

摘 要

近年来,鄱阳湖流域经历了快速的城市扩展过程,及时有效地模拟和评估城市扩展过程对自然生境的影响对于维持和促进区域可持续性具有重要意义。但是,目前针对该区域城市扩展过程分析模拟和对自然生境的影响研究比较缺乏。为此,本研究将基于“格局与过程-响应与机制-模拟与预测-管理与调控”的可持续科学研究思路,系统地研究了鄱阳湖流域城市扩展过程及其对自然生境的影响。主要工作和发现如下:

(1) 探究了鄱阳湖流域在 1990-2020 年间的城市扩张过程。研究表明,鄱阳湖流域的城市土地持续增加。在 1990-2020 年间,该研究区的城市土地面积从 509.08km² 增加到了 2710.80km²,年均增长面积为 220.01km²,城市用地占区域总面积的比例从 0.31% 增长到 1.62%。其中南昌市的城市面积增长量最大,从 1990 年的 99.76km² 增长到 2020 年的 527.81km²,增长量达到 428.06km²,增长了 4.29 倍。对城市扩张驱动因素的分析可知,1990 年到 2020 年研究区的建设用地扩张与区域经济发展的耦合协调度在不断提高,两个系统向着更加有序的方向发展。

(2) 模拟了该研究区 2020-2050 年不同情景下的城市扩张过程。利用共享社会经济路径 (SSPs) 情景和分区 LUSD-urban 模型对该研究区 2020-2050 年不同情景下的城市扩张过程进行了模拟。全区不同 SSPs 情景下城市土地面积将从 2710.80km² 增长至 3120.99km²~3500.50km²,其中 SSP2 情景下区域城市土地增长的面积最大。其中南昌市在所有选择的情景中城市土地增加量都是最多的,其城市土地增长面积为 101.47km²~172.66km²。

(3) 评价了鄱阳湖流域城市扩张对自然生境的直接和间接影响。鄱阳湖流域自然生境面积大、分布广,自然生境类型以林地为主。研究区在 1990 年的自然生境面积为 117858.58km²,其中林地面积为 103562.45 km²,占整个自然生境面积的 87.87%。赣州市拥有最多的自然生境面积,其总自然生境面积为 32197.63km²,占整个研究区自然生境面积的 27.32%。鄱阳湖流域的城市扩张过程在 1990-2020 年期间共占用了 411.53km² 的自然生境,其中占用最多的自然生境地类是林地,累计占用林地面积 306.38km²。2020-2050 年间将会由于城市扩张而直接导致自然生境面积减少 377.27km²~491.81km²。在这些自然生境当中,林地因城市扩张而被侵占的面积最大,其减少面积达到 304.55km²~403.63km²;分情景来看,SSP2 情景下城市扩张侵占自然生境的面积最大,被侵占的面积为 491.80km²,分区域来看,无论是哪种 SSPs 情景,赣州市未来城市扩张侵占自然生境的面积都是最大的,侵占的面积为 93.90km²~120.49km²。鄱阳湖流域城市扩张对自然生境的间接影响导致生境质量从 1990 年的 0.7345 下降至 2020 年的 0.7044

下降了 4.10%，是直接影响的 1.53 倍。2020-2050 年，鄱阳湖流域不同情景下的城市扩张过程的间接影响导致生境质量降低了 0.0162-0.0288，降幅为 2.30%-4.09%，是直接影响的 1.29-2.5 倍。其中直接影响与间接影响差距最大的是 SSP2 情景，直接影响是间接影响的 2.49 倍。

关键词：城市扩张；情景模拟；自然生境；鄱阳湖流域

Abstract

In recent years, the Poyang Lake Basin has experienced a rapid process of urban expansion. Timely and effective simulation and evaluation of the impact of urban expansion on natural habitats are of great significance for maintaining and promoting regional sustainability. However, there is currently a lack of analysis and simulation on the process of urban expansion in the region, as well as research on its impact on natural habitats. Therefore, this study will systematically study the process of urban expansion in the Poyang Lake Basin and its impact on natural habitats based on the sustainable scientific research approach of "pattern and process response and mechanism simulation and prediction management and regulation". The main work and findings are as follows:

(1) Explore the process of urban expansion in the Poyang Lake Basin during the period 1990-2020. The results of the study show that the urban land in Poyang Lake Basin continues to increase. During the period of 1990-2020, the urban land area of the region increased from 509.08km² to 2710.80km², with an average annual growth area of 220.01km², and the proportion of urban land to the total area of the region increased from 0.31% to 1.62%. Among them, Nanchang City has the largest growth in urban area, from 99.76km² in 1990 to 527.81km² in 2020, with a growth of 428.06km², an increase of 4.29 times. The analysis of urban expansion drivers shows that the coupling and coordination between construction land expansion and regional economic development in the study area from 1990 to 2020 is increasing, and the two systems are developing in a more orderly direction.

(2) The urban sprawl process in the study area was simulated under different scenarios for the years 2020-2050. The urban expansion process under different scenarios for 2020-2050 in the study area was simulated using the shared socio-economic pathways (SSPs) scenario and the zonal LUSD-urban model. The urban land area will grow from 2710.80km² to 3120.99km²~3500.50km² under different SSPs scenarios in the whole region, among which the SSP2 scenario has the largest area of regional urban land growth. Among them, Nanchang City has the largest urban land increase in all selected scenarios, and its urban land growth area is 101.47km²~172.66km².

(3) The direct and indirect impacts of urban expansion on natural habitats in the Poyang Lake Basin were evaluated. The natural habitats in Poyang Lake Basin are large in area and widely distributed, and the types of natural habitats are mainly woodland. The area of natural

habitats in the study area in 1990 was 117,858.58 km², of which the area of woodland was 103,562.45 km², accounting for 87.87% of the whole area of natural habitats. The city of Ganzhou has the largest natural habitat area, with a total natural habitat area of 32,197.63 km², accounting for 27.32% of the natural habitat area of the whole study area. The urban expansion process in Poyang Lake Basin occupied a total of 411.53km² of natural habitats from 1990 to 2020, of which the most occupied natural habitat was forest land, with a cumulative area of 306.38km². 2020-2050 will see a decrease in the area of natural habitats by 377.27km² to 491.81km² as a direct result of urban expansion. The area of natural habitats will decrease by 377.27km² to 491.81km² between 2020 and 2050 due to urban expansion. Among these natural habitats, the area of forest land encroached by urban expansion is the largest, with a reduction of 304.55km²~403.63km²; in terms of scenarios, the area of natural habitats encroached by urban expansion in the SSP2 scenario is the largest, with an encroachment area of 491.80km², and in terms of regions, the area of natural habitats encroached by urban expansion is the largest in the Ganzhou city in the future in both scenarios. natural habitat is the largest, with the encroached area ranging from 93.90km² to 120.49km². The indirect impacts of urban expansion on natural habitats in the Poyang Lake Basin resulted in a 4.10% decrease in habitat quality from 0.7345 in 1990 to 0.7044 in 2020, which is 1.53 times higher than the direct impacts. Between 2020 and 2050, indirect impacts of the urban expansion process under different scenarios in the Poyang Lake Basin resulted in a decrease in habitat quality of 0.0162-0.0288, The decrease is 2.30%-4.09%, which is 1.29-2.5 times of the direct impact. The largest gap between direct and indirect impacts is found in the SSP2 scenario, where direct impacts are 2.49 times greater than indirect impacts.

Key Words: Urban expansion; Scenario simulation; Natural habitat; Poyang Lake Basin

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