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The Population Carrying Capacity of Waters Ecosystem in China

GE Liqiang[1, 2], LI Shimei[3], XIE Gaodi[2*], CHENG Yanpei[1], NI Zengshi[1]

1 Institute of Hydrogeology and Environmental Geology, Chinese Academy of Geological Sciences, Shijiazhuang, Hebei Province, 050061, China
2 Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing , 100101, China
3 College of Landscape Architecture and Forestry, Qingdao Agricultural University, Qingdao, Shandong Province, 266109, China

Abstract: The study of waters ecosystem and their population carrying capacity demonstrates the role of these ecosystems in economic and social development and provides a theoretical basis for the management and allocation of aquatic ecosystems. In this study, the concept of waters ecosystem population carrying capacity was defined and developmental trends in the population carrying capacity of waters ecosystem in China were evaluated. Results show that waters ecosystem population carrying capacity in China increased from 0.176×10^9 person $year^{-1}$ in 2000 to 0.255×10^9 person $year^{-1}$ in 2010; the population carrying capacity of the standard sea remained at 0.2-0.3 person ha^{-1}; and the standard inland waters population carrying capacity increased from 1.8 to 3.2 person ha^{-1}. This analysis indicates notable regional difference in waters population carrying capacity. In southeastern coastal China and Yangtze River drainage areas where inland waters are widely distributed and aquaculture is developed, the population carrying capacity is higher; however, in northwest China where water resource are deficient and the distribution is relatively small, the waters population carrying capacity is low. The waters ecosystem population carrying capacity of China in 2030 was predicted and results indicate strong potential for increasing waters population carrying capacity.

Key words: waters ecosystem; biological production; population carrying capacity; aquatic resources; China

1 Introduction

With rapid development of science and technology, significant changes have taken place and living standards have greatly improved, however, an insatiable need for natural resources has fueled these changes. Thus, the resource base that humans live on has been continuously weakened, giving rise to a series of problems such as population growth, food shortage, poverty, environment deterioration, disaster and war. These problems are closely related to resources to some extent, and the developmental trend of resource issues will determine the developmental trend of other global issues and decide the future of earth. Aquatic resources, especially sea aquatic resources, are one of the main options for relieving the shortage of land resources and environmental deterioration. Waters ecosystem provides aquatic products for humans as an important source of high quality protein and influences the development of human society. At present, aquatic products provided by oceans each year is about 3×10^9 ton, enough to feed 30×10^9 people. The ocean provides about 20% of food and about 16% of protein for people, so there is great developmental potential for sea fishing and aquaculture. Along with continuous development and utilization of waters ecosystems, aquatic resources and environments face increasing pressure. Therefore, it is necessary to evaluate waters ecosystem population carrying capacity to provide a theoretical basis and decision support for the management of waters ecosystem and their allocation. In particular, the present study is of important significance for promoting sustainable development in China.

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Author: GE Liqiang (1979－), male, main research on hydrogeology and ecosystem service. E-mail: geliqiang220@163.com
***Corresponding author:** E-mail address: xiegd@igsnrr.ac.cn

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2 Waters ecosystem population carrying capacity and evaluation index

2.1 Concept and connotation

The waters ecosystem population carrying capacity (waters carrying capacity hereinafter) is an incorporation of the carrying capacity concept, aquatic resources and sustainable development theory (Arrow et al. 1995; Cohen 1995; Price 1999; Chen 1998). Waters carrying capacity is defined as follows: the capacity that aquatic resources (products) produced by local waters ecosystems can support the existence of humans and social development in a certain area and in a specific stage in accordance with modern social and cultural criteria, on the condition that the sustainable utilization of aquatic resources can be achieved and the ecosystem will not be destroyed; here it specially means the number of people it can feed. The calculation is as follows:

$$ACC = F / F_{PC} \quad (1)$$

where, ACC is waters carrying capacity; F is output of aquatic products (calculated as the productivity of standard water area); and F_{PC} is average consumption of aquatic products per capita.

The connotation of waters carrying capacity contains the aspects:

(1) In the concept of waters carrying capacity, the subject is the aquatic resources produced by the waters ecosystem, and the object is people and their existent social and economic system and environmental system.

(2) The waters carrying capacity possesses spatio-temporal attributes.

(3) The waters carrying capacity is an important component of sustainable development capacity.

2.2 Determination of consumption of aquatic resources per capita

Aquatic products are an important part of human food components and an important source of high quality protein (protein conversion ratio of 1.5:1 by intake of fish). Here the consumption of aquatic resources per capita refers to the intake of aquatic product per capita. Different foods contain different nutrients, which perform different functions. Any kind of natural food cannot provide all the nutrients needed by the body. In order to live, people must obtain various nutrients from a variety of foods so as to meet all kinds of human nutritional needs. Different energy demand levels require different food intake (Chinese Nutrition Society 2008; Li, 2007). According to the "Food and Nutrition Development Outline of China (2001-2010)" issued by the State Council ([2001] No. 86), in order to guarantee a reasonable nutrient intake, the daily intake of energy is fixed at 2300 kcal per capita, 80% of which is from plant food and 20% from animal food; the protein intake is fixed at 77 g, 30% of which is from animal food; the fat intake is fixed at 70 g, accounting for 25% of total energy.

Assuming that aquatic products feed people by providing protein, based on the annual aquatic product protein requirement per capita and the protein quality that future water products can provide, the population fed by aquatic products can be calculated, namely, waters ecosystem bearing capacity. Different aquatic products provide different nutrients with different protein content (Sun, 2011), here the protein content of aquatic products is assumed to be 20% and according to the daily intake of 77g of protein per capita and conversion rate 1.5: 1 of aquatic products, the daily intake of aquatic products per capita is 577.5 g and the annual intake of aquatic products per capita is 210.8 kg.

3 Water distribution and production status of aquatic products

3.1 Water distribution

There are seven provinces in China (Hubei, Jiangsu, Heilongjiang, Qinghai, Xinjiang, Tibet and Inner Mongolia) with an absolute area of inland waters ecosystem exceeding 1×10^4 km^2. Waters ecosystems account for a small percentage of the provincial area, the area of waters ecosystem of Tianjin is higher than that of other provinces (autonomous regions), about 14.52%. According to remote sensing data, during 2000 to 2010 the total area of inland waters in China was almost unchanged; sea area also remained unchanged.

3.1.1 Inland waters

The total area of inland water means the area occupied by rivers, lakes, ponds and reservoirs. The percentage of inland water area in China's total territory often reflects water resources of the country as well as development conditions of inland fisheries. The total inland water area of China in 2010 was 39.42×10^4 km^2, among which the pond area was 1.922×10^4 km^2, lake area was 7.561×10^4 km^2, reservoir area was 2.302×10^4 km^2, river and gully area was 5.278×10^4 km^2 and others were 0.445×10^4 km^2. The basic conditions of major rivers and lakes are shown in Table 1 and Table 2.

3.1.2 Seas

Eastern and southern parts of China border the Bohai Sea, Yellow Sea, East China Sea and South China Sea. The total sea area is 472.7×10^4 km^2, among which the total area of continental shelf within 200 m is 148×10^4 km^2, and the area

Table 1 Main rivers in China

Name	Drainage area (10^4 km^2)	Length (km)	Annual runoff (10^9 m^3)
Yangtze River	180.85	6300	951
Yellow River	75.244	5464	66
Songhua River	55.718	2308	76
Liaohe River	22.896	1390	15
Pearl River	45.369	2214	334
Haihe River	26.363	1090	23
Huaihe River	26.928	1000	62

Data source: China Statistical Yearbook for 2011

Table 2 Lake water area and water storage

Lake area	Lake water area (10^4km^2)	Lake water storage (10^9m^3)
Total	**7.561**	**751**
Qinghai-Xizang Plateau	3.656	546
Eastern Plain	2.343	82
Inner Mongolia-Xinjiang Plateau	0.867	76
Northeastern Plain	0.434	20
Yunnan Plateau	0.11	24
Others	0.151	3

Data source: China Statistical Yearbook for 2011

of fishing grounds is 280×10^4 km^2, equal to 0.28×10^9 ha and exceeding arable land area by 69%. The coastal line starts from the mouth of the Yalu River in Liaoning to the mouth of the Beilun River in Guangxi with a length of 1.8×10^4 km. The zigzagging land and coastal line results in many excellent bays and harbors. The mud flat area of the coastal intertidal zone is 186×10^4 ha, the area of shallow sea within 10 m isobaths is 733×10^4 ha, and the area of shallow sea within 15 m isobaths is 1200×10^4 ha (Table 3).

3.2 Production of aquatic products

Aquatic products refer to animal and plant species and numbers in natural waters with development and utilization value, also known as fishery resources. According to different classifications, aquatic products can be divided into different types. For example, according to the production waters of aquatic products, they can be divided into sea water aquatic products and freshwater aquatic products; according to the mode of production, they can be divided into fishing aquatic products and aquaculture aquatic products; and according to specific product categories can be divided into fish products, shrimp and crab products, shellfish products, algae products and other products.

The production characteristics of aquatic products makes the production distribution regional: in places where water resources are rich, the temperature is appropriate and suitable for aquaculture and fishing, the output is relatively high (e.g. southeast coastal China, Yangtze River drainage area); on the contrary, in places where water resource are deficient and the temperature is inappropriate, the output is low (e.g. northwest China). There are typical regional differences for the production of aquatic products in China.

The production status of aquatic products in China during the period of 2000 to 2010 is shown in Table 4:

There is a long history of aquaculture in China and it was the first country where aquaculture output exceeded fishing

Table 3 Ocean resources in China

Name	Sea area (10^4 km^2)	Percentage in China's sea areas (%)	Fishery area (10^4 km^2)	Percentage in China's fishery grounds (%)	Coastal line length (km)	Tide flat area (10^4 ha)	Percentage in China's tide flat area (%)	Shallow sea area (10^4 ha)	Percentage in China's shallow sea areas (%)	Average area per kilometer coastal line(10^4 ha)	
										Tide flat	Shallow sea
Bohai Sea	7.7	1.6	7.7	2.8	2937	51	26.4	10.8	22	227	733
Yellow Sea	38	8	35.3	12.6	3927	55	28.7	13.4	27.4	140	507
East China Sea	77	16.3	54.9	19.6	5745	49	25.7	14.2	29	93	393
South China Sea	350	74.1	182.1	65	5792	37	19.1	10.6	21.6	76	330
Total	472.7	100	280	100	18401	192	100	49	100	536	1963

Data sources: Compilation Committee of Natural Resources in China, 1995; China Statistical Yearbook for 2011

Table 4 Production status of aquatic products in China from 2000 to 2010

Item	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Output of aquatic products (10^4 ton)											
Sea fishing	1276.0	1244.1	1238.0	1237.0	1253.2	1255.1	1245.5	1243.6	1258.0	1275.9	1315.2
Sea aquaculture	928.0	989.4	1060.5	1095.9	1151.3	1210.8	1264.2	1307.3	1340.3	1405.2	1482.3
Freshwater fishing	193.4	186.2	194.7	213.3	209.6	221.0	220.4	225.6	224.8	218.4	228.9
Freshwater aquaculture	1308.9	1376.2	1461.7	1530.9	1632.5	1733.0	1853.6	1971.0	2072.5	2216.5	2346.5
Water area (10^4 ha)											
Sea fishing	47145.7	47141.3	47135.5	47116.8	47107.6	47100.6	47142.8	47136.9	47112.1	47084.1	47061.9
Sea aquaculture	124.3	128.7	134.5	153.2	162.4	169.5	127.2	133.1	157.9	185.9	208.1
Freshwater fishing	3406.6	3407.7	3400.1	3392.9	3386.4	3373.2	3361.4	3344.6	3288.9	3243.6	3233.6
Freshwater aquaculture	526.5	539.9	551	560.9	572.3	585	425.4	441.4	497.1	542.4	556.4
Standard water area output (kg ha^{-1})											
Sea fishing	27.1	26.4	26.3	26.3	26.6	26.6	26.4	26.4	26.7	27.1	27.9
Sea aquaculture	7464.6	7688.2	7886.5	7152.5	7090.2	7145.5	9940.7	9818.4	8488.8	7557.6	7123.4
Freshwater fishing	56.8	54.6	57.3	62.9	61.9	65.5	65.6	67.5	68.4	67.3	70.8
Freshwater aquaculture	2486.1	2548.8	2653.0	2729.2	2852.4	2955.5	4357.5	4465.7	4169.2	4086.6	4217.0

Data source: China Fishery Statistical Yearbook for 2001-2011

output. Aquaculture is an industry that obtains aquatic products with certain production sites, and with a certain amount of capital and labor force, including seawater aquaculture and inland freshwater aquaculture (Han, 2007). During 1990 to 2010, the total aquaculture water area increased from 425.87×10^4 ha to 764.52×10^4 ha, among which the area of inland aquaculture increased from 382.98×10^4 ha to 556.43×10^4 ha, while the area of seawater aquaculture increased from 42.89×10^4 ha to 208.09×10^4 ha, nearly five times.

Since China's reform and opening up, fisheries have undergone rapid development and the output of aquatic products has greatly increased and ranked first in the world since 1990. According to statistics in 1980, the output of aquatic products was 449.7×10^4 ton. During 1980-2000, the output of aquatic products in China increased rapidly, but after 2000 growth leveled off; this may be related to the government policy of "aquaculture is encouraged with fishing zero growth or negative growth".

The output of standard sea aquatic products in China increased year by year from 46.6 kg ha^{-1} in 2000 to 59.2 kg ha^{-1} in 2010 and is closely related to the promotion of sea aquaculture. The standard output of sea fishing changed little with aquatic products at 27 kg per hectare; the standard output of sea aquatic products is within the range of 7150 to 9950 kg and showed no special regularities, which may be related to the immaturity of seawater aquaculture in China.

The output of standard inland aquatic products in China increased year by year from 397.5 kg ha^{-1} in 2000 to 679.5 kg ha^{-1} in 2010. The standard output of freshwater fishing changed little, tending to be stable, with output of aquatic products at 65 kg ha^{-1}. The standard output of freshwater aquaculture increased to 4000 kg from 2000 kg.

4 Analysis of waters carrying capacity (2000-2010)

The standard waters ecosystem carrying capacity means the population that aquatic products per hectare can support. In 2000, the waters carrying capacity in China was 0.176×10^9 persons, and in 2010 was 0.255×10^9 persons. The waters carrying capacity in China is mainly the aquaculture waters carrying capacity (Table 5).

4.1 Status of sea ecosystem carrying capacity

The sea ecosystem carrying capacity in China increased to 0.133×10^9 persons from 0.105×10^9 during 2000-2010, among which the sea fishing carrying capacity remained relatively stable, being 0.06×10^9 persons, while the sea aquaculture carrying capacity increased to 0.070×10^9 persons from 0.044×10^9 persons. The standard sea ecosystem carrying capacity is within the range of 0.2-0.3 persons.

4.2 Inland waters ecosystem carrying capacity

The inland waters ecosystem carrying capacity in China increased to 0.122×10^9 persons in 2010 from 0.071×10^9 persons in 2000, among which the freshwater fishing carrying capacity is around 0.01×10^9 persons; the freshwater aquaculture carrying capacity increased to 0.111×10^9 persons in 2010 from 0.062×10^9 persons in 2000. The standard inland waters ecosystem carrying capacity increased to 3.2 persons from 1.8 persons.

The inland waters ecosystem carrying capacity of each province is shown as Fig. 1 and shows regional differences. Inland waters are extensively distributed in coastal areas of southeast China and Yangtze River drainage areas, the waters

Table 5 Waters carrying capacity in China 2000-2010

Item	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Standard waters ecosystem carrying capacity (persons)											
Sea waters	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
Sea fishing	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sea aquaculture	35.4	36.5	37.4	33.9	33.6	33.9	47.2	46.6	40.3	35.9	33.8
Inland waters	1.8	1.9	2.0	2.1	2.2	2.3	2.6	2.8	2.9	3.1	3.2
Freshwater fishing	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Freshwater aquaculture	11.8	12.1	12.6	12.9	13.5	14.0	20.7	21.2	19.8	19.4	20.0
Waters ecosystem carrying capacity (10^4 persons)											
Sea fishing	6053	5902	5873	5868	5945	5954	5908	5899	5968	6053	6239
Sea aquaculture	4402	4694	5031	5199	5462	5744	5997	6202	6358	6666	7032
Freshwater fishing	917	883	924	1012	994	1048	1046	1070	1066	1036	1086
Freshwater aquaculture	6209	6528	6934	7262	7744	8221	8793	9350	9832	10515	11131
Sea ecosystem carrying capacity (10^4 persons)	10455	10595	10904	11067	11406	11698	11905	12101	12326	12719	13271
Inland waters ecosystem carrying capacity (10^4 persons)	7127	7412	7858	8274	8739	9269	9839	10420	10898	11551	12217
Total waters ecosystem carrying capacity (10^4 persons)	17582	18007	18761	19341	20145	20967	21744	22521	23224	24269	25488

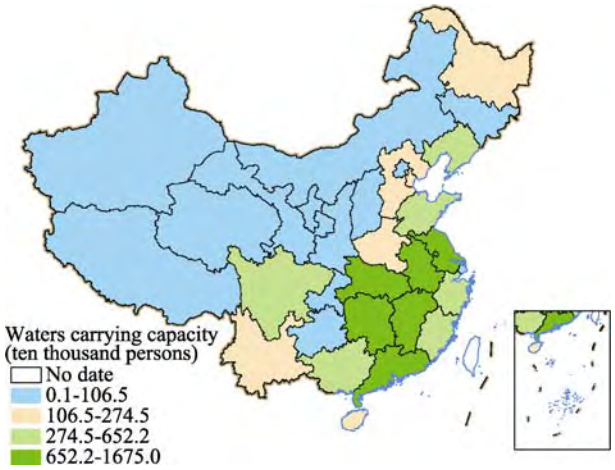

Fig.1 Inland waters ecosystem population carrying capacity of each province in China in 2010

carrying capacity is high where aquaculture is developed; while in northwest China, water resources are deficient, freshwater fishing is much less and aquaculture develops slowly, resulting in a low carrying capacity. In 2010 there are four provinces (Hubei, Guangdong, Jiangsu and Jiangxi) with an inland waters ecosystem carrying capacity over 0.01×10^9 persons, among which Hubei is highest at 0.017×10^9. Four provinces with the lowest waters ecosystem carrying capacity are Tibet, Qinghai, Gansu and Shanxi, among which Tibet is the lowest with an inland waters ecosystem carrying capacity of only 0.2×10^4 persons.

5 Waters carrying capacity predictions (2030)

5.1 Production capability prediction of aquatic product

Data shows that ocean primary productivity in China is below the global average, however, the developmental degree of aquatic resources in China ranks among the top six countries with the largest continental shelf, and sea fishing is in an excessive state (Han, 2003). In 1990, the Chinese government developed a policy focused on aquaculture and called for zero increases or even negative growth in the fishing sector. In China, fisheries have been adjusted and the focus has shifted to aquaculture. Aquaculture has developed rapidly in every area of China from coastal areas, Yangtze River drainage areas and Pearl River drainage areas. Thus, the output of aquatic products in 2030 is predicted, assuming that the amount of sea fishing and freshwater fishing remains as the maximum fishing amount during 2000-2010, while sea aquaculture and freshwater aquaculture will be developing with aquaculture technology and extension of aquaculture areas, resulting in an increase of standard aquaculture output and the total aquaculture output.

5.1.1 Freshwater aquaculture

Aquaculture area: the inland usable water surface for aquaculture is 674.9×10^4 ha, assuming that the whole area of usable water surface is used for aquaculture.

Standard waters ecosystem aquaculture output (per unit output): in light of progress in aquaculture technology, assuming that standard area freshwater aquaculture output in 2030 will be 1.2 times the peak value during 2000-2010 (4465.7 kg in 2007) the standard freshwater aquaculture output will be 5358.8 kg in 2030.

5.1.2 Sea aquaculture

Aquaculture area: based on sea aquaculture status in recent years, the growth curve of sea aquaculture area was fitted and found that the sea aquaculture area accords with a simple regression equation (Fig. 2):

$$Y = 58.429X - 115618 \quad (2)$$

where, X is an independent variable indicating the year and Y is the dependent variable indicating aquaculture area over years.

Through Equation 2, the prediction value of sea aquaculture area in 2030 is 299.29×10^4 ha.

The standard sea aquaculture output (per unit yield): in light of aquaculture technique progress, assuming that the sea aquaculture output of standard area in 2030 is 1.2 times the peak value during 2000-2010 (9940.7 kg in 2006) then the standard sea aquaculture output will be 1.193×10^4 kg in 2030.

The prediction of aquatic production for 2030 is shown in Table 6 as follows:

5.2 Waters carrying capacity (2030)

The predicted waters ecosystem carrying capacity of China in 2030 is shown in Table 7: the standard waters ecosystem carrying capacity will be 0.8 persons, the waters ecosystem carrying capacity will be 0.433×10^9 persons, among which the sea ecosystem carrying capacity will be 0.242×10^9 persons (aquaculture carrying capacity 0.177×10^9 persons and fishing carrying capacity 0.065×10^9 persons); the standard sea ecosystem carrying capacity will be 0.5 persons (standard aquaculture carrying capacity 59.1 persons and standard fishing carrying capacity 0.1 person).

The inland waters ecosystem carrying capacity will be 0.191×10^9 persons (freshwater aquaculture carrying capacity 0.179×10^9 persons, and fishing waters ecosystem carrying capacity 0.012×10^9 persons); the standard inland waters ecosystem carrying capacity will be 4.8 persons (standard

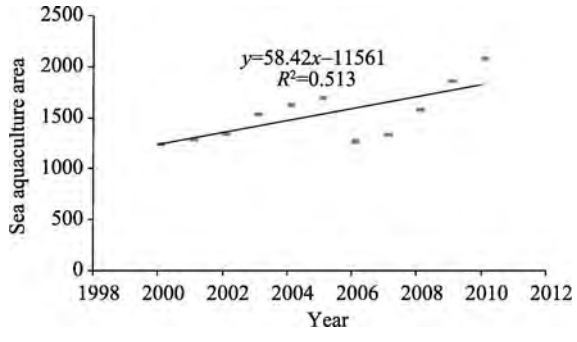

Fig.2 Change in sea aquaculture area in China 2000-2010

Table 6 Production of aquatic products in China in 2030

Item	Output of aquatic product ton	Water area for production 10^4 ha	Standard output of water area Kg ha^{-1}
Sea aquatic product	**48854009**	**47270**	**103.35**
Sea aquaculture	35701705	299.3	11928.8
Sea fishing	13152304	46970.7	28
Freshwater aquatic product	**38479648**	**3942**	**976.15**
Freshwater aquaculture	36166541	674.9	5358.8
Freshwater fishing	2313107	3267.1	70.8
Total	**87333657**	**51212**	**170.53**

Table 7 Waters ecosystem population carrying capacity in China in 2030

Item	Water area 10^4 ha	Standard output of water area Kg ha^{-1}	Standard carrying capacity of water area persons	Total carrying capacity 10^4 persons
Sea waters	**47270**	**103.35**	**0.5**	**24208.9**
Sea aquaculture	299.3	11928.8	59.1	17691.6
Sea fishing	46970.7	28	0.1	6517.2
Inland waters	**3942**	**976.15**	**4.8**	**19068.3**
Freshawater aquaculture	674.9	5358.8	26.6	17922.0
Freshwater fishing	3267.1	70.8	0.4	1146.2
total	**512120**	**170.53**	**0.8**	**43276.4**

aquaculture carrying capacity 26.6 persons and standard fishing carrying capacity 0.4 person).

6 Conclusion and prospects

The waters carrying capacity of China in 2000 was 0.176×10^9 persons and increased to 0.255×10^9 persons in 2010.

The seawaters ecosystem carrying capacity increased from 0.105×10^9 persons in 2000 to 0.133×10^9 in 2010, among which the seawater fishing carrying capacity remained stable at 0.06×10^9 persons. The seawater aquaculture carrying capacity increased from 0.044×10^9 persons in 2000 to 0.070×10^9 persons in 2010. The standard seawater carrying capacity is within the range of 0.2 to 0.3 persons.

During 2000 to 2010, inland waters ecosystem carrying increased from 0.071×10^9 persons to 0.122×10^9 persons, among which the freshwater fishing carrying capacity is 0.01×10^9 persons, and freshwater aquaculture carrying capacity increased from 0.062×10^9 persons in 2000 to 0.111×10^9 persons in 2010. The standard inland waters ecosystem carrying capacity increased from 1.8 persons to 3.2 persons. The inland waters ecosystem carrying capacity in China shows regional differences. Inland waters in southeast coastal areas and Yangtze River drainage areas are widely distributed and aquaculture is well developed with a high carrying capacity; in northwest China where water resources are deficient, freshwater fishing is less and aquaculture develops slowly with a relatively low carrying capacity.

From the prediction of waters ecosystem carrying capacity in 2030 there is great potential for increasing the waters ecosystem carrying capability in China. On the one hand, both the inland water surface and seawater surface for aquaculture are far from full utilization and there is room for extension, on the other hand the unit output of aquaculture in China is uneven, and there remains potential. In addition, pelagic fishery production is not developed, and the share of the world ocean fishery is very small, only accounting for about 3% and not commensurate with the proportion of China's human population (about 22% of the global population). Many fishery resources have not been fully utilized so the pelagic fishery has very broad prospects.

This study represents the constraints and supporting role of the waters ecosystem carrying capacity in China on population and economic development. The inland waters ecosystem carrying capacity reveals the unbalanced relationship between the population and waters ecosystem so as to provide the basis and decision reference for realizing rational allocation of resources and high efficient utilization of aquatic resources and carrying out regional development planning. More attention should be paid to the optimization of fishery structures, fishery innovation and ecological fishery yield and quality.

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中国水域生态系统人口承载力研究

盖力强[1,2]，李士美[3]，谢高地[2]，程彦培[1]，倪增石[1]

1. 中国地质科学院水文地质环境地质研究所 河北石家庄 050061；
2. 中国科学院地理科学与资源研究所 北京 100101；
3. 青岛农业大学园林与林学院 山东青岛 266109

摘　要：水域生态系统人口承载力研究展示了水域生态系统对社会经济发展的支撑作用，为水域生态系统科学管理及水产资源合理配置提供理论依据。本文定义了水域生态系统人口承载力的概念，对中国水域生态系统人口承载力的现状及发展趋势进行了评价和预测。结果表明：2000-2010 年中国水域人口承载力由 1.758×10^8 人逐年递增到 2.549×10^8 人，标准海域人口承载力基本不变维持在 0.2-0.3 人/公顷之间，标准内陆水域人口承载力由 1.8 人/公顷增加到 3.2 人/公顷。分析表明：中国内陆水域人口承载力表现出显著的地域差异。中国东南沿海、长江流域内陆水域分布广泛，水产养殖业发达的地区，水域人口承载力高；西北水资源匮乏，水域分布较少，淡水捕捞量少，水产养殖业发展缓慢，水域人口承载力低。另外，通过预测 2030 年水域人口承载力可知，中国水域人口承载力仍有很大的提高潜力。

关键词：水域生态系统；人口承载力；水产资源；中国