hydrologic factors, for instance, non-point source pollutant, retention rate of runoff and runoff process, dwelling time, water depth, etc. have close relation; however, the dwelling time of the runoff in the wetland system is controlled by the runoff inflow process. The main mechanism of the wetland system to control the non-point source pollution is to increase the runoff infiltration, delay runoff flow, increase dwelling time, etc., and then make pollutants detain in the system to decompose and transform, and finally reduce the pollutant loads from going into the downstream water body; Meanwhile, the rainfall runoff intercepted shall be recycled, which can improve the utilization ratio of water sources and relieve the scarce water source.

When designing the wetland system for controlling the non-point source pollution, it is needed to consider the characteristics of rainfall runoff (rainfall strength, rainfall duration, rainfall time interval, etc.), wetland dewatering time, drought tolerance of plants, transpiration and other factors so as to make the structure and functions of wetland fit to the randomness and rapid change of rainfall. The load of unit area affects the degradation efficiency of the wetland on pollutants; the improper design can make wetland system unworkable; in other words, the primary issue of the design work is to determine the pollution load of wetland area (currently it is needed to determine the pollutant reduction objective of wetland in accordance with the pollution source investigation result, and then obtain the pollution load of wetland area). In the wetland, the degradation extent of pollutant is related to its dwelling time; whereas the dwelling time is inversely proportional to the unit area's load of wetland.

Dianshan Lake evolves from the ancient lagoon in the Holocene period; the whole lake area is the plain water network zone formed under the fluvial outwash of the Yangtze River and the depositing effect of the ancient lagoon in the Quaternary period. According to the record of "Qingpu county annals", the shore of Dianshan Lake in the Song Dynasty was about 100 km long; but now the whole lake shore is about 62.3 km long. In Dalian Lake Demonstration Zone, there are mainly the aquatic forest, farming point, watercourse and *Phragmites communis Trin* marsh etc.; where Douji Port and Dalian River pass through the demonstration zone and connect with Lanlu Port, which is about 40 ha. Dalian Lake is an integral part of Dianshan Lake water area; its formation reason is rightly as same as that of Dianshan Lake. According to the wetland category, Dalian Lake wetland belongs to the mixed wetland of the natural lake wetland and the artificial wetland caused by fishponds.

Meanwhile, Due to the river courses in Dalian Lake wetland are open to the outer area, the biological species includes not only the conventional sedentary species, but also the migration-oriented species, as well as the external species; the hybrid species causes the local original species to change from time to time.

2.2 Regional Wetland Biology

2.2.1 Plankton

In the period from May to August 2008, Nanjing University, Nanjing Agricultural University and Shanghai Ocean University and other units established an investigation party to investigate the biological resources in Dalian Lake water area; the collection, stabilization and number of phytoplankton sample was done by referring to "*Lake Eutrophication Investigation Code*". Additionally 1 L water sample was taken, and the 25 mL methanal and 15 mL iodine solution were adopted to stabilize the water sample; afterwards the water sample was taken back to the laboratory and kept still for 48 h; following the clear solution was absorbed and the rest was concentrated to 50 mL; after shaking sufficiently, 0.1 mL sample was taken by the pipette to make the category appraisal and cell counting under the optical microscope; where the references for such category appraisal were the documents prepared by Han Maosen et al. (1980), every sample was counted two pieces repeatedly, and the sample with the tolerance exceeding 15 % was re-counted one piece additionally. For the investigation scope and sampling point, see Fig. 2.1 as follows.

Fig. 2.1 Sampling point for investigation on biological resource

2.2.1.1 Phytoplankton

Kinds of Phytoplankton

Upon the investigation, totally 86 kinds of algae were found; all of them belong to 7 phyla and 48 genuses (see appendix Table A.1). Among which there were 11 genuses and 17 kinds of cyanophyta, accounting for 22.9 % of the total phyla and 19.8 % of the total kinds; 1 genus and 14 kinds of *Xanthophyta*, accounting for 2.2 % of the total phyla and 1.3 % of total kinds; 1 genus and 1 kind of *Pyrroptata*, accounting for 2.1 % of total genuses and 1.2 % of total kinds; 1 genus and 2 kinds of *Cryptophyta*, accounting for 2.1 % of the total genuses and 2.3 % of total kinds; 2 genuses and 6 kinds of *Euglenophyta*, accounting for 4.2 % of the total genuses and 7.0 % of total kinds; 7 genuses and 12 kinds of *Bacilariophyta*, accounting for 14.6 % of total genuses and 14.0 % of total kinds; 25 genuses and 47 kinds of *Chlorophyta*, accounting for 52.1 % of total genuses and 54.7 % of total kinds. Among which the kind of VII algae from the sampling point of the external river course was minimal, but the kind of II algae from the sampling point of pond was maximal.

Dominant Species of Phytoplankton

In view of the density and the distribution of phytoplankton, the dominant species of the phytoplankton in Dalian Lake water source area are: *Phormidium sp.* and *Merismopedia tenuissim of Cyanophyta, Cryptomonas erosa of Cryptophyta, Synedra ulna of Bacillariophyt*a, *Chlorella vulgaris*, *Tetraëdro trigonum*, *Chlamydomona simplex* and *Scenedesmus quadricauda of Chlorophyta*.

2.2.1.2 Zooplankton

Kind Composition and Distribution

Totally 24 kinds of zooplankton were found in Dalian Lake water source area, belong to 15 genuses. Among which the rotifer is of 6 genuses and 13 kinds, accounting for 40.0 % of total genuses and 54.2 % of total kinds; *Cladocerans* 4 genuses and 6 kinds, accounting for 26.7 % of total genuses and 25.0 % of total kinds; copepods 5 genuses and 5 kinds, accounting for 33.3 % of total genuses and 20.8 % of total kinds.

The kinds of zooplankton found in the samples from all river courses and marshes were found maximally, but it is rather less in the samples from all sampling points of ponds. No rotifer was found in the samples from the sampling points VI, VII, VIII and IX.

Dominant Species of Zooplankton

In view of the distribution and the density, the dominant species of the zooplankton in Dalian Lake water source area are *Brachionus calyciflorus*, *Diaphanosoma brachyurum* and *Cyclops vicinus*.

2.2.2 Aquatic Vascular Bundle Plants

There were 10 vascular bundle plants in Dalian Lake water source area, including 3 floating plants, 3 submerged plants, 3 emergent aquatic plants and 1 floating-leaved plant. The *Phragmites communis* and the *Zizania caduciflora* are full of the coastal areas of river courses, scattered with *Paspalum paspaloides*; the water surface of river courses is full of *Spirodela polyrhiza,* with additional piles of *Hydrocharis dubia* (Blume) Backer and *Alternanthera philoxeroides*; the submerged plant includes: *Cabomba caroliniana*, *Ceratophyllum demersum*, and *Potamogeton malaianus* Miq.; where the dominant plants in the coastal areas of ponds include the *Phragmites communis* and the *Paspalum paspaloides*, and the one on the water surface includes: *Spirodela polyrhiza, Hydrocharis dubia*, *Alternanthera philoxeroides* and *Trapa natans.*

2.2.2.1 Floating Plant

Spirodela polyrhiza, *Lemnaceae*, *Spirodela*; *Hydrocharis dubia*, Hydrocharitaceae, *Hydrocharis*; *Alternanthera philoxeroide*s, Amaranthaceae, *Alternanthera*.

2.2.2.2 Submerged Plant

Ceratophyllum demersum, *Ceratophyllaceae*, *Ceratophyllum*; *Potamogeton malaianus*, *Potamogetonaceae*, *Potamogeton*; *Vallisneria natans*, *Hydrocharitaceae*, *Vallisneria.*

2.2.2.3 Emergent Aquatic Plant

Phragmites communis, *Gramineae, Phragmites*; *Zizania caduciflora*, *Gramineae*, *Zizania*; *Paspalum paspaloides* , *Gramineae*, *Paspalum.*

2.2.2.4 Floating-Leaved Plant

Trapa natans, *Trapaceae*, *Trapa*.

Table 2.1 Kind composition and distribution of zoobenthos in every sampling point

Kind		Sampling point							
		I	IV	V	VI	VII	VIII	IX	X
Mollusca									
Bellamya	*B. aeruginose*		+			+			
	B. purificata	+		+	+		+		+
	B. purificata	+		+	+	+			+
Angulyagra	*A. polyzonata*	+			+				
Alocinma	*A. longicornis*	+	+	+	+	+	+		
Parafossarulus	*P. sinensis*	+				+			
Limnoperna	*L. lacutris*	+			+				
Unio	*U. douglasiae*	+				+			
Anodonat	*A. fluminea*					+			
Annelida									
Limnodrilus	*L. claparedeianus*		+		+			+	
	L. hoffmeisteri		+	+			+	+	
Branchiura	*B. sowerbyi*	+						+	
Tubifex	*T. tubifex*								
Arthropoda									
Chironomus	*C. flaviplumus*					+		+	+
Dicrotendipes	*D. pelochloris*							+	
Statistics		8	4	4	6	7	3	5	3

2.2.3 Zoobenthos

2.2.3.1 Kind Composition and Distribution of Zoobenthos

The substrate of the sampling point II and III in Dalian Lake water source area pond is the hard sediment, where no zoobenthos were found. As for the other sampling points, 15 zoobenthos were found upon the appraisal, belonging to 3 phyla and 12 genuses (Table 2.1); among which, the mollusca is of 7 phyla and 9 kinds; oligochaeta is of 3 phyla and 4 kinds; Chironomidae is of 2 phyla and 2 kinds, accounting for 60 %, 26.7 % and 13.3 % of the total kinds respectively.

2.2.3.2 Dominant Zoobenthos in Dalian Lake

The dominant zoobenthos in Dalian Lake water source area includes: *B. purificata*, *B. purificat* and *A. longicornis.*

2.2.4 Fishes

Dalian Lake has the characteristics of the fish compound ecosystem of Dianshan Lake water system, dominating by cyprinid fish; following it is the sedentary small freshwater fish, estuary-oriented rich saltwater fish and migratory fish; where the main fishes include: *Coilia nasus*, *C. nasus taihuensis*, *Neosalanx tangkehkeii taihuensis Chen*, common carp, crucian carp, gurnard, *Erythroculter mongolicus*, *Topmouth culter*, *Erythroculter illshaeformis*, *Erythroculter dabryi*, *Paracanthobrama guichenoti*, *Hemibarbus maculatus*, *Elopichthys bambusa*, *Saurogobio dabryi*, *Hemicculter Leuciclus*, various *Rhodeus sinensis Gunther*, catfish, eel, mullet, *Siniperca chuatsi*, *Cymoglossus robustus*, *Channa argus*, *Takifugu obscurus*, and other breeding fishes, such as grass crap, black carp, silver carp, bighead carp, Bluntnose black bream, carp and so on. Upon the investigation on Dalian Lake water source area, the fishes under 5 orders, 9 families and 24 species were found.

2.2.5 Birds

There are flourishing vegetations, excellent habitat and special rich bird resources in Dianshan Lake area. According to the investigation, the birds under 17 orders, 48 families and 183 species were found, including 1 bird species under the first-grade State protection (*Mergus squamatus*), 39 bird species under the second-grade State protection, 1 bird species under the Chinese endemic species (*Paradoxornis heudei*), 8 bird species under Chinese White Paper for Endangered Animals and 33 bird species under *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

2.2.6 Animals

The animals recorded in Dianshan Lake area involve in 9 orders and 34 species, including 3 animals under the second-grade State protection (Common Otter, rasse, zibet), and 5 animals under CITES.

2.2.7 Endangered Rare Species

According to the years' investigation and the historical records, there are 40 mammalian species, 424 bird species (including the subspecies), 32 Reptiles species, 14 amphibians species and 250 fish species in Shanghai area. Among which there are 9 wildlife animal species under the first-grade state protection, for instance,

hooded crane, Ciconia boyciana, Chinese sturgeon, etc.; 62 wildlife animal species under the second-grade State protection, for instance, black-faced spoonbill, grey crane, *Cygnus columbianus*, *Platalea leucorodia*, tiger frog, sea turtle, etc.; 56 species in the appendix to *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), 185 birds species under *Agreement of the People's Republic of China and Japanese on the Protection of Migratory Birds and their habitats*, 86 bird species under *Agreement of the People's Republic of China and Australia on the Protection of Migratory Birds and their habitats*, and 46 wildlife animal species under the key protection of Shanghai City, for instance, leopard cat, *rrinaceus earopaeus*, hog-nosed badger, magpie, *zaocys dhumnade*, etc.

2.2.8 Invasive Species

The invasive species in Dalian Lake water source area includes *Cabomba carolimana, Eichhirnia crasslpes* and *Ampullaria gigas* Spix, etc.

2.3 Regional Wetland Evolution

Dianshan Lake water area evolves from the ancient lagoon in the Holocene period; the whole lake area is the plain water network zone formed under the fluvial outwash of the Yangtze River and the depositing effect of the ancient lagoon in the Quaternary period. According to the record of *Qingpu county annals*, the bank of Dianshan Lake in the Song Dynasty was about 100 km long; but now the whole lake bank is about 62.3 km long. Dalian Lake is an integral part of Dianshan Lake water area; its formation reason is rightly as same as that of Dianshan Lake. According to the wetland category, Dalian Lake wetland belongs to the mixed wetland of the natural lake wetland and the artificial wetland caused by fishponds.

Due to the river courses in Dalian Lake wetland are open to the outer area, the biological species includes not only the conventional sedentary species, but also the migration-oriented species, as well as the external species; the hybrid species causes the local original species to lose and change from time to time.

Since the beginning of the twentieth century, as the local population increases hugely and the frequent actions to reclaim farmland from lakes, the lake area of Dalian Lake has reduced sharply. The water area of Dalian Lake in 1980s was 1.474 km^2, but now it is only 0.9 km^2. Additionally, due to river courses are silted seriously and the lake is netted to breed fishes, which causes poor flow and high density of suspended matters to Dalian Lake water area, and makes the water of whole lake area eutrophicated; which affects the native species for survival and the migrant fishes for activity seriously. Currently plenty of important species in Dalian Lake area have already extinguished, and the Gorgon fruit, Brasenia schreberi and myxiocyprinus asiaticus are at the risk of disappearing too.

2.3.1 Kinds of Phytoplankton and Evolution of Dominant Species

In recent 50 years, the blue and green algae have been growing rapidly in Dalian Lake water source area. According to the data, the phytoplankton quantity in Dianshan Lake in 1959 was not beyond 2,000/L, but in 1991, it was 9×10^5/L; however in 2000, it exceeded 10×10^7/L; in the year of 2008, the phytoplankton quantity in Dianshan Lake was 2.04×10^7/L; but a downward trend in the percentage of the algae fitting for aquatic economic (Table 2.2).

2.3.2 Kinds and Quantity Evolution of Zooplankton

The zooplankton is the first secondary productivity of lake and the important nature bait for fishes. The kinds and changes of zooplankton reveal the influence of lake eutrophication to lake ecology to some extent (Table 2.3).

In view of the historical investigation results, it can be seen the zooplankton in Dianshan Lake water area is mainly dominated by protozoa, rotifera, cladocera animals and copepoda animals under the crustacean category. In view of the biological number, the rotifera and the protozoa are the main zooplankton. The number of the rotifera is an important indicator species for the eutrophication extent of water. In view of Table 2.4 as follows, it can be seen the number of the rotifera in 2000 increased highly comparing with the one in 1982; which shows the water eutrophication intensifies to some extent.

2.3.3 Type, Quantity and Distribution Evolution of Aquatic Vascular Bundle Plants

The aquatic vascular bundle plants are the higher aquatic plants with the vascular bundle structure. According to the ecological features, the aquatic vascular bundle plants can be divided into four categories, namely emergent aquatic plant, floating-leaved plant, floating plant and submerged plant.

In accordance with the two investigations made by East China Normal University respectively in the period of 1983–1985 and 1987–1988, the aquatic vascular bundle plants under 23 families and 26 species were found in Dianshan Lake water area. The two investigation results had no big difference, but no *Nymphoides peltatum* (Gmel.) O. Kuntze*, Pseudobulbus Cremastrae Seu PLeiones, Nymphaea alba, Spirodela polyrr-hiza Schleid* were found by the investigation made in 1987–1988, however the *Najas marina, Najas minor-Caulina fragilis*, *Potamogeton pectinatus* and *Alternanthera philoxeroides* were additionally found in the investigation sample. The emergent aquatic plants in Dianshan Lake water area was absolutely

Table 2.2 Evolution of phytoplankton in Dianshan Lake water area

	Species/quantity								
Year	*Cyanophyta*	*Chlorophyta*	*Bacillariophyta*	*Cryptophyta*	*Pyrrophyta*	*Euglenophyta*	*Xanthophyta*	*Chrysophyta*	*Euglenophyta*
1982	13	28	26		3			1	3
1985–1986	6	14	7	2		2		2	
1987–1988	11	37	15	3	2	3	3	6	
2000	12	25	12	1	3	2	2	1	
2008	11	25	7	1	1	2	1		

Table 2.3 Kinds of zooplankton and evolution of their dominant species in Dianshan Lake water area

Investigation time (year)	Category	*Protozoa*	*Rotifera*	*Cladocera*	*Copepoda*
1982	Species type	28 genera 28 species	27 genera 51 species	14 genera 18 species	9 genera 11 species
	Dominant species	*Difflugia, Strombidium, Tintinnopsis*	*Diaphanosoma spp.*	*Limnoithona sinensis, Sinocalanus*	
1987–1988	Species type	20 genera 23 species	12 genera 24 species	9 genera 21 species	10 genera 12 species
	Dominant species	*Trinema lineare*	*Brachionus calyciflorus Pallas, Keratella quadrata, Polyarthra trigla*	*Diaphanosoma brachyurum, Bosminopsis deitersi*	*Limnoithona sinensis, Mesocyclops leuckarti, Schmackeria forbesi, Sinocalanus dorrii*
2000	Dominant species	*Epistylis lacustris*	*Brachionus plicatilis, Brachionus diversicornis, Asplachna priodonta Gosse, Trichocerca sp., Keratella*	*Diaphanosoma spp., Daphnia pulex, Moina, Bosmina, Chydorus sphaericus*	*Calanus, Cyclops, Canthocamptu spp.*
2008	Dominant species		*Brachionus calyciflorus Pallas*	Diaphanosoma brachyurum	Cyclops vicinus

Table 2.4 Comparison on zooplankton biomass in Dianshan Lake water area

	Biomass/(piece/L)			
Year	*Protozoa*	*Rotifera*	*Cladocera*	*Copepoda*
1982	754–1,320	81–400	24–56.1	18.5–40.56
1987–1988	1,400	783	60	140
2000	400	1,160	109	117
2008		710	370	500

dominated by the *Phragmites communis*; which was scattered in the south of Dianshan Lake and the lakeside area in Shangta Town; the floating-leaved plant in Dianshan Lake water area was the *Trapa*; the floating plants were mostly distributed in the broad water area, mainly the *Alternanthera philoxeroides, duckweed*, *Azoila imbricate*, *Hydrocharis dubia, Spirodela polyrrhiza, Eichhornia crassipes*, *Nymphaea alba* etc.; the submerged plants included *Vallisneria natans, Hydrilla verticillata*, *Ceratophyllum demersum*, *Myriophyllum spicatum, Najas marina* and *Najas minor. Caulina fragilis*, etc. Upon the two investigations above, It was found the kinds of the submerged plant different hugely each other and the submerged plant community changed hugely in the investigation in 1988, where a large area of *Myriophyllum verticillatum*, *Hydrilla verticillata*, *Najas marina* and other algae with less nutrient substances and hard to collect and utilize occurred; such algae have strong adaptability; if they grow into the main community of the submerged plants, it shall hugely change the ecological environment of the local water area.

In the year of 2000, Shanghai Ocean University Fishery College made an investigation in Dianshan Lake water area, where the aquatic plants under 2 families and 20 species were totally collected; among the collected aquatic plants, the *Vallisneria natans, Hydrilla verticillata, Ceratophyllum demersum* were the main species; the aquatic plants in the coastwise area were mainly the *Phragmites communis* and the *Zizania caduciflora;* the floating aquatic plants in water were mainly the *Eichhornia crassipes, Commom Duckweed, Salvinia natans*, etc.; the submerged plants were mainly the *Vallisneria natans*.

2.3.4 Type, Quantity Distribution and Evolution of Bentonic Organism

The bentonic organism is a group of organism living at the bottom of water. In August 1983, the Biology Department of East China Normal University made a qualitative and quantitative research on samples collected from 39 points (frequencies), where 21 mollusks, 8 crustaceans, 2 aquatic insects and 1 polychaetes animal and 1 oligochaeta animal were found. In the biocenosis the mollusk dominated, which accounted for 93.23 %; following it was the crustacean (3.69 %) and aquatic insect (0.9 %).

Again in the period from 1987 to 1988, East China Normal University, upon its another investigation, found the bentonic organism under 3 families and 6 classes, all of which belonged to 16 families 35 species; comparing with the investigation result in 1983, its community structure did not change hugely; where the mollusk dominated absolutely (90.9 %); however, the quantity of the Chironomid larvae and the oligochaeta organisms, which was stable originally, shown the increasing tendency; but the large mollusk animals, for instance, the number of Trigonioides, reduced and shown a tendency to become smaller; the number of the arthropods shown its reduction tendency too, even the Chinese soft-shell turtle was rare to see.

In 2000, ten zoobenthos were found in the samples collected by Shanghai Ocean University from the given collection points, which were mussel, corbicula fluminea, oncomelania, Bellamya, viviparid, Schistodesmus lampreyanus, Semisulcospira libertine, Chironomid larvae, clam worm, Bithynia tentaculata. Comparing with the investigation made by East China Normal University in 1983, the bentonic organism in Dianshan Lake water area, whichever it is the quantity or the species, shown its reduction tendency; however, the quantity percentage of the Chironomid larvae and Tubificidae approached to 50 %; which shown the pollution in Dianshan Lake water area became serious day after day.

2.3.5 Composition, Distribution Characteristics and Aquatic Product Types of Fishes in Dianshan Lake

The Dianshan Lake water area is an integral part of the Tai Lake water system, having the characteristics of the fish compound ecosystem of Tai Lake water system; where the cyprinid fish dominates; following it is the sedentary small freshwater fish, estuary-oriented rich saltwater fish and migratory fish. The main fish species in Dianshan Lake water area includes: *Coilia nasus*, *C. nasus taihuensis*, *Neosalanx tangkahkeii taihuensis Chen*, common carp, crucian carp, gurnard, *Erythroculter mongolicus*, *Topmouth culter*, *Erythroculter dabryi*, *Paracanthobrama guichenoti*, *Hemibarbus maculatus*, *Elopichthys bambusa*, *Saurogobio dabryi*, *Hemicculter Leuciclus*, various *Rhodeus sinensis Gunthers*, catfishs, eels, mullets, *Siniperca chuatsi*, *Cymoglossus robustus*, *Channa argus*, *Takifugu obscurus*, and other breeding fishes, such as grass crap, black carp, silver carp, bighead carp, Bluntnose black bream and mirror carp and so on. Upon the multiple investigations made by Shanghai Ocean University respectively in 1959, 1974, 1981–1982, 1982–1985 and 1987–1988, the fishes under 60 families 75 species, 47 families 61 species, 42 families 62 species, 44 families 55 species and 34 families 45 species were found accordingly. Upon the multiple investigations on the composition of fish fauna, the wildlife cyprinid fish were dominated in 1950s, but the breeding fish species were very rare; however, there were a quantity of estuary-oriented fishes and the migratory fishes, and some large yellowcheck carps; in 1970s, the migratory fishes and the estuary-oriented fishes reduced in Dianshan Lake water area, but the breeding fish species were increased rapidly. In view of the yield data obtained from the fishery service, the breeding fish

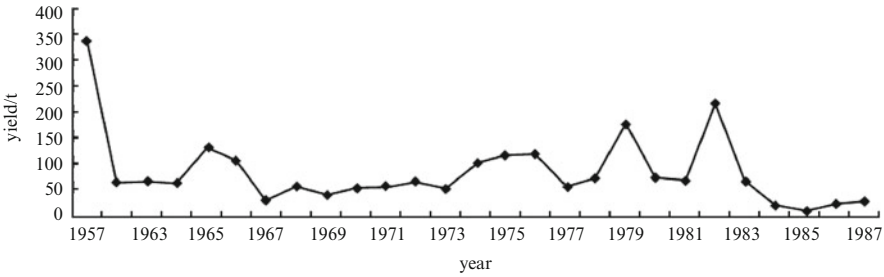

Fig. 2.2 Yearly crab yield in Dianshan Lake water area

species in Dianshan Lake water area increased to 50 % in 1980s from 5 % in 1950s and 30 % in 1970s.

In view of the multiple investigation results, the fish fauna in Dianshan Lake water area changed hugely in the past 30 years, and 30 fish species disappeared. The investigation result 2008 shown the fish species available in Dianshan Lake water area currently was only 40 % of the one in 1959, where 14 fish species were under the cyprinoid; most of fish species reduced were the migratory fishes and the semi-migratory fishes; the direct reason to cause such reduction is the dam structure constructed by human being, which possibly blocked the migration channels of fishes; the other possible reason is the unreasonable fishing operations. Figure 2.2 shows the Chinese Wollhandkrabbe yield in Dianshan Lake water area in the past 30 years (Data source: Qingpu District Aquatic Products Department).

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