



Aquaculture and marine fisheries resources in China

中国水产养殖与海洋渔业资源

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1 Foreword

前言

China's dominant role in supply of aquatic products in the world 中国在世界水产品供应版图中占据绝对主导地位

- China is the largest country producing aquatic products and engaging in aquaculture in the world
- 中国作为当今世界上最大的水产品生产国、最大的水产养殖生产国

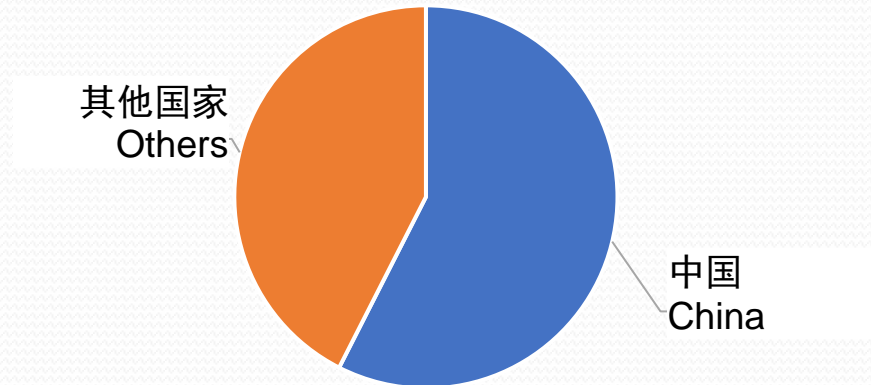


Fig. Proportion of aquaculture production in China to that in the world

图：中国水产养殖产量在全球占比
Data source/数据来源: FAO 2021

- China has basically guaranteed the food security (macroelement supply), while China still has a large gap of microelement supply, causing **hidden hunger**.
- 我国的粮食安全（宏量元素供应）已经基本解决，但微量元素供应仍有较大缺口，形成**隐性饥饿**（Hidden Hunger）。
- The per capita consumption of aquatic products in China increased rapidly from **6.49kg in 2001 to 14.4kg in 2020**;
- 中国人均水产品消费从**2001年的6.49kg**快速上升至**2020年的14.4kg** ;
- China Statistical Yearbook 2020
- 《中国统计年鉴2020》
- The per capita consumption of aquatic products recommended in Outline of **China's Food and Nutrition Development is 18kg**.
- 《中国食物与营养发展纲要》**推荐人均水产品消费18kg**。



More than 80% of aquatic products in China from aquaculture 水产养殖为中国供应了80%以上的水产品

- Reduction of capture production and capture share in supply of aquatic products
- 捕捞产量和其在水产品供应中的占比逐渐降低

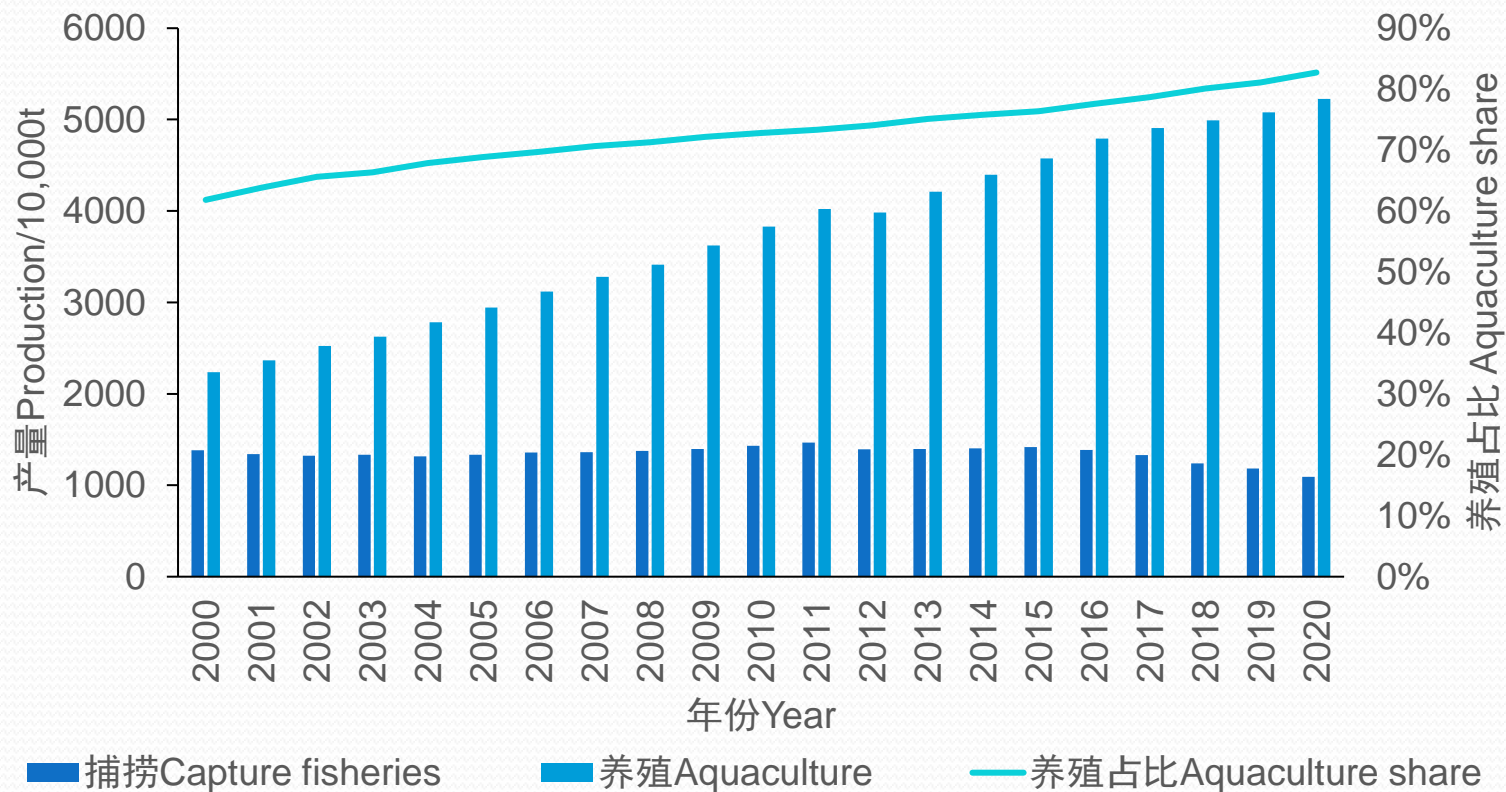
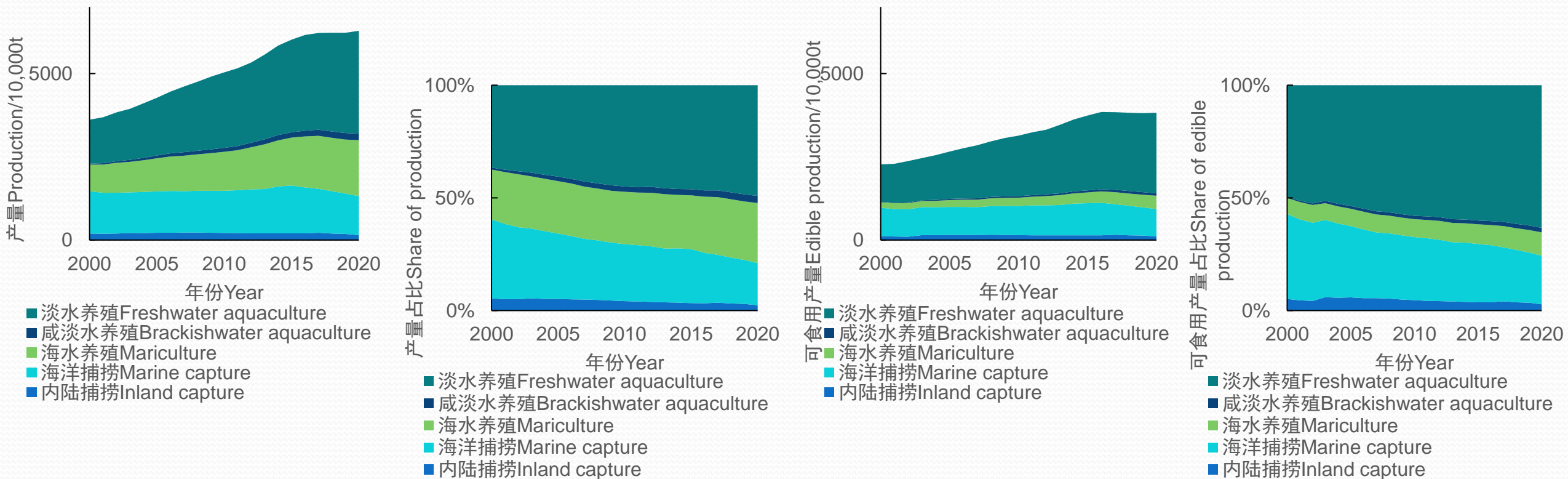


Fig. Production of aquatic food by producing methods and aquaculture share in total production in China in 2000-2020
图：2000-2020年中国按生产方式分水产品产量和养殖产量在总产量的占比
Data source: Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021
数据来源:农业农村部渔业渔政管理局2021



Freshwater aquaculture-the most important source of aquatic products 淡水养殖是最重要的水产品来源



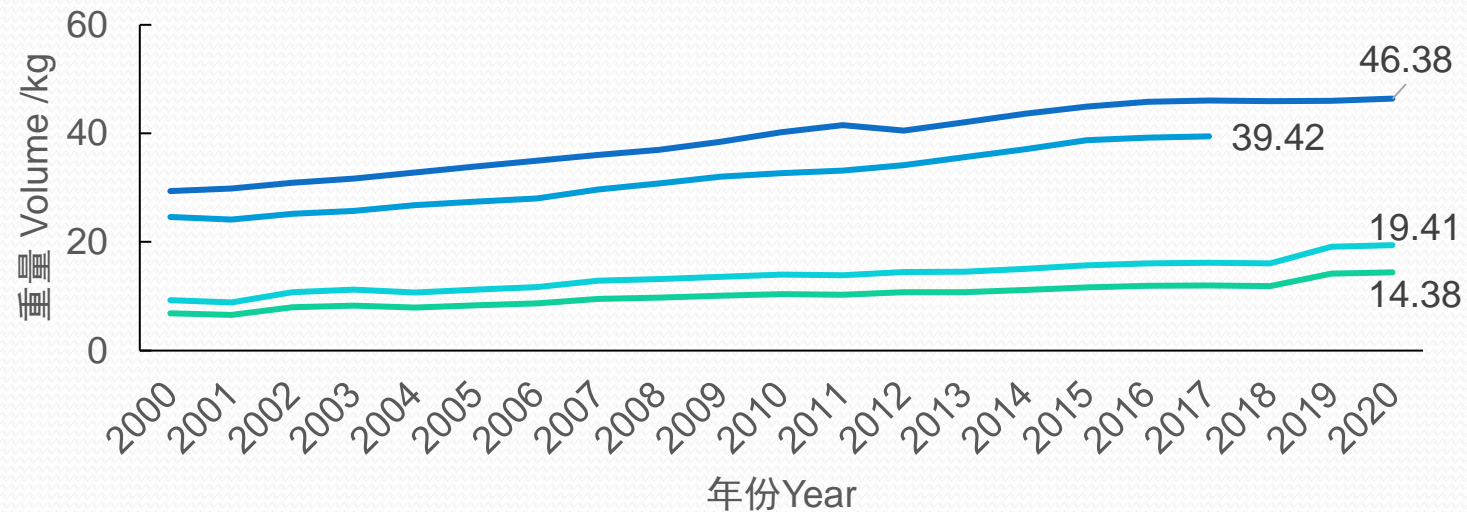
图：中国水产品按生产方式分产量（a）、占比（c），可食用产量（b）和占比（d），不包括藻类，可食用产量转换系数（甲壳类0.36，贝类0.17，鱼类0.87，其他0.21）来自Edwards等2019（数据来源：FAO, 2022）

Fig. Production(a) and share of productions (c) , edible production(b) and share of edible productions (d) of aquatic food by producing sources in China, excluding aquatic plants, edible production calculated using conversion factors (Crustaceans 0.36; Molluscs 0.17; Finfish 0.87; Others 0.21) in Edwards et al. 2019 (Data source: FAO, 2022)



Increase of supply and consumption of aquatic products in China in successive years 中国水产品供给与消费逐年增加

- Significant gap between the per capita availability or supply and per capita consumption of aquatic products in China
- 中国水产品人均占有或供给量与消费量间差距显著



- 水产品人均占有量Per capita availability of aquatic food
- 食用水产品人均供应量Per capita supply of aquatic food for direct human consumption
- 增加35%后的水产品人均消费量Per capita aquatic food consumption plus 35% more
- 水产品人均消费量Per capita aquatic food consumption

图：中国水产品人均占有量、人均供给量，人均消费量，以及增加35.00%家庭外消费的人均消费量

Fig. Per capita availability, per capita supply, per capita consumption of aquatic food in China, and per capita consumption with 35% more out-of-home consumption.

人均占有量数据来自国家统计局，食用水产品人均供给量为FAO人均表观消费量，人均消费量来自国家统计局住户收支与生活状况调查，增加的家庭外消费按家庭消费35.00%计算，数据来源：FAO, 2022; 国家统计局, 2022; Chiu et al. 2013; Crona et al. 2020。 Per capita availability data are from the National Bureau of Statistics, per capita supply for direct human consumption is the per capita apparent consumption reported by FAO, and per capita consumption is the result of the household income and living conditions survey by the National Bureau of Statistics. The per capita consumption plus 35% more was added with 35.00% out-of-home consumption. Data source: FAO, 2022; National Bureau of Statistics, 2022; Chiu et al. 2013; Crona et al. 2020



2 Marine fisheries resources for aquaculture

用于水产养殖的海洋渔业资源

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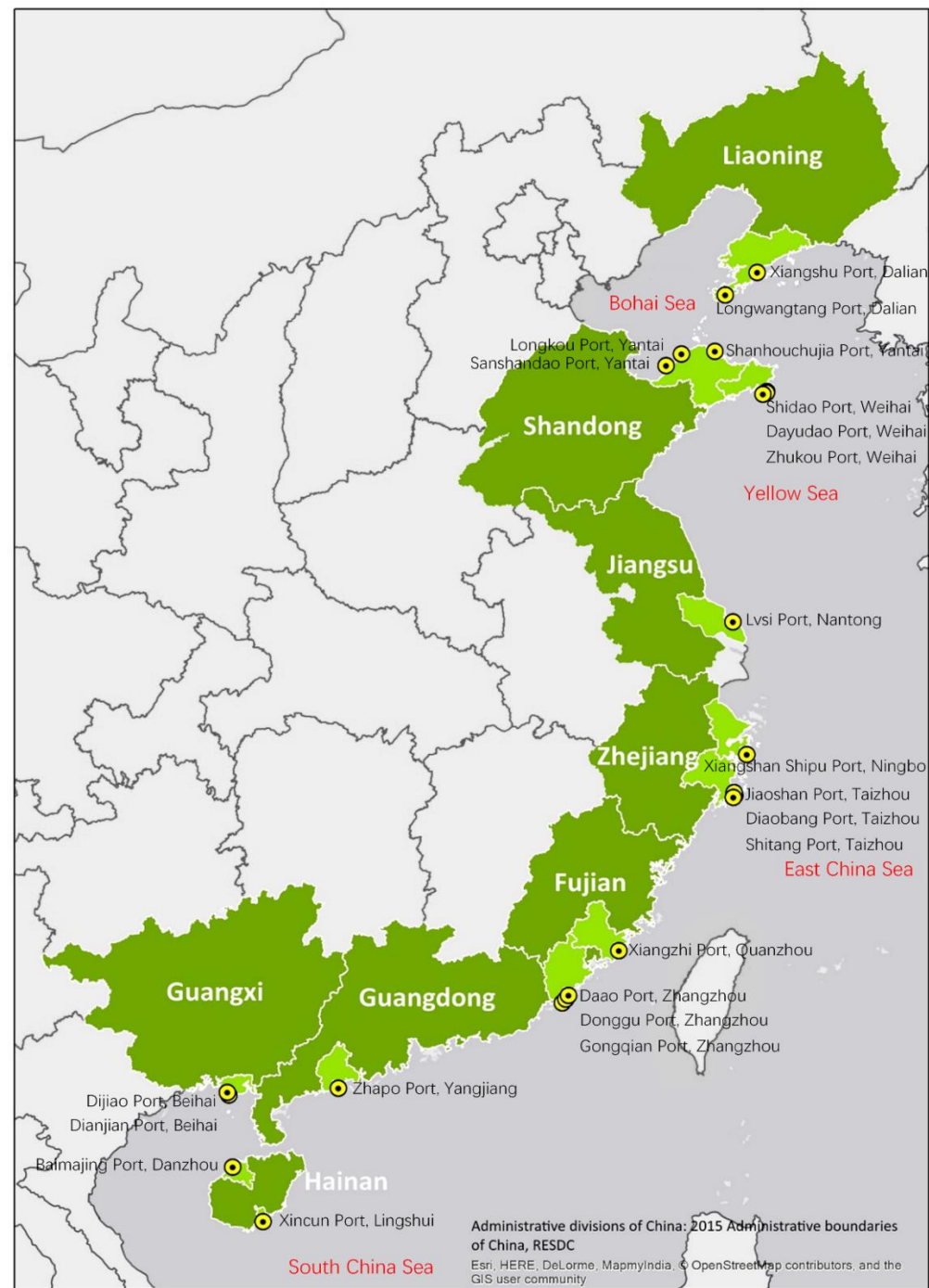
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Fishing for feed in China: Facts, impacts and implications

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Duncan Leadbitter⁶ | Richard Newton⁷ | David C. Little⁷ | Songlin Li¹ | Yi Yang⁸ |
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- An integrated, interdisciplinary methodology was used.
- 采用了一种综合的跨学科方法。
 - Systematic literature reviews
 - 系统性的文献综述
 - A nationwide field survey of fishing vessels/gears
 - 对全国范围内的渔船/渔具进行实地调查
 - Analysis of feed grade fish samples
 - 饲料级鱼类样本的分析



Proportion of feed grade fish in catch

饲料级鱼类在渔获量中的占比

- A total of 886 interviews was conducted from domestic vessels in 22 major fishing in December 2016. Trawls and stow nets were identified as the main fishing gears taking feed grade fish.
- 2016年12月，在22个主要渔场的国内渔船上一共进行了886次采访。拖网和张网被认为是用于捕捞饲料级鱼类的主要渔具。

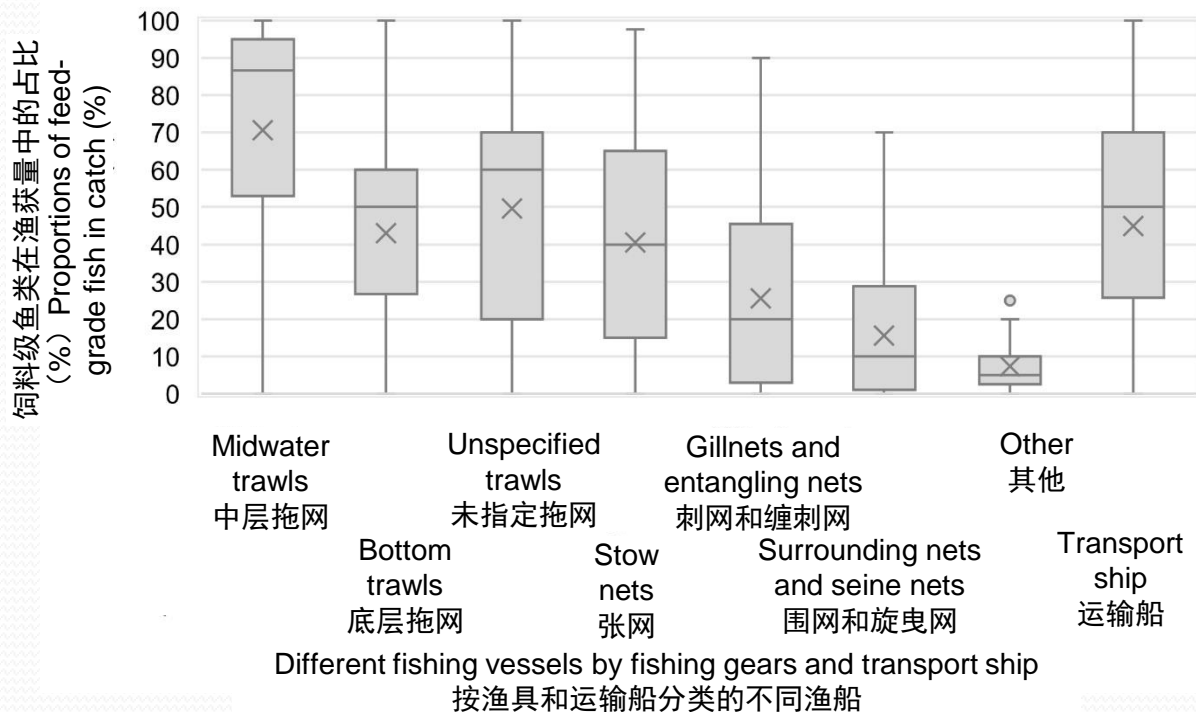


Figure. Proportions of feed grade fish in catches (by weight) from different fishing vessels classified by fishing gears and transport ship.

图：按渔具和运输船分类的不同渔船捕捞的饲料级鱼类在渔获量中的占比（按重量计算）

'Other' category includes hooks and lines, pots, rakes and other miscellaneous gears

'其他'类别包括鱼钩和钓丝、渔笼、鱼耙和其他各种渔具



Feed grade fish production

饲料级鱼类产量

- Weighted by production by gear and province, 34.7% of China's marine catch, or 4.6 mmt, was feed grade fish.
- 按渔具和各省份的产量计算，中国34.7%的海洋渔获量为饲料级鱼类，即460万公吨。
- The Monte Carlo analysis also shows 4.6 mmt (95% confidence interval: 2.1–7.0 mmt) of total production was feed grade fish.
- 蒙特卡罗分析还显示，460万公吨（95%置信区间：210-700万公吨）的总产量为饲料级鱼类。

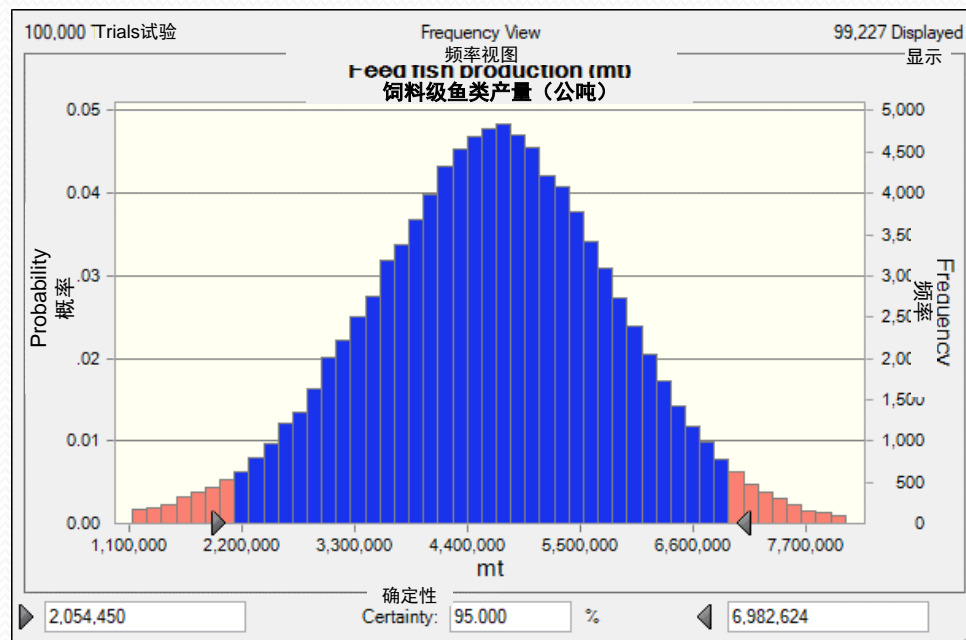


Figure. Distribution of feed-grade fish production in China (mt), resulting from 100,000 Monte Carlo simulations

图：通过100,000次蒙特卡罗模拟得出的中国饲料级鱼类产量的分布（公吨）



Use and prices of feed grade fish

饲料级鱼类的用途和价格

- The consumption of feed grade fish (4.6 mmt) was estimated according to survey data.
- 根据调查数据对饲料级鱼类（460万公吨）的消费量进行了估算。

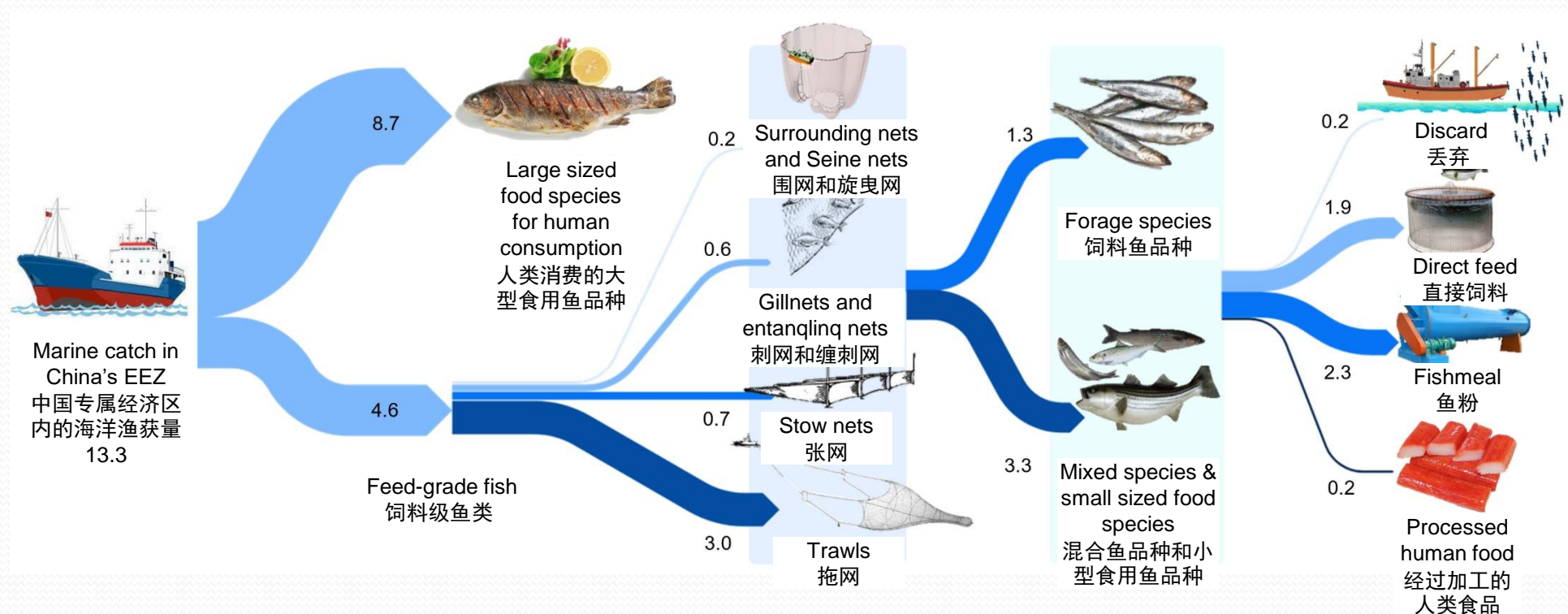


Figure. Estimated production and consumption of marine catch in China's EEZ. the use of feed grade fish in Zhejiang was set at national average (Figure 5); the unit for all numbers is mmt.
 图：中国专属经济区内的海洋渔获量的估算产量和消费量。将浙江的饲料级鱼类用途设定为全国平均水平（图5）；所有数量均以百万公吨为单位。

Food fish species and juveniles

食用鱼的品种和稚鱼

- The majority (88.9%) of food fish were likely to be in their juvenile stage while 71.8% and 73.1% of forage fish and mixed fish were juveniles respectively.
- 大多数食用鱼（88.9%）可能处于稚鱼期，处于稚鱼期的饲料鱼和混合鱼分别为71.8%和73.1%。

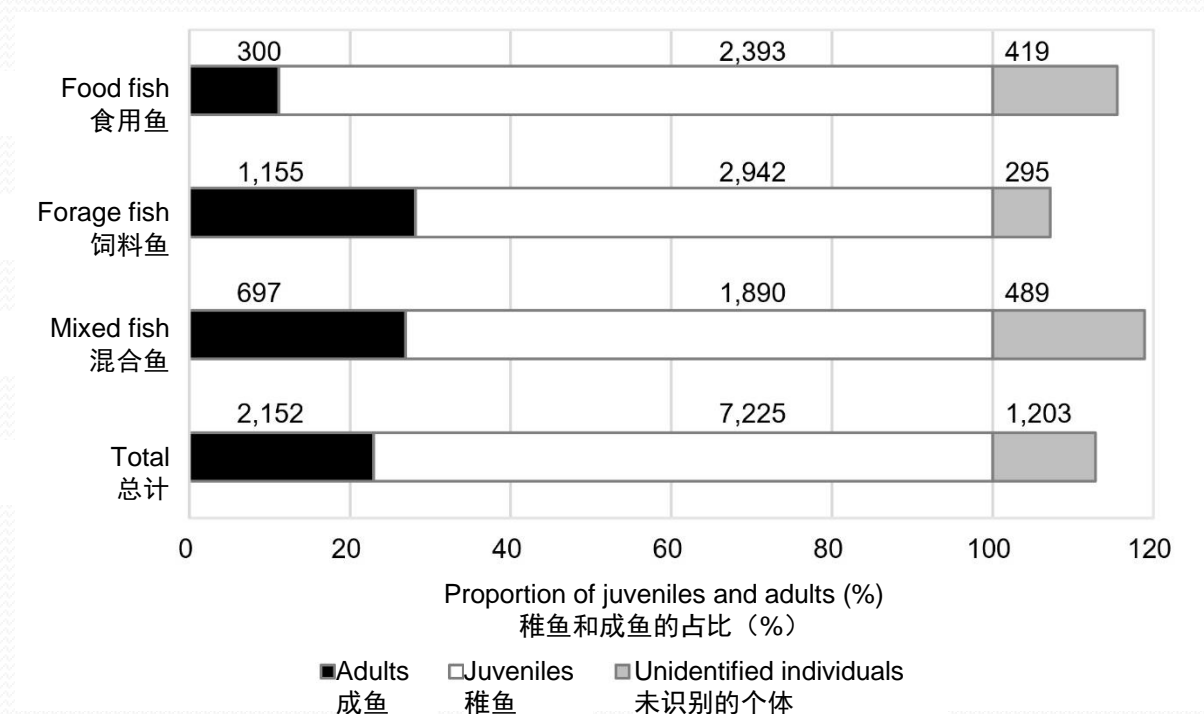


Figure. Number and the proportion of juveniles and adults in the samples in three categories (Food fish, Forage fish, Mixed fish).
图：三类（食用鱼、饲料鱼、混合鱼）样本中稚鱼和成鱼的数量和占比。
Unidentified individuals are those individuals identified to species level, but no available measurable body length
未识别的个体是达到品种水平，但体长未达到可测量水平的个体



Fishing for feed in China is substantial and biologically unsustainable

中国的饲料级鱼类捕捞数量巨大，而且不具有生物学上的可持续性

- Considering China's feed grade fish production alone would rank it fourth among World's leading marine fisheries countries.
- 仅考虑饲料级鱼类产量，中国就可以在世界领先的海洋渔业国家中排名第四。

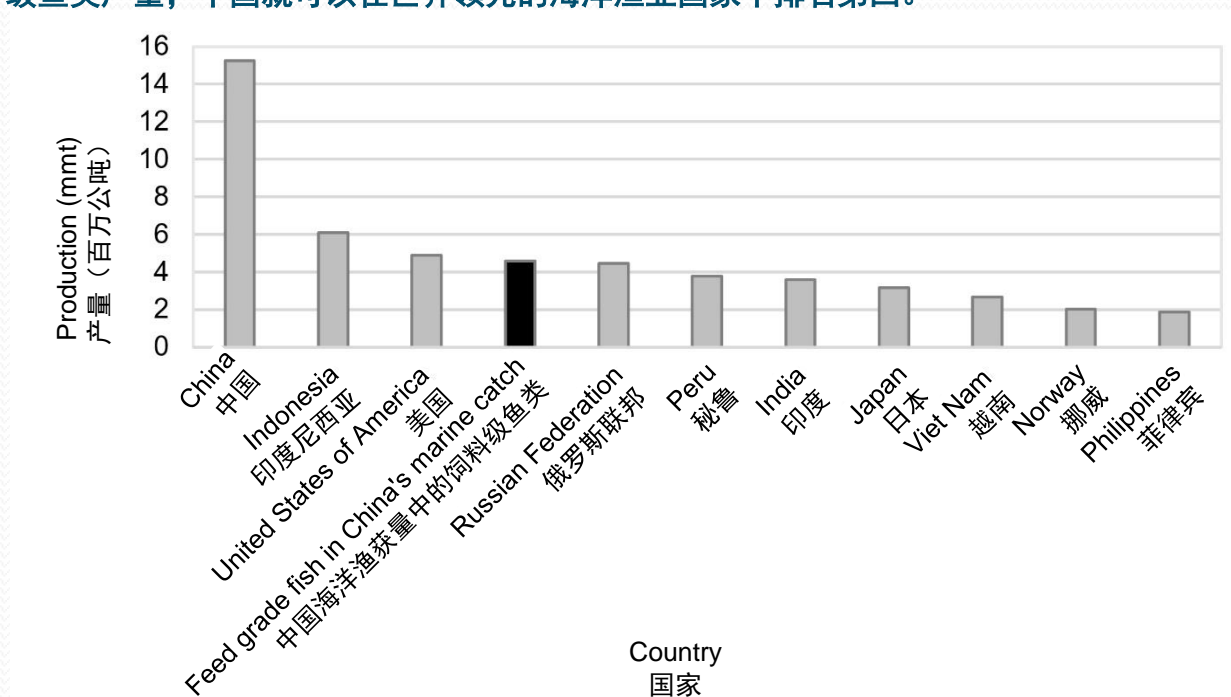


Figure. Production of top 10 World's leading marine (domestic + distant) fisheries countries and production of feed grade fish in China's marine catch in 2016.

图：2016年世界前十个领先的海洋（国内+远洋）渔业国家的产量以及中国海洋渔获量中的饲料级鱼类的产量。

Data source: (FAO, 2017); Aquatic plants excluded

数据来源：（联合国粮食及农业组织，2017年）；不包括水生植物



3 Marine fisheries

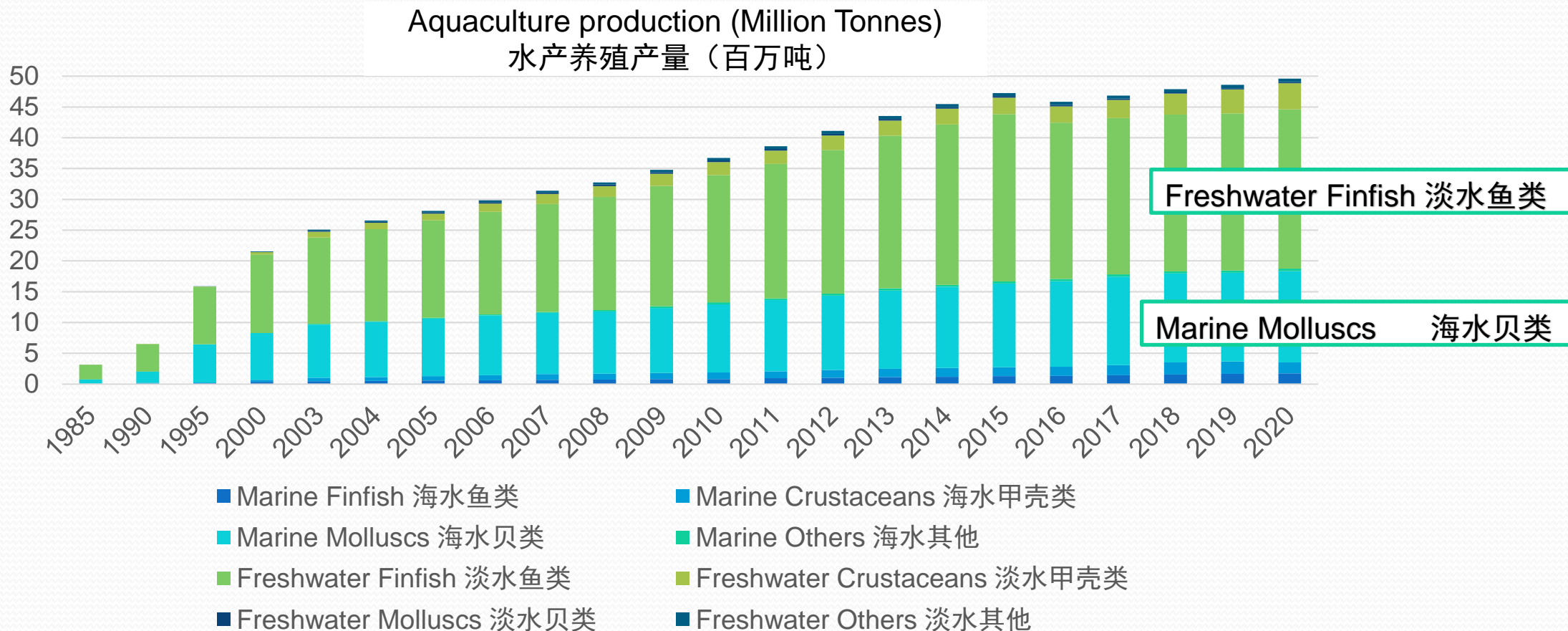
**resources consumed in
aquaculture**

水产养殖消费的海洋渔业资源

Need of input of large amount of marine fisheries resources in aquaculture in China
中国水产养殖需要大量海洋渔业资源的投入



Aquaculture production in China by species type 中国水产养殖产量按品种类型分类



图：主要养殖品种投饵类型产量占比变化，含贝类壳重，不含水生植物

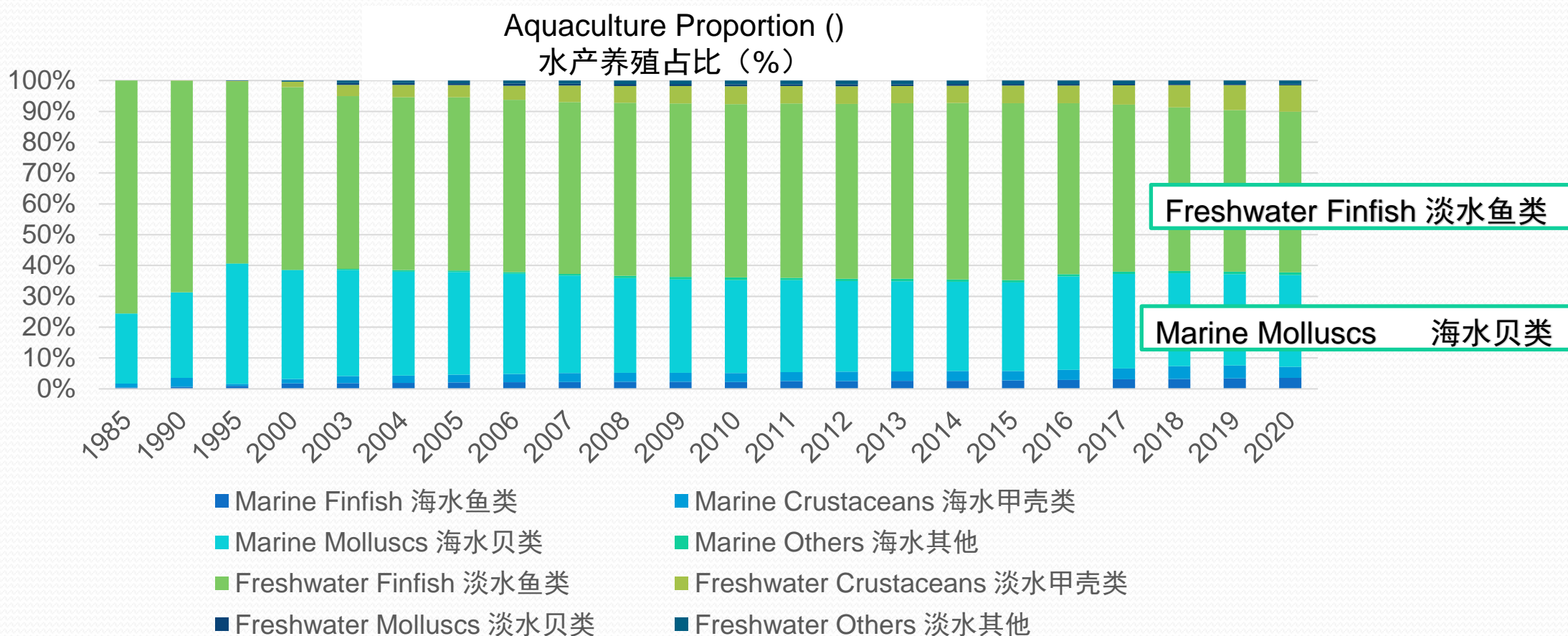
Fig. Aquaculture production in China is classified by species type

数据来源：根据唐 et al., (2016)，农业农村部渔业渔政管理局(2021)和(FAO, 2022)及相关品种FCR整理

Data source: National Bureau of Statistics 2022, Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021



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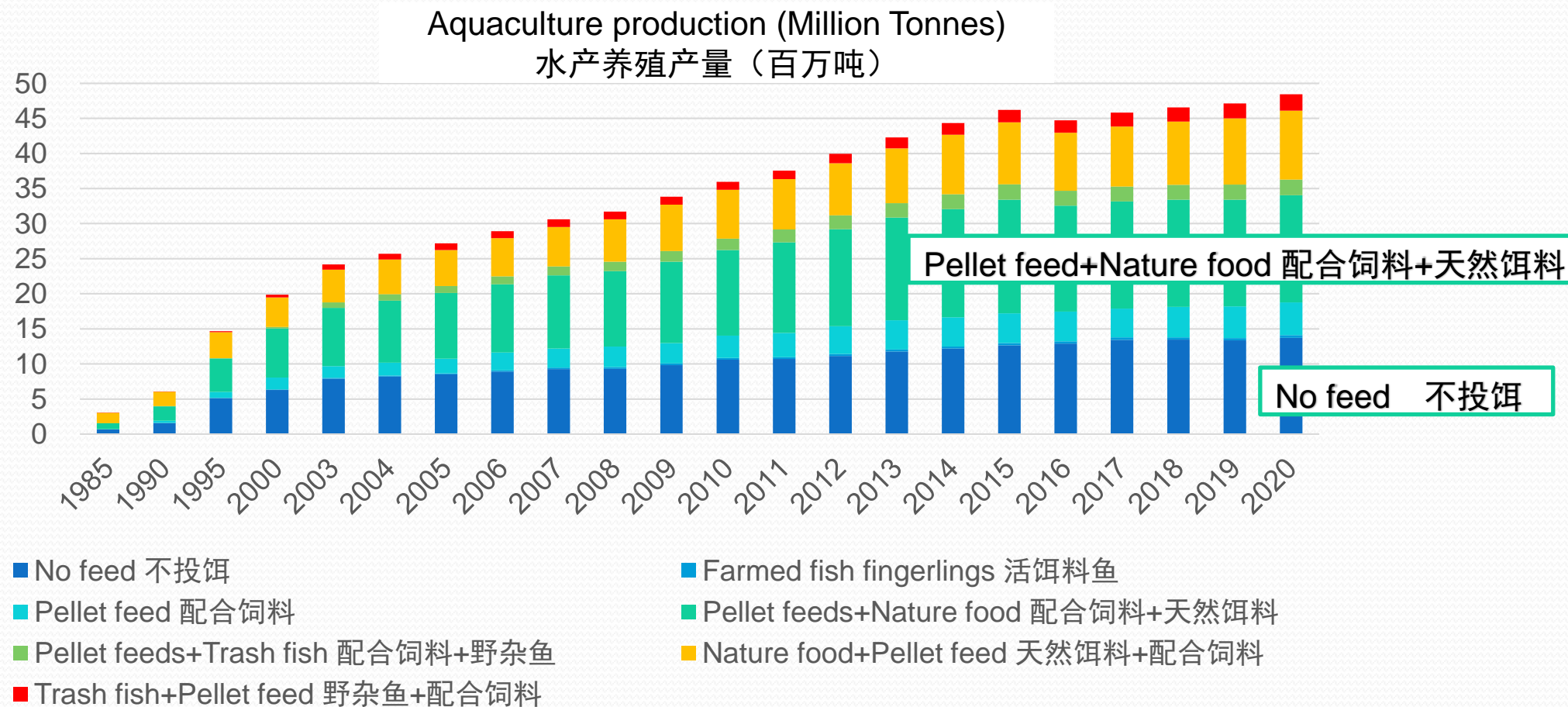
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Aquaculture production in China by feeding type 中国水产养殖产量按投喂类型分类



图：中国水产养殖产量按投喂类型分类

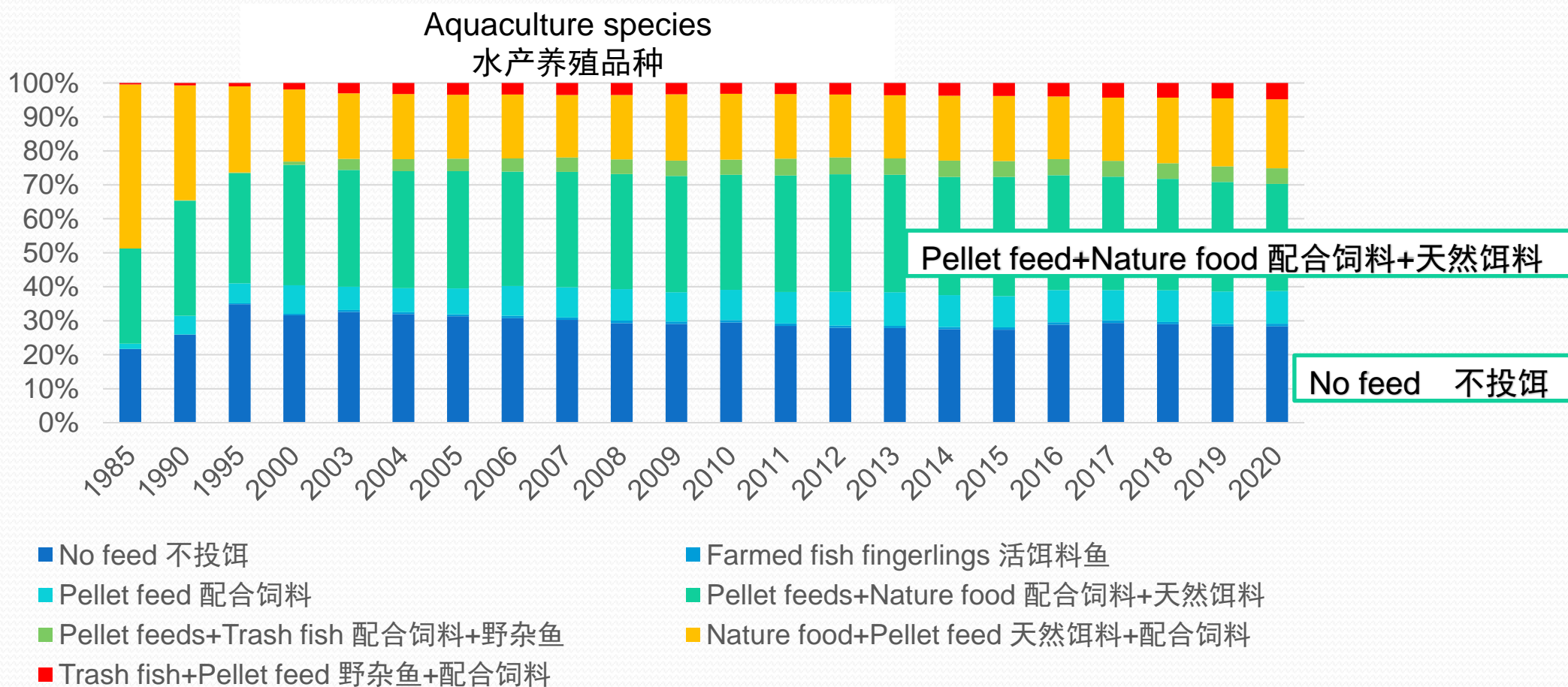
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Aquaculture production in China by feeding type 中国水产养殖产量按投喂类型分类



图：中国水产养殖产量按投喂类型分类

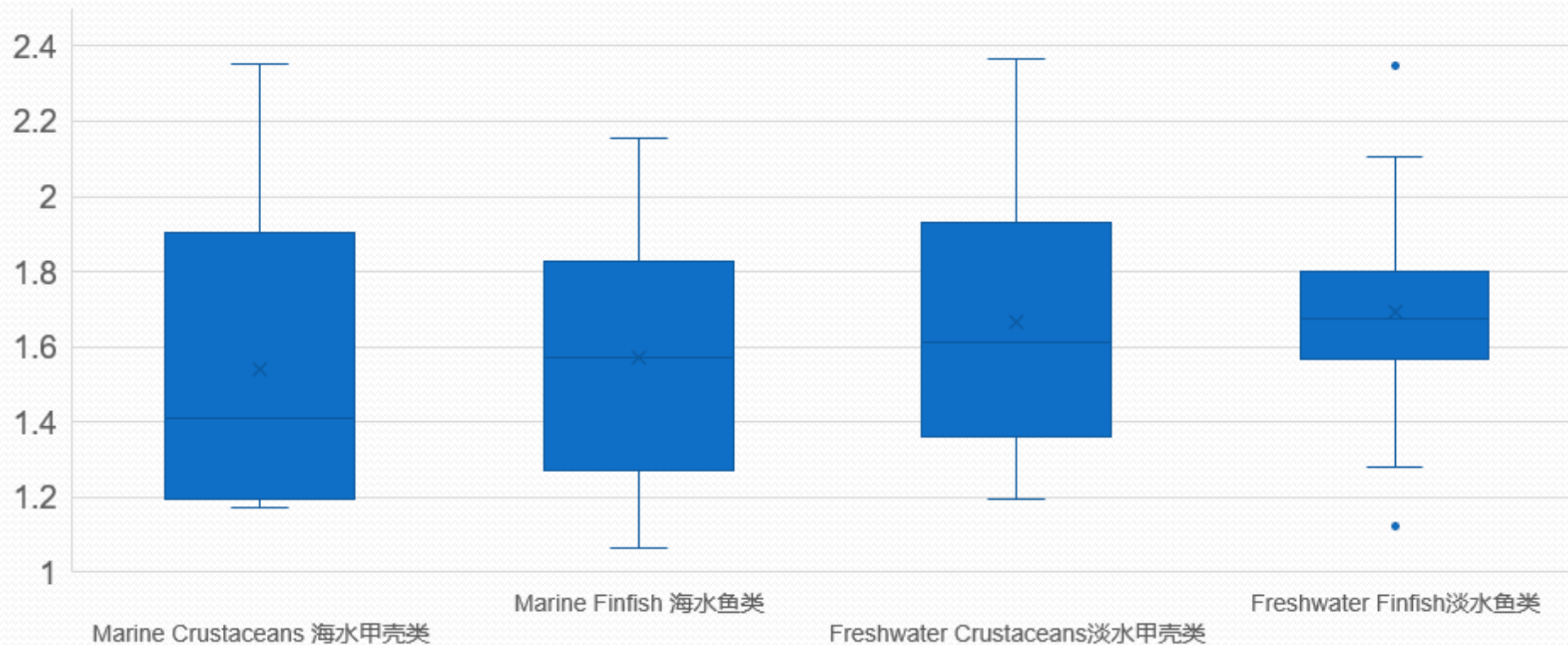
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FCR of aquaculture species in China 中国水产养殖主要养殖类型饲料系数



图：中国水产养殖主要养殖类型饲料系数

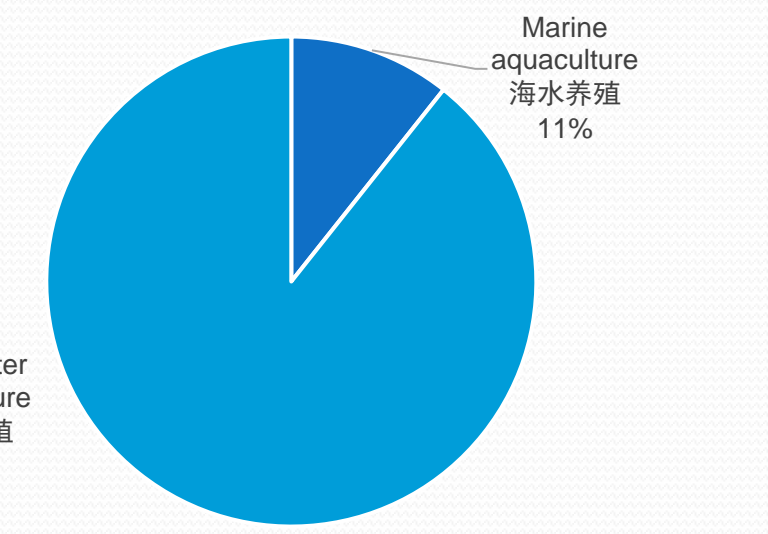
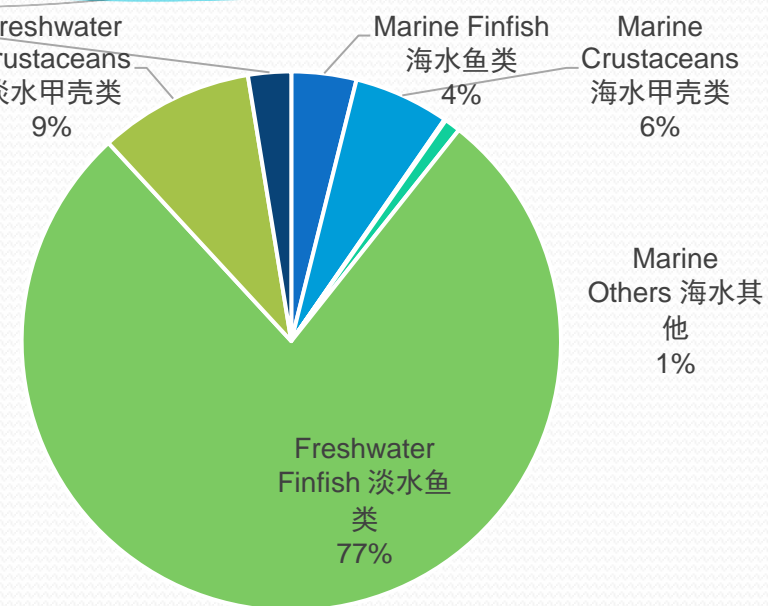
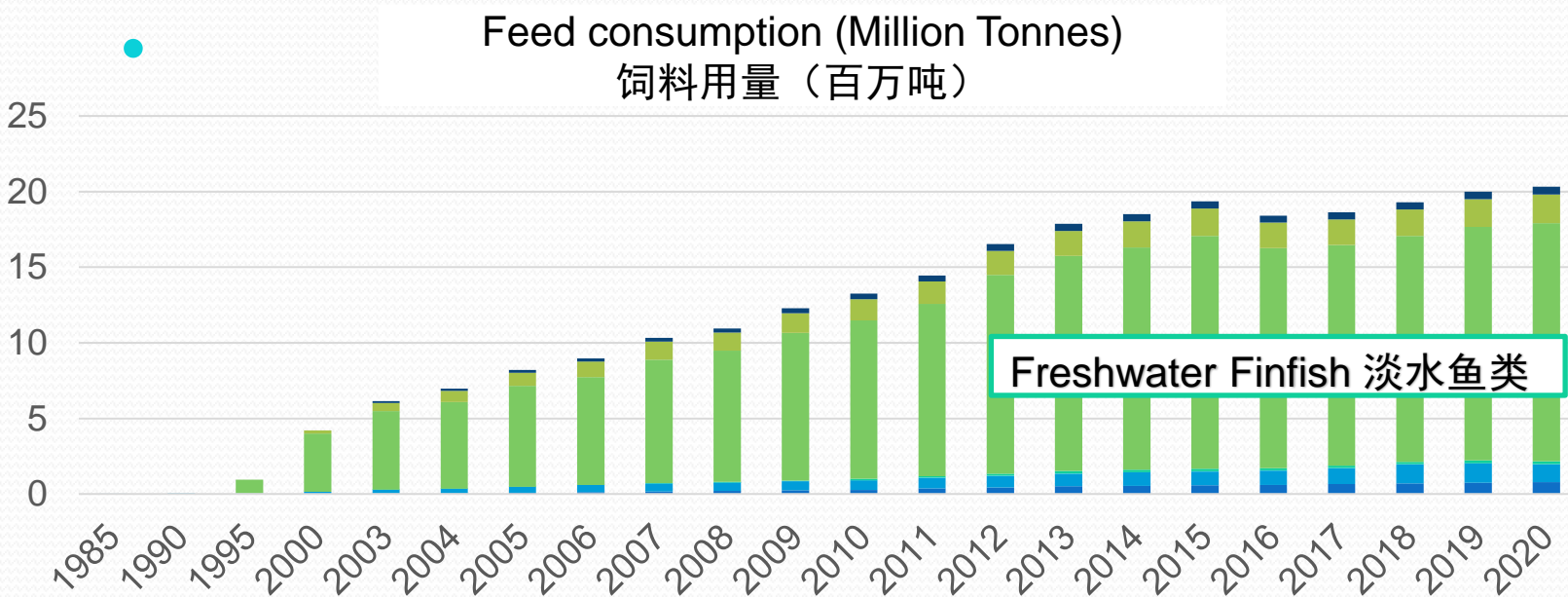
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Data source: National Bureau of Statistics 2022, Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021



Feed consumption by aquaculture species in China 中国水产养殖饲料用量



图：中国水产养殖饲料用量

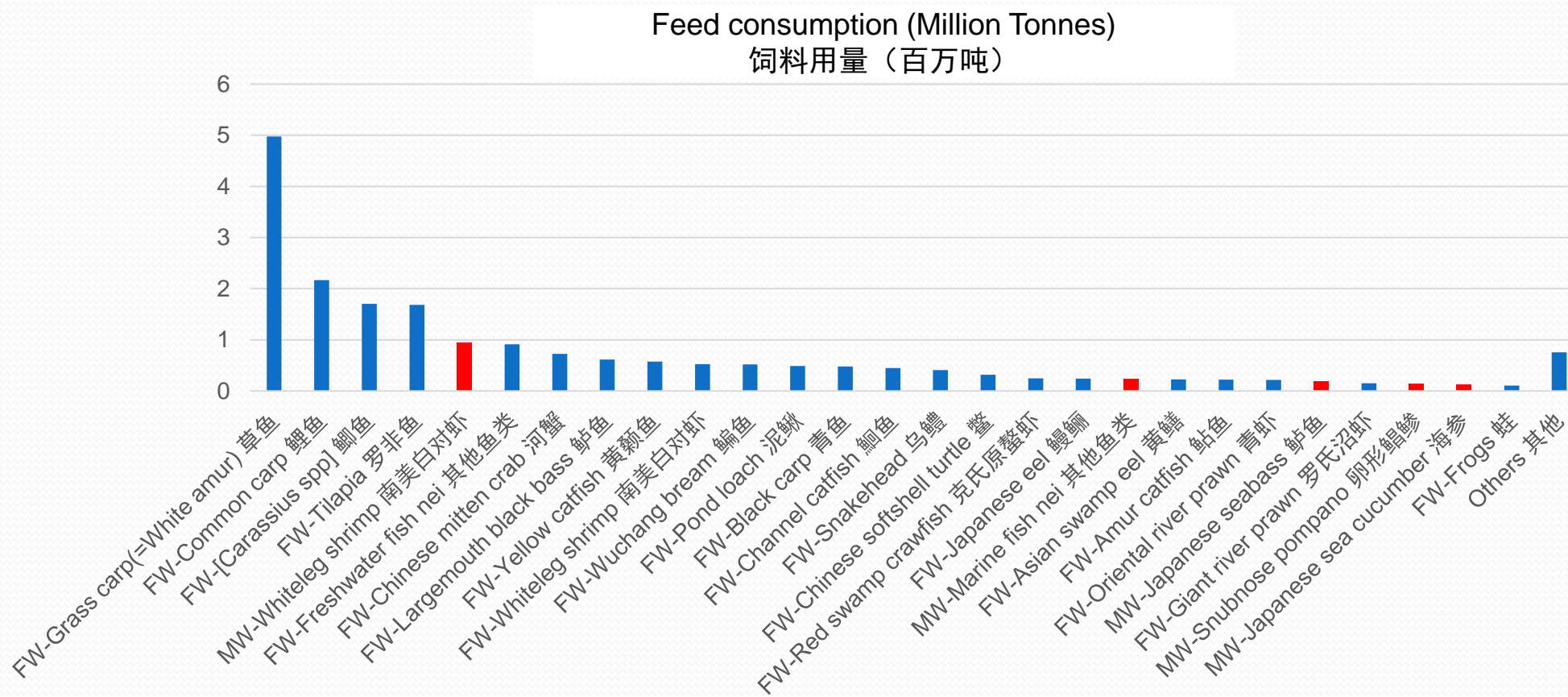
Fig. Feed consumption by aquaculture species groups in China

数据来源：根据唐 et al., (2016), 农业农村部渔业渔政管理局(2021)和(FAO, 2022)及相关品种FCR整理

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Feed consumption by aquaculture species in China 中国水产养殖饲料用量



图：中国水产养殖饲料用量

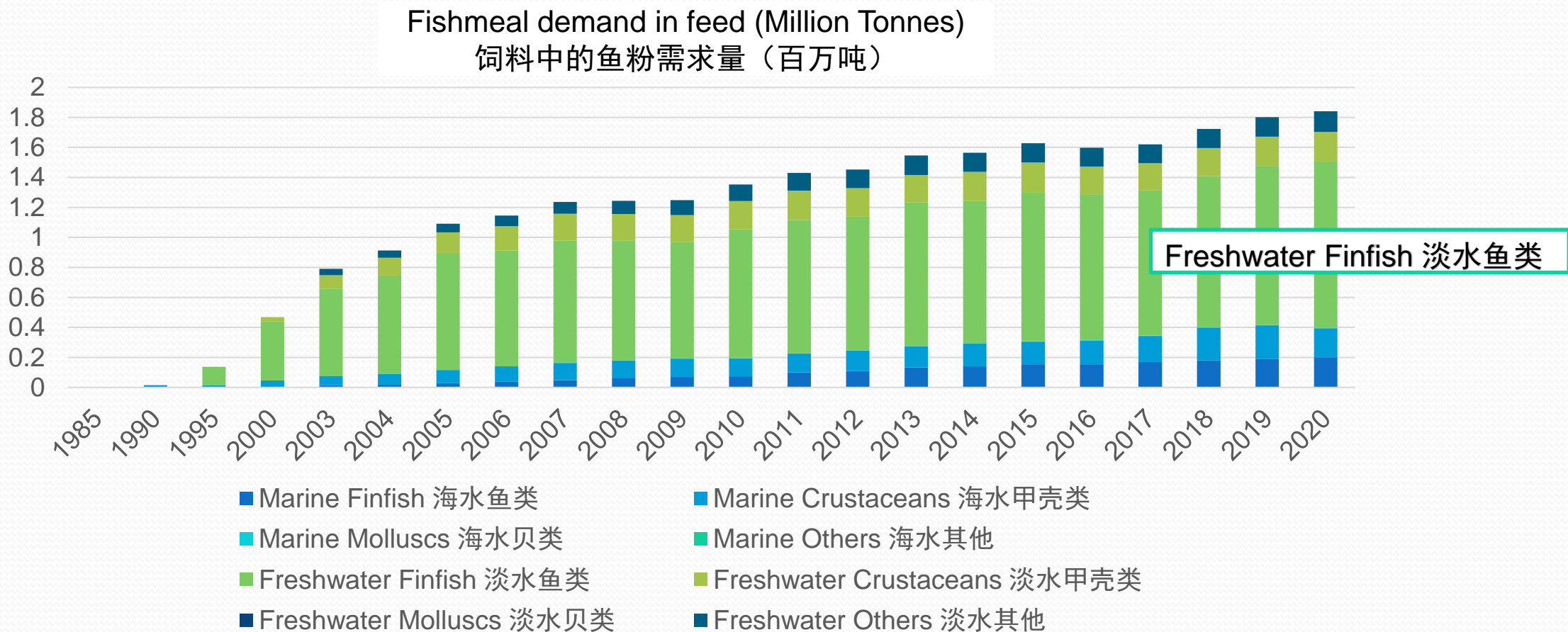
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Fishmeal demand in feed 饲料中的鱼粉需求量



图：按种类类别鱼粉需求量

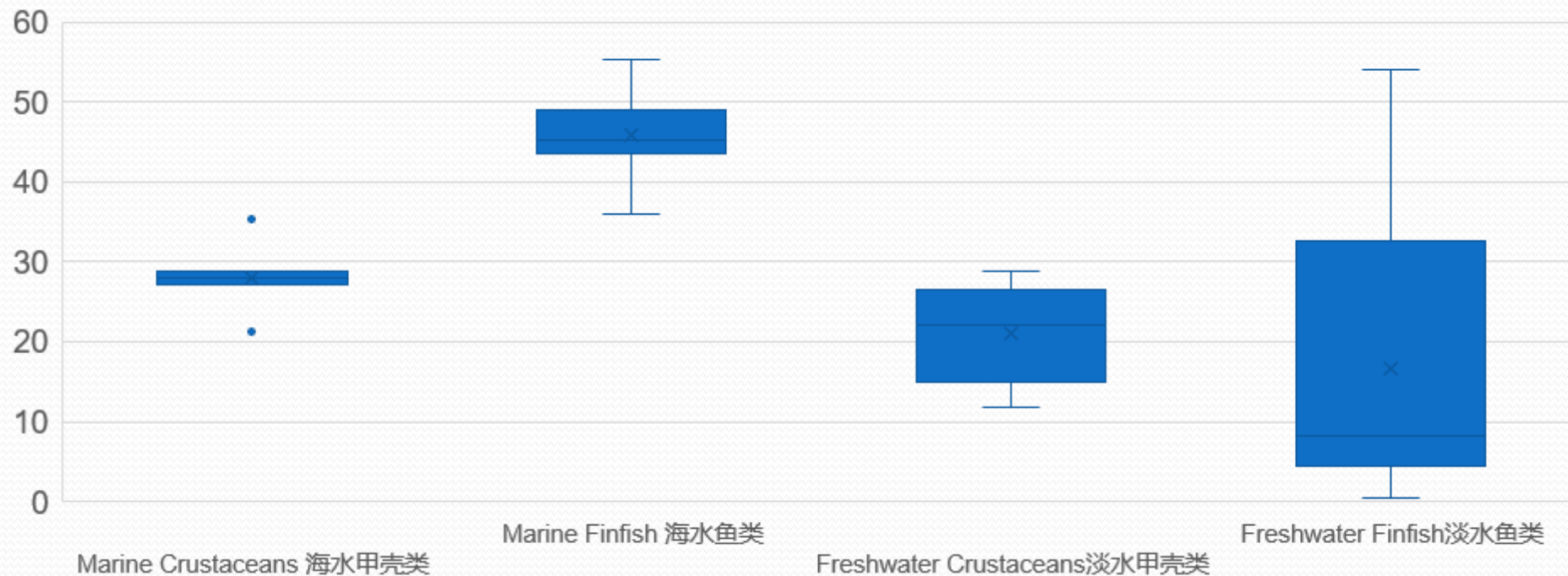
Fig. Fishmeal demand in feed by species groups

数据来源：根据唐 et al., (2016)，农业农村部渔业渔政管理局(2021)和(FAO, 2022)及相关品种FCR整理

Data source: National Bureau of Statistics 2022, Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021



Fishmeal inclusion levels 中国水产养殖主要养殖饲料中鱼粉用量百分比



图：中国水产养殖主要养殖饲料中鱼粉用量百分比

Fig. Fishmeal inclusion levels

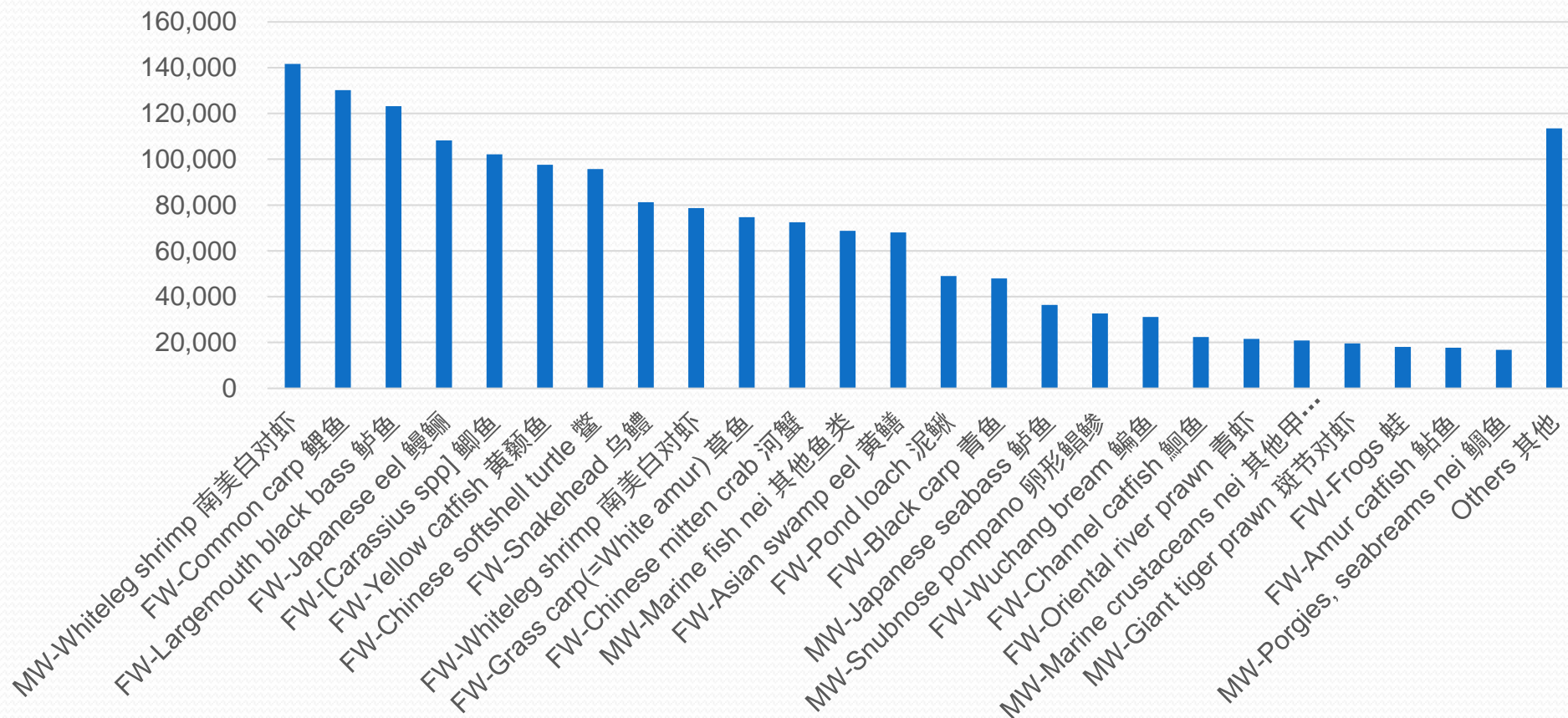
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Fishmeal demand in feed 饲料中的鱼粉需求量

Fishmeal demand in feed (Tonnes)
饲料中的鱼粉需求量 (吨)



图：按种类鱼粉需求量

Fig. Fishmeal demand in feed by species

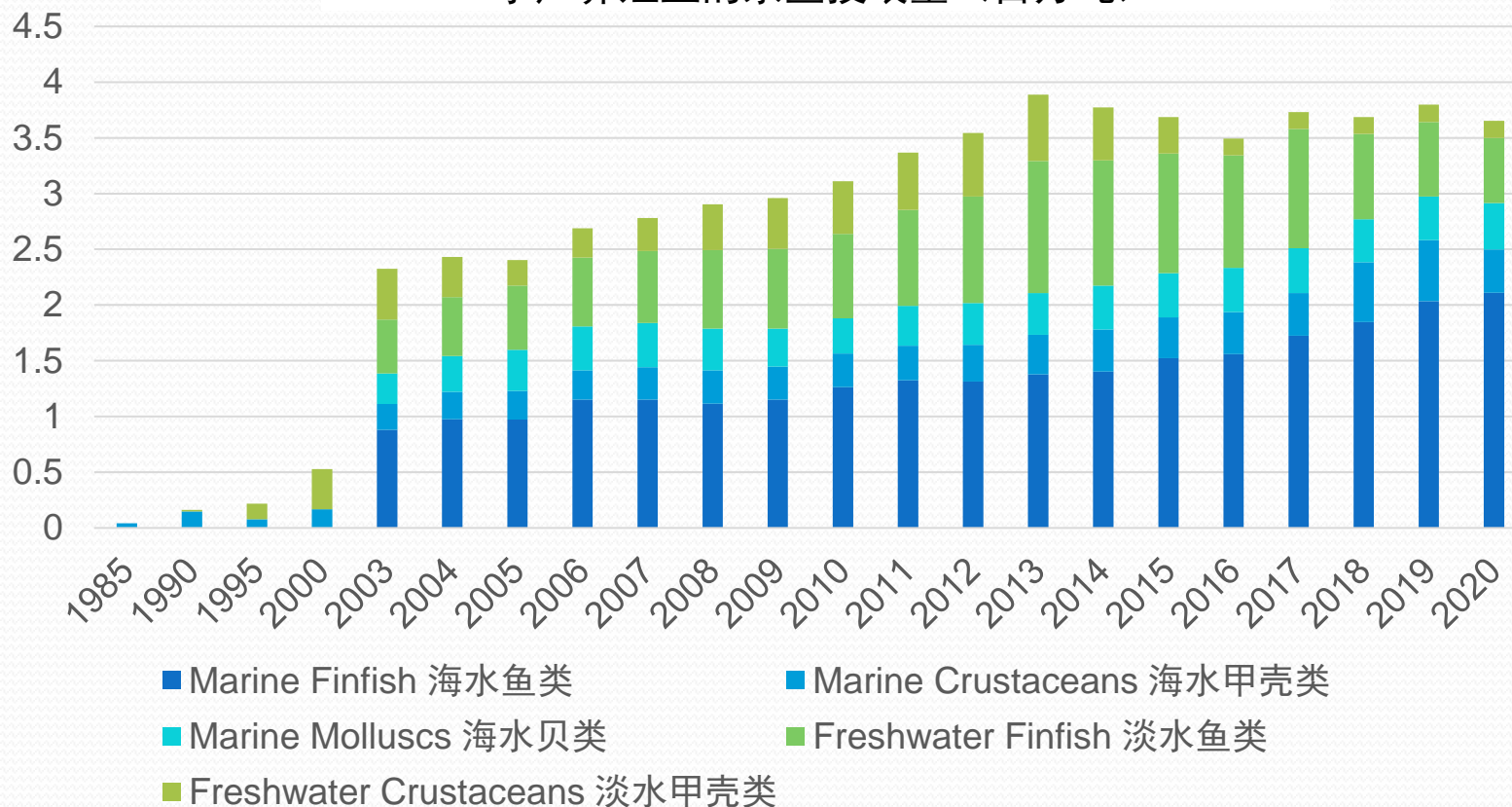
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Trash fish used in aquaculture 水产养殖业的杂鱼投喂量

Trash fish used in aquaculture (Million Tonnes)
水产养殖业的杂鱼投喂量 (百万吨)



图：杂鱼投喂量

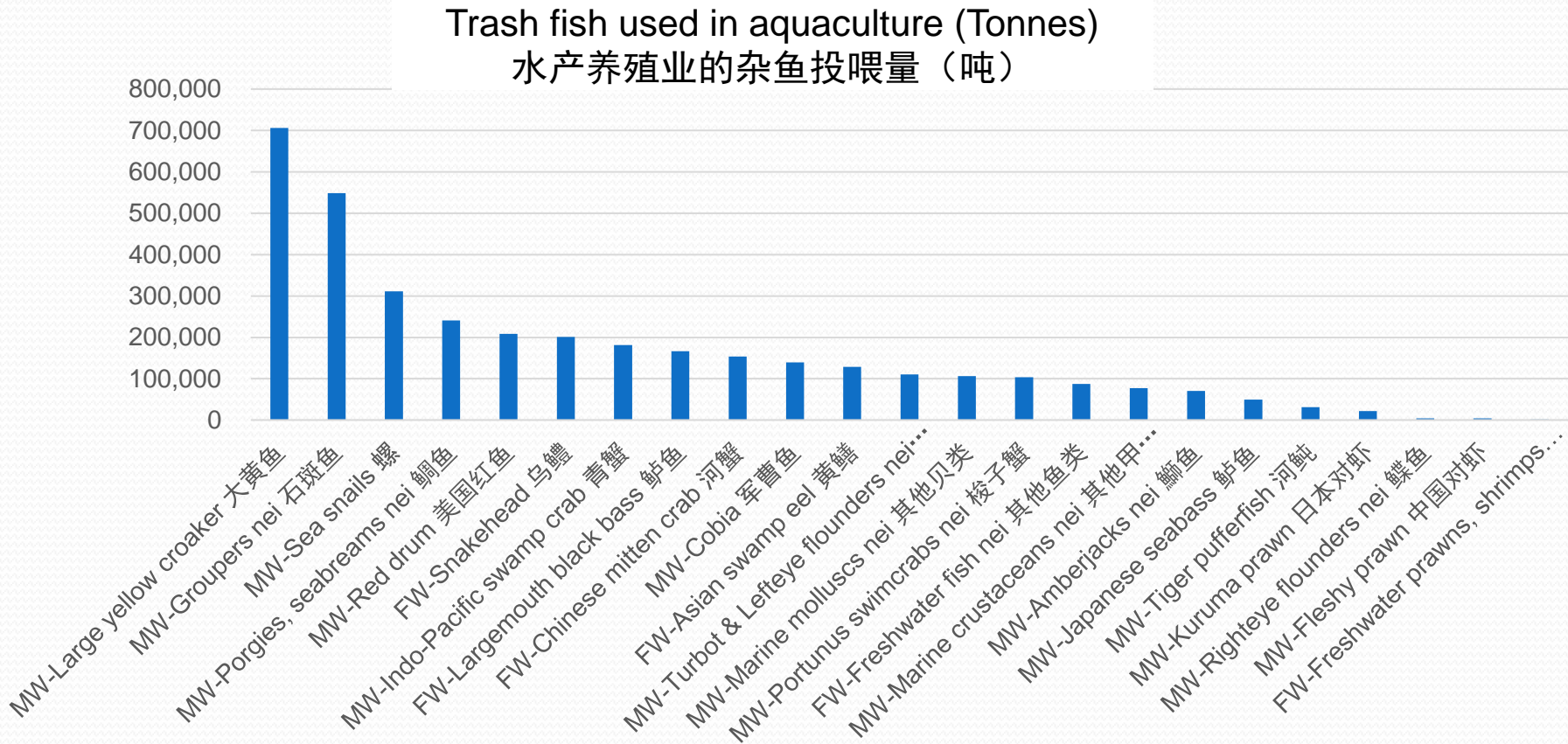
Fig. Trash fish used in aquaculture

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Data source: National Bureau of Statistics 2022, Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021



Trash fish used in aquaculture 水产养殖业的杂鱼投喂量



图：杂鱼投喂量

Fig. Trash fish used in aquaculture

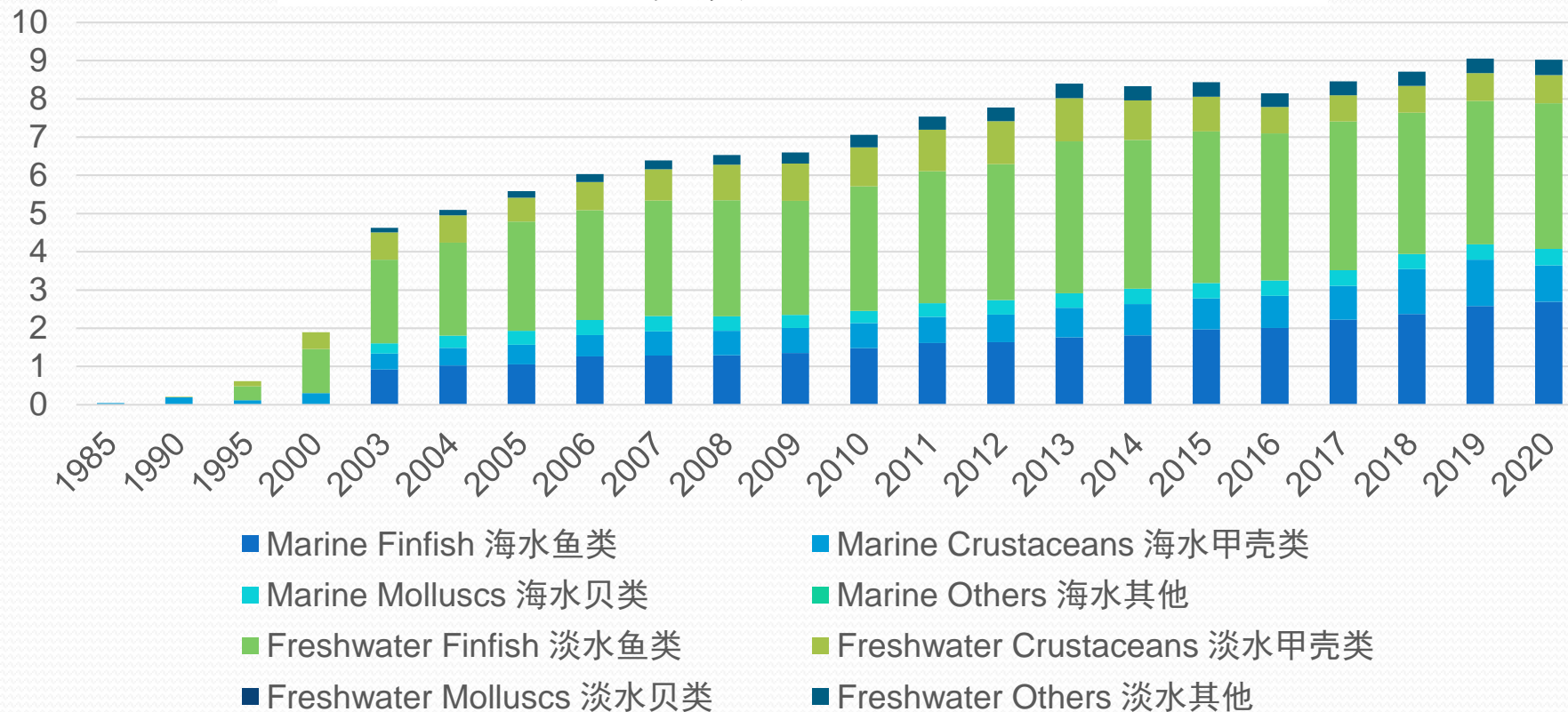
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Fisheries Resources consumption 渔业资源投入量

Fisheries Resources consumption (Million Tonnes)
渔业资源投入量 (百万吨)



图：总的渔业资源投入量

Fig. Fisheries Resources consumption

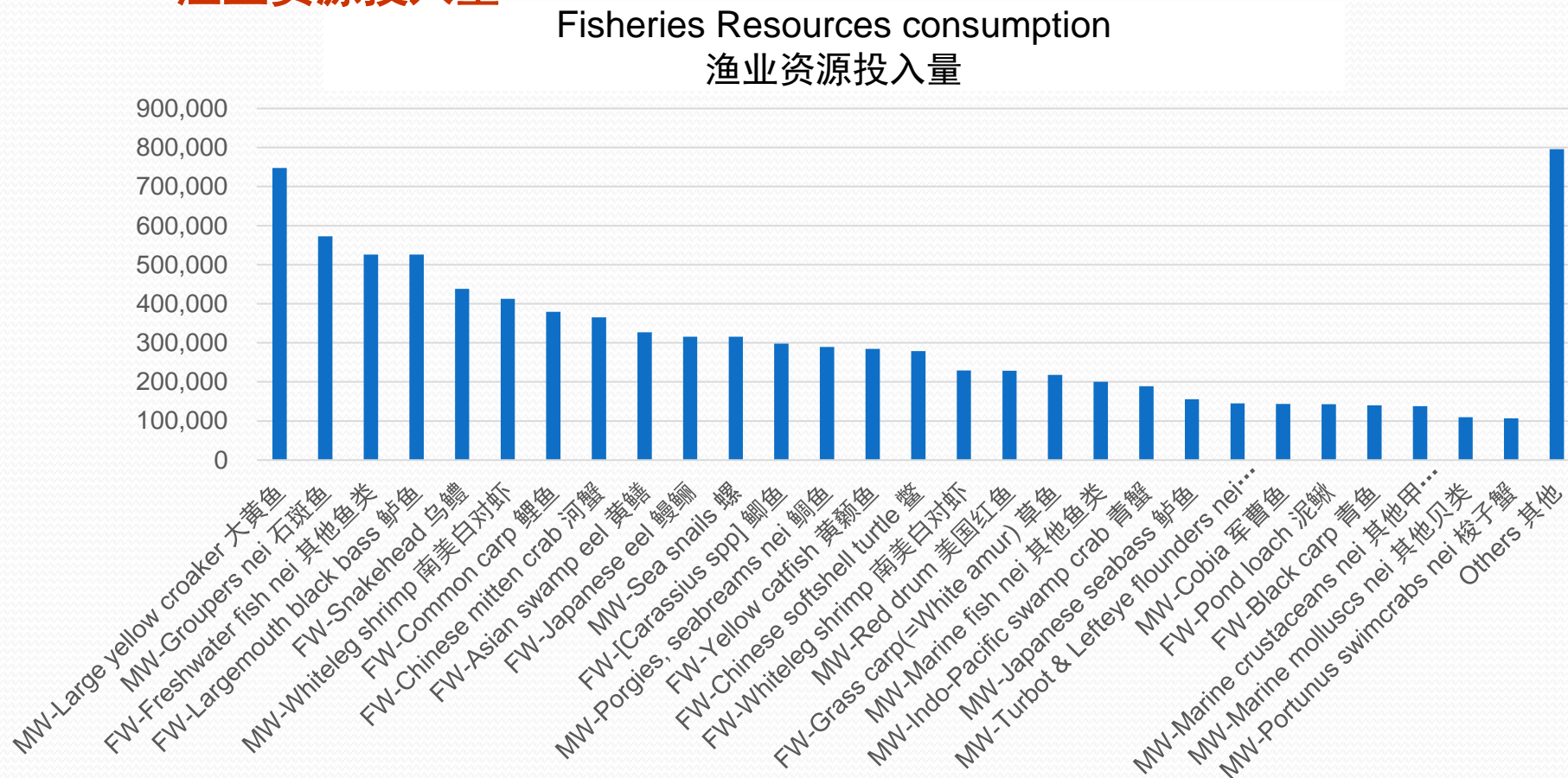
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Fisheries Resources consumption

渔业资源投入量



图：总的渔业资源投入量

Fig. Fisheries Resources consumption

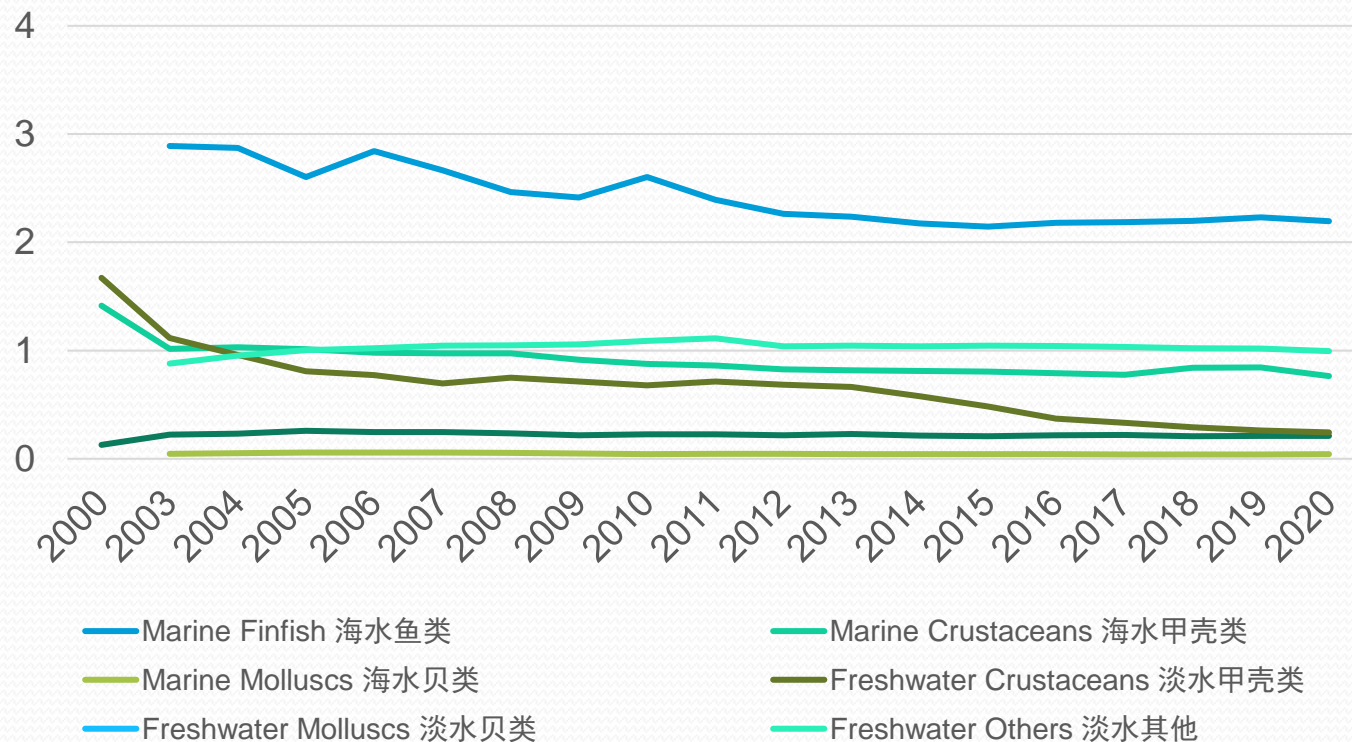
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FIFO of different aquatic product species 不同养殖水产品的鱼投入鱼产出系数（FIFO）

FIFO of China's aquaculture (1985-2020)
中国水产养殖业的鱼投入鱼产出系数（1985-2020）



图：鱼投入鱼产出系数（FIFO）

Fig. FIFO

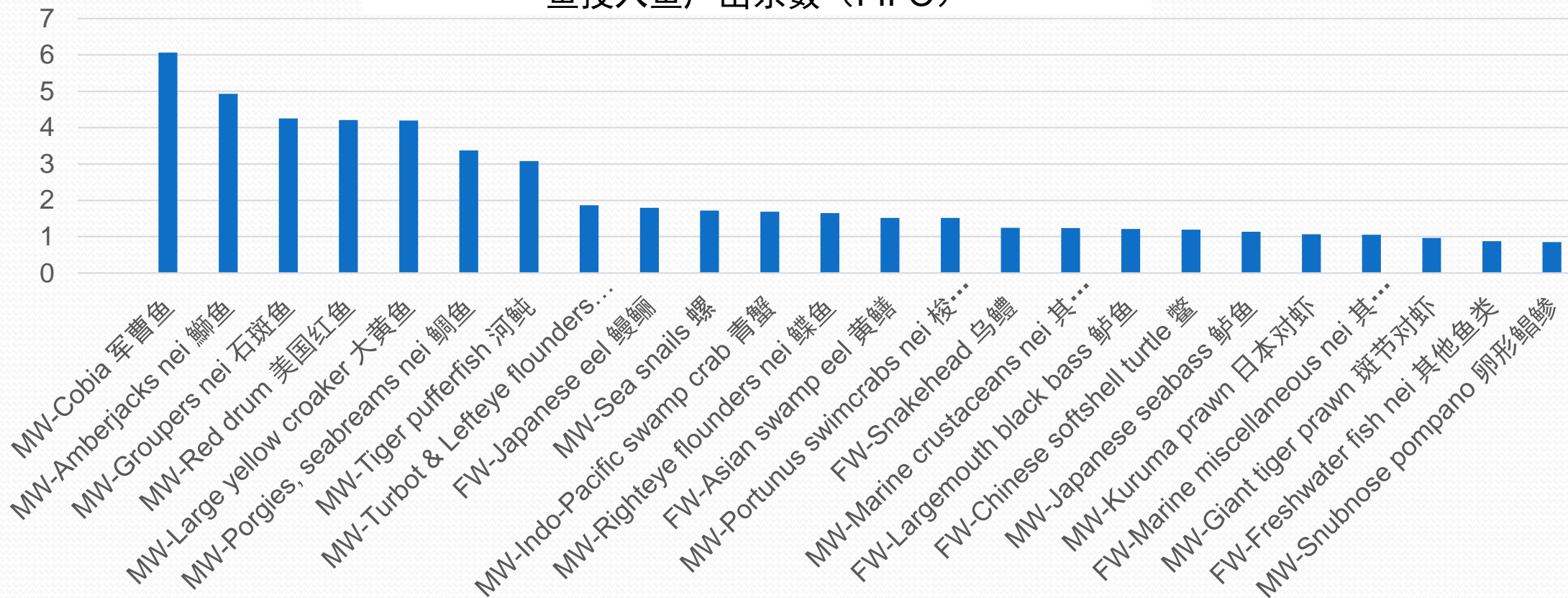
数据来源：根据唐 et al., (2016)，农业农村部渔业渔政管理局(2021)和(FAO, 2022)及相关品种FCR整理

Data source: Tang et al (2016), Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021, FAO 2022



FIFO of different aquatic product species 不同养殖水产品的鱼投入鱼产出系数 (FIFO)

FIFO
鱼投入鱼产出系数 (FIFO)



图：鱼投入鱼产出系数 (FIFO)

Fig. FIFO

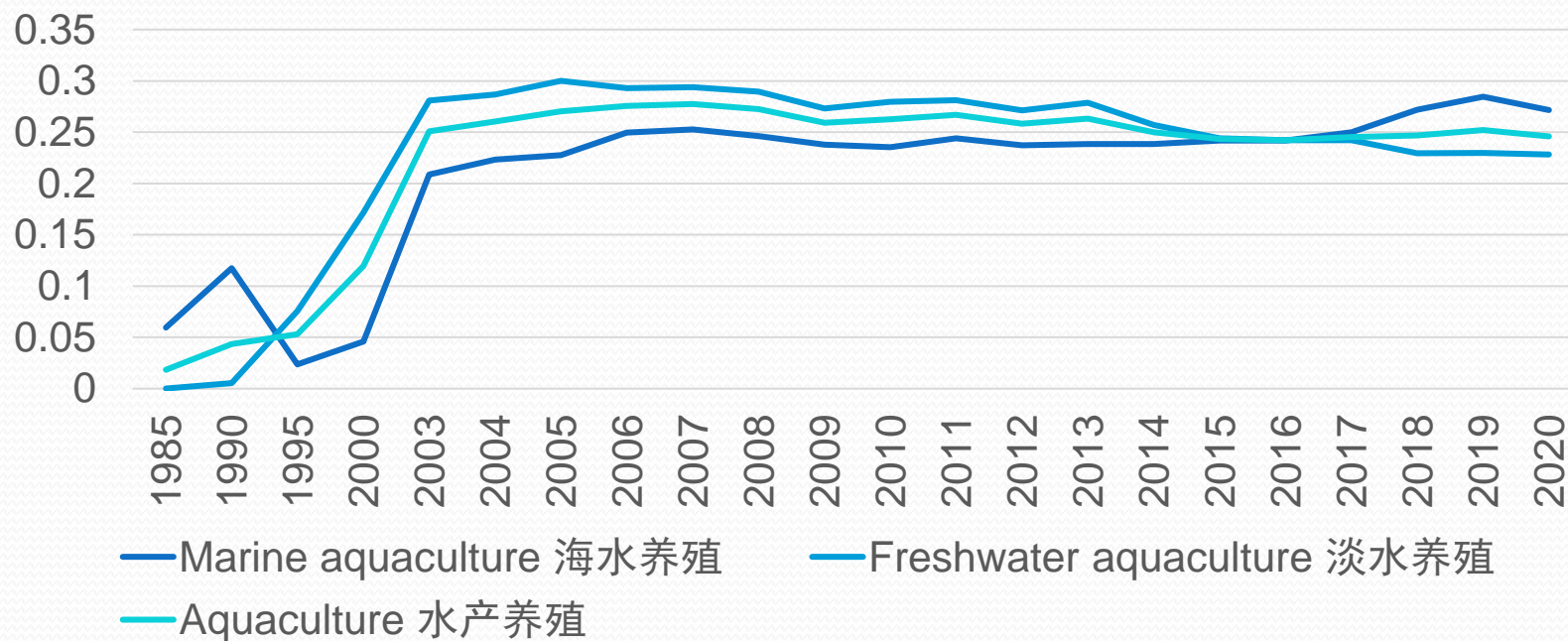
数据来源：根据唐 et al., (2016)，农业农村部渔业渔政管理局(2021)和(FAO, 2022)及相关品种FCR整理

Data source: Tang et al (2016), Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021, FAO 2022



FIFO of different aquatic product species 不同养殖水产品的鱼投入鱼产出系数 (FIFO)

FIFO of China's aquaculture (1985-2020)
中国水产养殖业的鱼投入鱼产出系数 (1985-2020)



图：鱼投入鱼产出系数 (FIFO)

Fig. FIFO

数据来源：根据唐 et al., (2016)，农业农村部渔业渔政管理局(2021)和(FAO, 2022)及相关品种FCR整理

Data source: Tang et al (2016), Fisheries Administration, Ministry of Agriculture and Rural Affairs 2021, FAO 2022



Discussion

讨论

- The utilization efficiency of marine fisheries resources in aquaculture in China is relatively high (FIFO is only 0.25).
- 我国水产养殖利用海洋渔业资源的效率相对较高（FIFO仅为0.25）
- The marine fisheries resources used in aquaculture in China are trash fish, fish oil and fishmeal produced by trash fish and by-products produced by aquatic products.
- 我国水产养殖利用海洋渔业资源包括：海水杂鱼直接投喂，海水杂鱼生产鱼油鱼粉，水产加工副产物的利用
- China consumes the most marine fisheries resources in aquaculture in the world.
- 我国是水产养殖消耗海洋渔业资源最多的国家。
- Besides the seawater trash fish, the freshwater trash fish is used in aquaculture, of which the influence should be discussed further.
- 除了海水野杂鱼之外，淡水野杂鱼也被水产养殖行业用做饵料，其影响需要进一步深入探讨。
- Freshwater aquaculture products (silver carp and bighead carp) are also used in aquaculture.
- 淡水养殖产品（鲢鳙）也被用作水产养殖饵料
- A more efficient utilization of marine fisheries resources in aquaculture is more desirable.
应在水产养殖中更有效地利用海洋渔业资源。



Thanks!

非常感谢!

I'm looking forward to your comments!

请各位专家指正!

