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Research and partnerships in studies on population genetics of Neotropical plants: A scientometric evaluation

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ABSTRACT

Population genetics contributes to the understanding of the origin and maintenance of Neotropical biodiversity. We performed a scientometric analysis of 'population genetics of Neotropical plants' publications in Thomson Reuters Web of Science database, to identify patterns and trends and generate useful information for science and technology policy and decision-making in research funding. A total of 270 articles were identified. We found a general increase in the number of 'population genetics of Neotropical plants' publications but at a lower rate than the overall increase in 'general population genetics'. Brazil and Costa Rica were the most studied countries, and Brazilians followed by North Americans authored the most publications. Twenty-five co-authorship collaboration groups and 9 institutional collaboration sub communities were identified. The number of groups remains low, and the distribution among countries is skewed. National and international partnerships significantly increased during the time period of our survey and at a higher rate than articles with no partnership. Despite the high biodiversity in the Neotropics, only 157 different species were studied during the last 68 years. Our results demonstrated low levels of 'population genetics of Neotropical plants' publications, which indicate the need to accelerate and increase research funding in this area.

1. Introduction

The Neotropics include a wide variety of biomes, ranging from deserts to tropical rain forests, and has the largest number of plants and animals in the world (Tundisi and Matsmura-Tundisi, 2008), including several hotspots of biodiversity (Myers et al., 2000). However, most Neotropical species are poorly studied, and many questions related to their origin, evolutionary history and maintenance of high biodiversity are poorly understood (Antonelli and Sanmartín, 2011).

Population genetics has contributed to understanding the origin and maintenance of Neotropical biodiversity (Turchetto-Zolet et al., 2013). Since the publication of Lewontin and Hubby (1966), molecular markers have been used to easily and quickly access the polymorphisms in natural populations, opening a new perspective from which to survey Neotropical biodiversity (Kirk and Freeland, 2011). In this context, understanding the background of publications on population genetics is essential to formulate future research strategies in the Neotropics.

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Quantitative and qualitative progress in science and technology over time can be monitored using scientometric studies, which contribute to understanding the level of development within a scientific field with large potential applications, such as in the development of scientific policies (Hood and Wilson, 2001; Wang et al., 2013). An analysis of partnerships may provide clues on scientific motivation and funding in a country (Lang et al., 2013; Uddin et al., 2013). In the era of knowledge-based economies, information on the trends in science and technology is highly important for planning and assessing research opportunities. In this study, we analyzed the context of the publications on population genetics of Neotropical plants. Additionally, we identified the temporal trends and patterns of institutional partnerships to generate information for science and technology policy and decision-making for directing research efforts.

2. Materials and methods

2.1. Database survey

To analyze the publications on 'population genetics of Neotropical plants', we surveyed the Thomson Reuters Web of Science database (http://apps.webofknowledge.com) using the Web of Science platform (ISI hereafter). We used the most frequent keywords in the subject area: "population genetics", "phylogeography", "mating system", "reproductive system" and "genetic structure" combined with (and) "Neotropical trees" and "Neotropical plants." Additional keywords, such as "pollen dispersal" and "gene flow", retrieved no additional papers. We excluded phylogenetic studies, reviews and studies on the development of molecular markers, such as microsatellite primer development studies or SNP discovery studies. The survey was performed based on the availability of publications in the database from 1945 to December 2013.

Each article was analyzed for variables: (i) the year of publication; (ii) the journal; (iii) the number of authors; (iv) the institution of each author; (v) the country of origin of each author; (vi) the country where the study was conducted; (vii) the botanical family; (viii) the genus; (ix) the species; (x) the study subject (genetic diversity, population genetic structure, phylogeography, pollen dispersal, seed dispersal, or spatial genetic structure); and (xi) the molecular marker used.

2.2. Descriptive and quantitative analyses

To quantify the increase in the number of papers published from 1945 to 2013, we first normalized the number of papers in 'population genetics of Neotropical plants' and 'general population genetics' (all issues in population genetics) to the total number of papers indexed in the ISI for each year. Such normalization removes the natural effect of the increase in scientific publications and yields unbiased estimates of temporal trends in scientific production. We then analyzed temporal trends in scientific production using linear regression (number vs. year of publication) for two periods: the time period before the discovery of PCR (polymerase chain reaction) in 1990 and after that (after 1990). By comparing the regression slopes (β) from previous analyses, we tested the hypothesis that the increases in publications in 'population genetics of Neotropical plants' and 'general population genetics' were similar. The analyses were performed using the functions "lm" and "t.test", respectively, within the "stats" package in the R environment (R Core Team, 2014).

We analyzed the number of papers per country based on the affiliation of the first author or the corresponding author, if different, and the country where the research was conducted. In this context, the partnership structure of the publications at the macro and regional levels was determined by counting the number of different countries and institutions involved in the publication. A collaboration network was analyzed as a group of 2 or more authors publishing at least 2 papers together or in scientific collaboration with other authors or groups. We also explored collaboration networks taking into account institutions and countries as the subject instead of authors. Networks were built using the function "network" from the R-package "network" (Butts, 2008, 2015). Moreover, we analyzed temporal trends in collaboration based on the number of coauthors per article using a quantile regression fitted by function "rq" in R-package "quantreg" (Koenker, 2013). Because these relationships resemble a triangular-shaped envelope in which the variance in response variable (Y-axis) increases along the predictor (X-axis), we fitted the slopes from 10% to 90% quantiles to set the edges of scatterplot (Cade and Noon, 2003).

We also analyzed the number of papers per journal and per molecular marker. To determine the representativeness of the number of species studied, we analyzed the publications for the numbers of families, genera and species studied. To understand journal preferences, we analyzed the relationships among journal, study area, molecular marker and year of publication in a multivariate space with a principal coordinates analysis (PCoA). These analyses were performed using the function "capscale" from the R-package "vegan" (Oksanen et al., 2013).

3. Results

Our survey retrieved 200,033 papers on 'population genetics' between 1945 and 2013, of which 270 papers specifically addressed questions about Neotropical plants (see raw data in Supporting Information Table S1). The first paper on the specific subject of 'population genetics of Neotropical plants' was published in 1988, 43 years after the first publication in 'general population genetics,' and the number did not exceed 10 publications per year until 2003. Publications on both subjects increased significantly after the discovery of PCR in 1990, but specific studies on Neotropical plants had a lower rate of increase than general studies of population genetics (Fig. 1a). When the data for publications on 'population genetics of