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硕 士 学 位 论 文

中国海岸带蓝碳价值评估

Measuring the Value of Blue Carbon in China Coastal Zone

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摘　要

自工业化以来，大气二氧化碳及其他温室气体的浓度已增加了 40%，不断增加的温室气体排放是全球气候变化的重要原因，从而对全球粮食生产以及人类的生活和生计造成严重影响，气候变化是人类 21 世纪面临的重大挑战之一。研究显示全球自然系统封存的生物碳中，超过一半是由海洋生态系统所捕获，被海洋生态系统捕获并封存的碳称为蓝碳。维持和促进海洋生态系统封存二氧化碳的能力是应对气候变化的关键措施之一，但是海洋生态系统在应对气候变化中的作用被长期忽略，其中重要的原因之一是没有赋予蓝碳适宜的价值。本文在对蓝碳理论系统梳理的基础上，借鉴国内外滨海植物生境、河口、浮游植物、养殖贝类的碳封存能力的评估方法，利用 InVEST 模型和 ArcGIS 软件对我国滨海湿地、河口、浮游植物、养殖贝类的碳封存量、固碳价值及其空间分布进行了研究，主要取得的成果如下：

1）论文对我国滨海植物生境、河口、浮游植物以及养殖贝类四个碳汇的碳储量、碳封存及各个碳汇的碳封存效率进行了系统估算。研究显示，我国四个碳汇每年从大气中捕获并封存的碳达到 315 万吨，相当于每年实现了 1157 万吨二氧化碳减排，这一数量可以抵消我国铁路部门二氧化碳排放量。其中浮游植物碳封存量最多，达到 117.22 万吨每年，占蓝碳总封存量 37.16%；其次是养殖贝类，养殖贝类碳封存 76.38 万吨每年，占蓝碳总封存量 24.21%；河口和植物生境的碳封存量所占比例分别为 20.54%和 18.08%。尽管植物生境碳封存总量最小，但是其碳封存效率最高，达到 383.14 t/(km^2 a)，其次是河口，其单位面积碳封存量 77.65 t/(km^2 a)，浮游植物碳封存效率最低，只有 4.50 t/(km^2 a)。考虑到植物生境和养殖贝类碳封存的高效率，以及这两个碳汇是可以由人类活动控制的，湿地修复和增加养殖贝类产量可以作为我国减缓气候变化的重要措施。

2）论文对我国滨海植物生境、河口、浮游植物以及养殖贝类蓝碳价值进行了系统评估。研究显示，我国四个海洋碳汇蓝碳价值高达 522.37 百万美元每年，其中浮游植物蓝碳价值最高，为 175.83 百万美元每年，所占比例达到 33.66%；其次是河口，蓝碳价值为 123.38 百万美元每年，所占比例达 23.62%。养殖贝类和植物生境的蓝碳价值分别为 114.57 百万美元每年、108.59 百万美元每年，所占比例分别为 21.93%、20.79%。

3）论文对“南红北柳”计划及养殖贝类对蓝碳的贡献进行了系统评估。实施了“南红北柳”计划后，植物生境碳封存量达到 74.39 万吨每年，增加了 17.35 万吨每年，增长率为 30.41%，蓝碳价值增加至 141.61 百万美元每年。到 2020 年，我国养殖贝类产量增加每年使碳封存量增加 18.86 万吨，养殖贝类蓝碳价值每年增加 10.93 百万美元，增长率为 24.69%。“南红北柳”实施完成后可以完成我国正在履行的《国家湿地保护公约行动计划》要求每年增加的碳捕获量。

将本论文关于滨海植物生境、河口、浮游植物、养殖贝类碳封存能力及蓝碳价值评估的结果，综合海洋生态系统为人类提供的其他服务的价值信息后，可以为海岸带生态系统保护和修复策略的制定提供决策支撑。

关键词：蓝碳；植物生境；河口；碳封存；浮游植物；养殖贝类

Abstract

IPCC has pointed that the concentration of atmospheric carbon dioxide has increased by 40 percent since industrialization. Increasing emissions of greenhouse gas are an important cause of global climate change and have a serious impact on global food production and and livelihoods.Climate change is one of the major challenges of the 21st century. The study shows that blue carbon which is captured by marine ecosystems is more than half of the biochar from the global natural system, Maintaining and improving the ability of marine ecosystems to capture and stock the carbon dioxideis one of the key measures to address climate change, but the role of marine ecosystems in mitigating the climate change has been overlooked for a long time. One of the important reasons is that the blue carbon is not valued rightly. In this paper, we have combed the blue carbon theory system, drawing on the assessment method of overseas academic community, we use the InVEST model and ArcGIS software to analyze the carbon sequestration and value as well as spatial distribution of coastal vegetated habitats, estuary, phytoplankton and cultured shellfish. The main achievements were as follows:

1) This paper estimated the carbon storage, carbon sequestration and carbon sequestration rate in coastal vegetated habitats, estuaries, phytoplankton and cultured shellfish of China. This four carbon sinks would sequestrate 3.15 million tons carbon from the atmosphere per year, equivalent to an annual realization of 11.57 million tons of CO_2 emissions reduction, which can offset CO_2 emissions of China's railway sector. Phytoplankton is the largest carbon sink, which sequestrates 1.17 million tons carbon per year, accounting for total blue carbon sequestration 37.16%; next one is cultured shellfish,the carbon sequestration is 0.76 million tons per year, accounting for total blue carbon sequestration 24.21%; the proportion of carbon sequestration in estuarine and vegetated habitat was 20.54% and 18.08%, respectively. Although the total amount of carbon sequestration in vegetated habitats is the smallest, the carbon sequestration efficiency is the highest, which is 383.14 t/km^2 per year; next one is estuary, the carbon sequestration rate is 77.65 t/km^2 per year, phytoplankton carbon sequestration rate is the lowest, only 4.50 t/km^2 per year. Taking into account the high carbon sequestration efficiency of plant habitat and cultured shellfish, and the two carbon sinks can be controlled by human activities, wetland restoration and increase

the production of shellfish can be used as an important measure to mitigate climate change in China.

2) This paper evaluated the economic value of blue carbon in coastal vegetated habitats, estuaries, phytoplankton and cultured shellfish. The results showed that these four carbon blue sinks valued 522.37 million dollars per year, the highest blue carbon value is phytoplankton，which is 175.83 million dollars per year, the proportion is 33.66%; the second one is estuary, which is 123.38 million dollars per year, the proportion is 23.62%. The blue carbon values of cultured shellfish and plant habitats is 114.57 million dollars per year and 108.59 million dollars per year, accounting for 21.93% and 20.79% respectively.

3) This paper analyzed the influence of " South Red and North Willow" and the expansion of cultured shellfish. After the "South Red North Willow" plan, Vegetated habitat carbon sequestration will be 0.74 million tons per year, increasing 30.41%. Vegetated habitat carbon value will increase to 141.61 million dollars per year. As the increasing production of cultured shellfish in China, the annual carbon sequestration will increase 0.19 million tons per year, cultured shellfish carbon value will increase 10.93 million dollars per year, the growth rate is 24.69%. After the "South Red North Willow" plan, Chinese carbon sequestration mission will be completed according to the "National Wetland Conservation Convention Action Plan".

The result of this study on blue carbon, together with the information of value of other marine ecosystems services, can provide support for development of coastal zone ecosystem protection and restoration strategy.

Key Words: Blue carbon; Vegetated habitats; Carbon sequestration; Phytoplankton; Cultured shellfish

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