黄河流域生态功能区植被 NPP 时空变化分析及驱动因素

王颖轩

（宁夏大学 宁夏 750021）

摘 要:黄河流域在中国经济社会发展和生态安全方面都具有十分重要的地位， 基于中国生态系统评估与生态安全数据库将黄河流域划分为 11 个生态功能区，以 MOD17A3HGF V6 植被净初级生产力(NPP)数据为基础，采用 Sen+MK 趋势分析、变异系数（Cv）、莫兰（Moran’s I）指数、Mann-Kendall 突变检验方法对黄河流域 2001-2020 年 NPP 时间序列变化和空间分布规律进行分析。结果表明：（1）黄河流域植被净初级生产力(NPP)在 2001—2020 年整体呈上升趋势，由北向南增加。黄河流域不同生态功能区植被 NPP 差异显著，秦巴山地落叶与常绿阔叶林生态区年均 NPP 值最高，内蒙古高原中部草原化荒漠生态区 NPP 值最低，黄土高原农业与草原生态区和江河源区-甘南高寒草甸草原生态区区内的 NPP 值变化差异明显。（2）黄河流域不同时间段植被 NPP 的空间自相关特征的研究显示，2001、2005、2010、2015、2020 年的全局自相关指数均在 0.8 以上，11 个功能区均表现为高-高聚类和低-低聚类地区呈正相关关系，差异显著，不显著区域集中在黄土高原农业与草原生态区和江河源区-甘南高寒草甸草原生态区内。（3）黄河流域内植被 NPP 的时空变化总体上相对稳定，江河源区-甘南高寒草甸草原生态区植被 NPP 波动较大。（4）Mann-Kendall 检验 NPP 的时间变化，I—13 华北平原农业生态区有 6 个突变点，辽东一山东丘陵落叶阔叶林生态区有 3 个突变点，NPP 趋势波动较大，但总体上升。根据生态功能区划进行分区评估，为实现黄河流域高质量发展及达到碳中和目标提供参考依据。

关键词: 黄河流域；植被净初级生产力；生态功能区

Analysis of spatial and temporal variation of vegetation NPP in the ecological functional area of the Yellow River Basin and its driving elements

Abstract: The Yellow River Basin is very important in China's economic and social development and ecological security. Based on the China Ecosystem Assessment and Ecological Security Database , the Yellow River Basin was divided into 11 ecological functional zones, and based on the MOD17A3HGF V6 vegetation Net Primary Productivity (NPP) data, the time-series changes of the NPP in the Yellow River Basin and its spatial distribution pattern from 2001 to 2020 were analyzed by using the methods of Theil-Sen Median trend analysis and the Mann-Kendall test, the coefficient of variation , the Moran's I index, and the Mann-Kendall mutation test.The results show that: (1) the net primary productivity (NPP) of vegetation in the Yellow River Basin showed an overall upward trend from 2001 to 2020, increasing from north to south. There are significant differences in the NPP of vegetation in different ecological functional zones in the Yellow River Basin, with the highest annual average NPP value in the Qinba Mountain deciduous and evergreen broad-leaved forest ecological zone, the lowest NPP value in the grassland desert ecological zone in the central part of the Inner Mongolia Plateau, and significant differences in the NPP value within the agriculture and grassland ecological zone of the Loess Plateau and the river source zone-Gannan alpine meadow grassland ecological zone.(2) The study of the spatial autocorrelation characteristics of vegetation NPP in the Yellow River Basin at different time intervals showed that the global autocorrelation indices in 2001, 2005, 2010, 2015 and 2020 were all above 0.8, and the functional regions showed positive correlations with significant differences between the high-high clustered and low-low clustered areas, with the non-significant areas concentrated in the Loess Plateau Agriculture and Grassland Ecological Region and the The non-significant areas were concentrated in the agriculture and grassland ecological zone of the Loess Plateau and the river source area-Gannan alpine meadow grassland ecological zone. (3) The spatial and temporal changes of vegetation NPP in the Yellow River Basin were relatively stable in general, while the fluctuation of vegetation NPP was larger in the River Source Region-Gannan Alpine Meadow Grassland Ecological Region. (4) The Mann-Kendall test for temporal changes in NPP showed that there were six mutation points in the I-13 North China Plain agro-ecological zone, and three mutation points in the Liaodong I Shandong Hills deciduous broad-leaved forest ecological zone, and that the NPP trend fluctuated more, but generally increased. The zonal assessment based on the ecological functional zoning provides a reference basis for realizing the high-quality development of the Yellow River Basin and reaching the carbon neutrality target.

Key words: Yellow River Basin; Net Primary Productivity of Vegetation; Ecological Functional Areas.