A wavelet-based search for Tweedie distribution indices in fish abundance data

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The Tweedie distribution, which has high flexibility in representation of data, for which their variance has a power-law dependence on their mean, is argued as an important tool for analysing ecological data since it prowides a solid mathematical background for so-called empiric Taylor's power power law for species abundance data [1]. In addition, it has been demonstrated recently [2] that taking into account specific features of this distribution can provide valuable corrections to accuracy of population dynamics modelling in the case of a strong data stochasticity.

In this work, we apply a newly developed algorithm based on the scaling of coefficients of the discrete wavelet transform with the Haar basis to fish abundance data [3] covering the time period from 1982 to 2017 for five spatial regions of the Pacific located from Alaska coast/Bering sea to Californian coastal area.

Is it shown for 20 most-frequently encountered species that these data with an excessive number of zeros, can be subdivided into groups, which include those that belong to the case of strong Taylor/Tweedy statistics (the power index is sufficiently less that 2), the Tweedie distributions close to Gamma distribution, and the case of Gamma-distributed data filled by zeros.

Acknowledgement: This work is supported by the Ministry of Science and Higher Education of the Russian Federation, the research project No. 3.9499.2017/8.9.

REFERENCE

[1] W. S. Kendal, Taylor's ecological power law as a consequence of scale invariant exponential dispersion models, Ecological Complexity, 1, 732, (2004).

[2] A. A. Khalin, E. B. Postnikov, A. B. Ryabov, Stochastic effects in mean-field population growth: The quasi-Gaussian approximation to the case of a Taylor's law-distributed substrate, Physica A, 511, 166, (2018).

[3] `https://github.com/James-Thorson/FishData`