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Functional Diversity Can Predict Ecosystem Functions Better Than Dominant Species: The Case of Desert Plants in the Ebinur Lake Basin

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Abstract: Studying the impact of biodiversity on ecosystem multifunctionality is helpful for clarifying the ecological mechanisms (such as niche complementary effects and selection) of ecosystems providing multiple services. Biodiversity has a significant impact on ecosystem versatility, but the relative importance of functional diversity and dominant species to ecosystem functions needs further evaluation. We studied the desert plant community in Ebinur Lake Basin. Based on field survey data and experimental analysis, the relationship between the richness and functional diversity of dominant species and the single function of ecosystem was analyzed. The relative importance of niche complementary effect and selective effect in explaining the function of plant diversity in arid areas is discussed. There was no significant correlation between desert ecosystem functions (soil available phosphorus, organic matter, nitrate nitrogen, and ammonium nitrogen) and the richness of the dominant species *Nitraria tangutorum* ($p < 0.05$). Soil organic matter and available phosphorus had significant effects on specific leaf area and plant height ($p < 0.05$). Functional dispersion (FDis) had a significant effect on soil available phosphorus, while dominant species dominant species richness (SR) had no obvious effect on single ecosystem function. A structural equation model showed that dominant species had no direct effect on plant functional diversity and ecosystem function, but functional diversity had a strong direct effect on ecosystem function, and its direct coefficients of action were 0.226 and 0.422. The results can help to explain the response mechanism of multifunctionality to biodiversity in arid areas, which may provide referential significance for vegetation protection and restoration for other similar areas.

Keywords: desert ecosystem; functional diversity; dominant species; functional traits

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1. Introduction

The increased rate of ecosystem degradation [1–3] aggravates the decline of ecosystem services [4–6], and the relationship between biodiversity and ecosystem functions is an important research issue [7,8]. Although the loss of biodiversity clearly has a negative impact on ecosystem functions [9–11], the mechanisms underlying this ecological process are poorly known [12,13]. The role of biodiversity in ecosystems can be explained by two proposed mechanisms: selection effect (sampling effect) [14] and niche complementary effect [15].

Niche complementary effect, also known as diversity effect, is the functional complementary effect among species caused by the increase of species diversity. This effect increases the utilization efficiency of resources, increases community stability, and supports the diversity–stability hypothesis [16,17]. Selection effects, also known as dominance effect or sampling effect, refer to the stability effect provided by stable high-yield dominant species [18]. With the increase of species diversity, the occurrence probability of high-yield dominant species in the community also increases, and the productivity or stability of the community is ultimately determined by stable high-yield dominant species. Therefore, compared to the complementary effect, the selective effect is caused by a single species or a few species with special characteristics. The complementary effect is caused by multiple species co-existing to affect the temporal stability of the community. Whether the selection effect can improve the time stability depends on the stability of dominant species and it is ultimately irrelevant or negatively correlated with species richness. Therefore, the selection effect is not always regarded as a diversity effect, but as a sampling effect [19–22]. Many studies have emphasized the importance of this effect when disturbance causes a community to change from a stable state of high diversity (low dominance) to a stable state of low diversity (high dominance) [23,24].

At present, some scholars mainly focus on temperate, tropical, subtropical forest, and grassland ecosystems [25,26], while some Chinese researchers in this field mainly focus on desert, meadow, grassland, and alpine grassland ecosystems. Most researchers focus on the study of species diversity and productivity, single ecosystem function, and the multiple functions of desert ecosystems [27,28]. However, this will likely underestimate the impact of biodiversity on ecological functions [29,30]. In arid areas, it is unclear whether only a few species or many species are needed to maintain a multi-functioning ecosystem. Most studies of arid areas emphasize species diversity while downplaying the role of functional diversity [31–33]. Research on the relationship between biodiversity and ecosystem multifunctionality in temperate arid desert ecosystems is still lacking. There are no clear answers to problems that include the relative importance of various functions in ecosystem multifunctionality, the number of species needed to successfully maintain and operate ecological multifunctionality, and the relative importance of functional diversity and species diversity for predicting and explaining ecosystem multifunctionality.

Quantitative determination of functional diversity can accurately reflect community function and the role of ecosystem development. The selection and measurement of relevant parameters should accurately reflect the functional traits of plants, the abundance of species, and all aspects related to functional diversity [34]. Early studies determined plant functional diversity by dividing the species in the plant community into different functional groups based on differences of a specific functional character. The richness of functional groups is the index of plant functional character diversity [33]. However, use of this method may overlook information presented by some continuous variables and may also weaken the important factor of species abundance. In addition, different methods of functional group division can lead to different research results and conclusions.

The functional richness index measures how much niche space the existing species occupy in the community [35], and a community with lower functional richness indicates insufficient utilization of resources. This means that there is surplus niche space and community productivity decreases [36]. The functional evenness index measures the distribution of species characters in the occupied character space. A high functional evenness index means that species are distributed regularly in the community, while a low functional evenness index indicates that there is a gap in the distribution of species. The functional uniformity index is generally used to predict the utilization of resources, and also to study productivity, resilience, and invasion vulnerability [37]. The functional dispersion index measures the maximum dispersion degree of the abundance distribution of community functional characters in character space. Functional dispersion indices are used to predict resource differentiation, such as competition, but they can also indicate the advantages of extreme species. High functional dispersion is mainly caused by the clustering or multiplicity of species located at the edge of character space, which indicates that niche overlap is small and resource utilization efficiency is high. Like the functional uniformity index, functional dispersion includes species abundance [38,39]. Regarding the relationship between functional traits and ecological processes and functions, most researchers believe that the attributes and relative abundance of dominant species in plant communities dominate the dynamic changes of ecological processes, which is the “mass ratio” theory [40]. Plant functional traits based on community functional parameters and diversity of plant functional traits can strongly influence plant community construction and ecosystem function or processes. Therefore, the combination of the comparative analysis of plant functional traits and the calculation of community functional parameters can more comprehensively characterize the functional diversity of plant communities.

Arid areas are one of the most vulnerable ecosystems and account for about 45% of the earth's surface. In China, the arid areas account for 25% of the mainland territory, and are mainly distributed in Xinjiang, Inner Mongolia, and Gansu [41,42]. Arid environments are very fragile, so they are key areas for studying biodiversity. Ebinur Lake Basin is a typical temperate arid desert ecosystem. It is a low depression that collects water and accumulates salt in the southwest margin of the Junggar Basin. It is sensitive to external interference and has an extremely fragile function that makes it excellent for the study of biodiversity and ecosystem functions. We used desert plants in the Ebinur Lake Basin as the research objects. Based on field studies and laboratory experiments, we determined if dominant species richness and species functional diversity can better predict and explain the ecosystem functions in the study area. The findings have practical significance for maintaining the local ecosystem versatility, and the study provides a basis for research and use of desert plant diversity in temperate arid regions.

2. Materials and Methods

2.1. Overview of the Study Area

The geographical coordinates of Ebinur Lake Wetland National Nature Reserve in Xinjiang are 82°36′–83°50′ W and 44°30′–45°09′ N. Ebinur Lake is located in the southwest portion of the Junggar Basin, which is a typical tail lake and a collection area for water and salt. The basin has a typical temperate continental arid climate, with annual evaporation of over 1600 mm, annual rainfall of about 100 mm, 2800 sunshine hours, an extreme maximum temperature of 44 °C and an extreme minimum temperature of −33 °C. Due to the complex terrain and harsh climatic conditions, a unique desert-wetland-Gobi composite landscape has formed in the basin. This nature reserve area has relatively high biodiversity. Common wild plant species include *Populus euphratica*, *Haloxylou ammodendron*, *Phragmites australis*, *Tamarix chinensis, Nitraria tangutorum*, *Halostachys caspica*, *Halocnemum strobilaceum*, *Alhagi sparsifolia*, *Kalidium foliatum*, *Kalidium caspicum*, *Apocynum venetum*, *Reaumuria soongoric Halimodendron halodendron*, *Glycyrrhiza uralensis*, *Aeluropus pungens*, *Suaeda pterautha*, *Suaeda microphylla*, and *Mulgedium tataricum*.

2.2. Field Community Survey

From mid-July to mid-August 2017, a field experiment was conducted in the Ebinur Lake Wetland National Nature Reserve, Xinjiang. The specific quadrat layout was as follows: vertical to Aqixu River, forming a natural water-salt gradient, and gradient changes in soil moisture and salt along the distance from the river. A sample plot was set up in the north of Dongdaqiao Management and Protection Station (Figure 1), with dimensions of 480 m from east to west and 600 m from north to south, the southeast corner of the quadrat is the first quadrat, and the size of each quadrat is 30 m ∗ 30 m. from Q1-1 (quadrat number). A total of 80 30 m × 30 m sample plots were laid out, with a spacing of 30 m between plots.

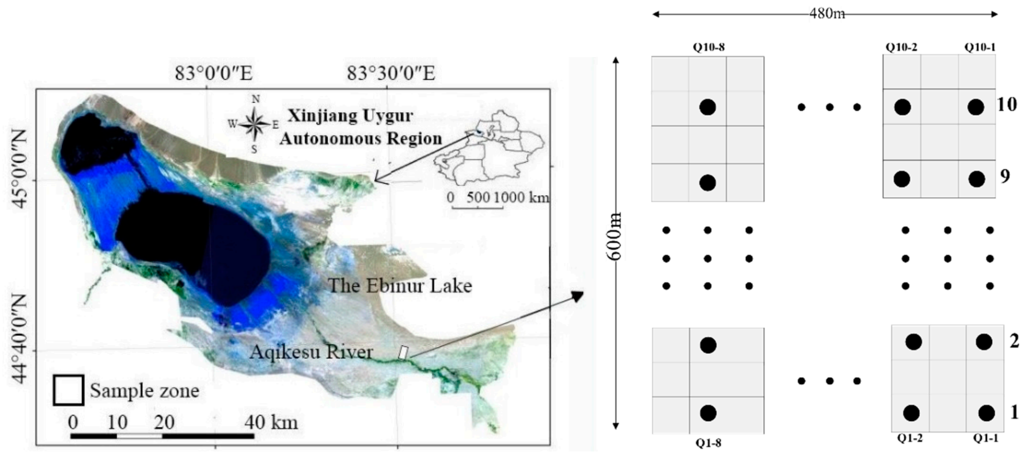

Figure 1. Schematic diagram of study area location and quadrat distribution.

2.2.1. Soil Sampling and Determination of Soil Factors

We dug a 30-cm soil profile with a spade, took three samples of soil (3 repetitions) for each quadrat, and sampled three layers of soil: 0–10 cm, 10–20 cm, and 20–30 cm. During soil collection, we used an aluminum box to collect soil samples. After the collection of soil in the aluminum box soil was completed, we coded the sample number, determined the fresh soil weight, and returned the soil to the laboratory where it was dried to obtain the dry weight and calculate the water content. We collected another soil sample, packed it in a self-sealing bag, returned it to the lab, and allowed the soil to air-dry. This sample was used for the determination of soil indexes in the later stage of the study. Five soil indexes, including water content, salt content, available phosphorus, nitrate nitrogen, and ammonium nitrogen, were determined.

Methods used for the indexes were water content (drying method), conductivity (precision conductivity meter), available phosphorus ($NaHCO_3$ extraction-molybdenum antimony resistance colorimetry), nitrate nitrogen, and ammonia nitrogen (ultraviolet spectrophotometry).

2.2.2. Sampling and Determination of Plants

(1) Within each selected survey quadrat, we recorded the latitude, longitude, and altitude of each quadrat by GPS. We recorded the species, abundance, coverage, and density of all plants in the sample. By calculating the frequency (frequency refers to the percentage of the number of plots that a certain plant appears in the community to the total number of plots) and relative abundance (an estimation target of the number of individual species in a plant community) of species, they were classified as “dominant species” if the frequency was greater than 70% and the relative abundance was greater than 5%.

(2) Measurement of leaf functional traits

In each quadrat, we measured the nutrient height, crown width (east-west × north-south), and heightof each plant, measured three plants for each species, and recorded the data. The investigation details of the plant traits were as follows:

a. Specific leaf area. For sampled plants, four fresh and mature leaves with the same growth and size were selected in four directions of their canopy, and 10 leaves of plants with smaller leaves were selected, put into sterile small sealed bags, photographed with numbers, and then, returned to the laboratory for calculation with ImageJ software. We put the photographed plant leaves into small sealed bags for airing, and then, returned them to the laboratory, where they were weighed, dried in a 105 °C oven, and then re-weighed.

b. Element content in leaves

After obtaining data on all species in each square, all plant species with good growth and consistency were selected, and about 100 g of healthy plant leaves were collected. The leaves were used to determine nutrient content. For plant organic carbon, the potassium dichromate method was used. Total nitrogen used the Kjeldahl method. Total phosphorus used the molybdenum antimony colorimetric method.

(3) Functional diversity calculation

According to the plant community structure, the community weighted average of each functional character was calculated (community weighted mean, CWM) as plant functional traits (plant traits refer to plant characteristics that are easy to observe or measure; they are the result of adapting to different environments during the long-term evolution of the species, and can objectively express the adaptability of plants to the external environment) representing community level:

$$CWM = \sum_{i=1}^{s} Pi = trait \quad (1)$$

In this formula, s is the number of species in the community, p is the relative contribution rate (relative richness or relative biomass) of species I in the community, and $trait_i$ is the character value of species "i".

Based on the measured plant functional traits, the functional uniformity (FEve), functional dispersion index (FDis), functional richness (FRic), and functional dispersion (FDiv) of each sample were calculated.

2.3. Data Processing and Statistics

Ordinary least squares (OLS) linear regression was used to analyze the relationships between dominant species abundance, plant community functional diversity, and ecosystem function. Pearson correlation was used to analyze the correlation between plant functional traits and functional diversity index and ecosystem function. Redundancy analysis (RDA) was used to further elaborate the relationships among plant traits, functional diversity, soil environmental factors, and ecosystem functions. The structural equations of dominant species abundance–plant functional diversity–ecosystem function were constructed, and the direct and indirect relationships between explanatory variables and ecosystem functions in each structural equation were compared.

The structural equation model was used to analyze the relationship between the richness and functional diversity of dominant species and the single function of the ecosystem. It was also used to compare the relative importance of the niche selection hypothesis and niche complementarity hypothesis in explaining plant diversity in arid areas. Before building the model, a priori assumptions were needed. Hypothesis: (1) The richness of the dominant species has a direct effect on the diversity of community functions and ecosystem functions; (2) The richness of the dominant species leads to the change of ecosystem function by affecting plant functional traits.

Data processing and analysis were completed by SPSS 22.0, and the structural equation model was constructed by AMOS.

3. Results and Analysis

3.1. Response of Soil Nutrients to Abundance and Functional Diversity of Dominant Species

The relative frequency of *Nitraria tangutorum* was 93.6% in the 80 30 m $\times$ 30 m quadrats, and *Nitraria tangutorum* was identified as the dominant species. There was no significant correlation between the richness *Nitraria tangutorum* and the function of the soil ecosystem (Table 1), However, there was a significant linear relationship between the species richness index and soil available phosphorus ($p < 0.05$), and there was a significant correlation between the functional uniformity index and soil organic matter ($p < 0.05$). There was also a very significant correlation between the functional dispersion index and soil available phosphorus content ($p < 0.05$). The richness of dominant species does not directly affect ecosystem functions, but the functional diversity directly affects the content of soil available phosphorus and organic matter. This indicates that the response of ecosystem functions to the richness of dominant species in this arid desert ecosystem was not significant compared to the influence of functional diversity.

Table 1. The response of ecosystem functions to the abundance and functional diversity of dominant species.

Functional Diversity Indices	Ecosystem Function	Fitting Equation	R^2	*p*
SR	SAP	y = −0.1x + 17.134	0.004	0.569
	SOC	y = 0.279x + 14.258	0.015	0.289
	SNN	y = −0.181x + 15.742	0.109	0.340
	SAN	y = 0.671 + 10.979	0.181	0.110
FRic	SAP	$y = -0.013x^2 + 0.562x + 8.017$	0.085	0.012
	SOC	y = 0.057x + 13.335	0.080	0.481
	SNN	y = 0.045 + 13.451	0.088	0.441
	SAN	y = −0.122x + 14.343	0.108	0.344
FEve	SAP	y = 0.004x + 0.505	0.022	0.192
	SOC	y = 0.008x + 0.0536	0.238	0.034
	SNN	y = 0.0002x + 0.568	0.0001	0.932
	SAN	y = −4.45x + 0.569	0.0001	0.995
FDiv	SAP	y = 0.012x + 0.613	0.181	0.0001
	SOC	y = 0.004x + 0.805	0.012	0.337
	SNN	y = 0.003x + 0.815	0.01	0.372
	SAN	y = −0.002x + 0.837	0.001	0.751
FDis	SAP	y = −0.015x + 1.503	0.02	0.211
	SOC	y = 0.009x + 1.2	0.003	0.626
	SNN	y = 0.011x + 1.209	0.009	0.401
	SAN	y = 0.04x + 0.972	0.026	0.158

Note: SR, FRic, FEve, FDiv, FDis, SNN, SAN, SOC, and SAP respectively represent species richness, functional richness index, functional uniformity index, functional dispersion index, soil nitrate nitrogen, soil ammonium nitrogen, soil organic matter, and soil available phosphorus.

3.2. Relationship between Functional Diversity and Plant Characters and Soil Environment

In this study, plant functional traits included plant height (H), specific leaf area (SLA), leaf C, N, P content (LCC, LNC, LPC). Soil factors included soil water content (SWC), and soil salt content (SSC). Functional diversity index included functional uniformity (FEve), functional dispersion index (FDis), and functional richness (FRic)

The relationship between ecosystem function, plant functional traits, and soil water and salt content and the RDA ranking of ecosystem function, plant functional traits, and soil factors is shown in Table 2. There was a positive correlation between nitrate nitrogen and ammonium nitrogen and soil moisture content, and soil moisture content has a great influence on it. There was a positive correlation between plant organic matter content and SSC. FDiv was greatly affected by soil available phosphorus content.

Table 2. The importance of plant functional diversity, soil factors, and traits on ecosystem functions.

Impact Factor	Explanatory Quantity%	*p*
SSC	47.5	0.002
SWC	35.1	0.004
LPC	30.0	0.004
LCC	29.7	0.004
H	21.8	0.014
FDiv	19.1	0.006

Note: SSC, SWC, LPC, LCC, H, and FDiv respectively represent soil salt content, soil water content, leaf phosphorus content, leaf carbon content, plant height, and functional dispersion.

The Monte Carlo method was used to test the significance of correlation among plant traits, soil factors, and ecosystem functions. The main influencing factors of related factors on ecosystem functions were judged according to the decision coefficient R2. The results are shown in Figure 2. The order of importance of factors affecting ecosystem function was soil salt content (47.5%) > soil water content (35.1%) > leaf P content (30.0%) > leaf C content (29.7%) > plant height (21.8%) > plant function dispersion (19.1%). Among them, LCC and H had significant negative effects on organic matter and available phosphorus ($p < 0.05$), and soil water content had a significant positive correlation with nitrate nitrogen and ammonium nitrogen ($p < 0.05$).

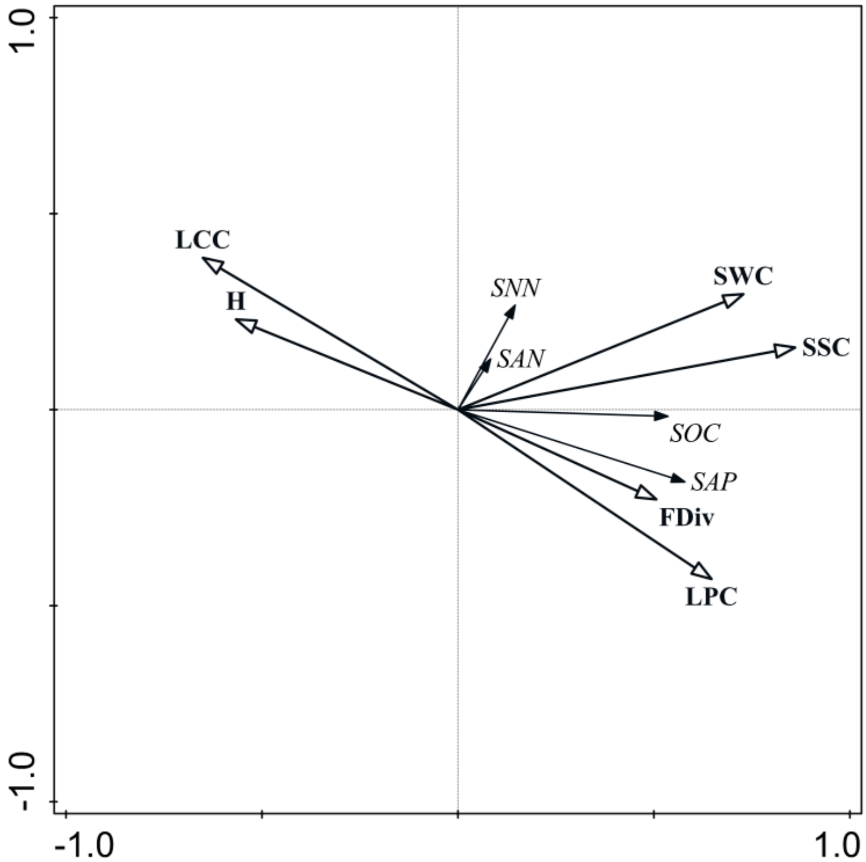

Figure 2. RDA ordination diagram of plant functional diversity, soil factors, traits, and ecosystem functions. Note: SSC, SWC, LPC, LCC, H, FDiv, SNN, SAN, SOC, and SAP respectively represent soil salt content, soil water content, leaf phosphorus content, leaf carbon content, plant height, functional dispersion, soil nitrate nitrogen, soil ammonium nitrogen, soil organic matter, and soil available phosphorus.

3.3. The Relationship between Ecosystem Functions and the Richness and Functional Diversity of Dominant Species

The ecosystem functions, richness of dominant species, and functional diversity were sorted by RDA (Figure 3) and the explanatory quantities are shown in Table 3. The first two axes explain 11.2% of the relationships between ecosystem functions and species richness and functional diversity. FEve had a positive correlation with ammonium nitrogen and organic matter. Available phosphorus was greatly affected by the positive correlation of FDiv. FDis had a strong response to ammonium nitrogen content in plants. The Monte Carlo method was used to test the significance of correlation among plant traits, soil factors, and ecosystem functions. The main influencing factors on ecosystem functions were judged according to the decision coefficient R^2, and the results are shown in Figure 3. Only FDiv had a significant positive correlation with available phosphorus, and its explanatory value was 41.6%. As for SR rich in dominant species, its influence on ecosystem function was not significant.

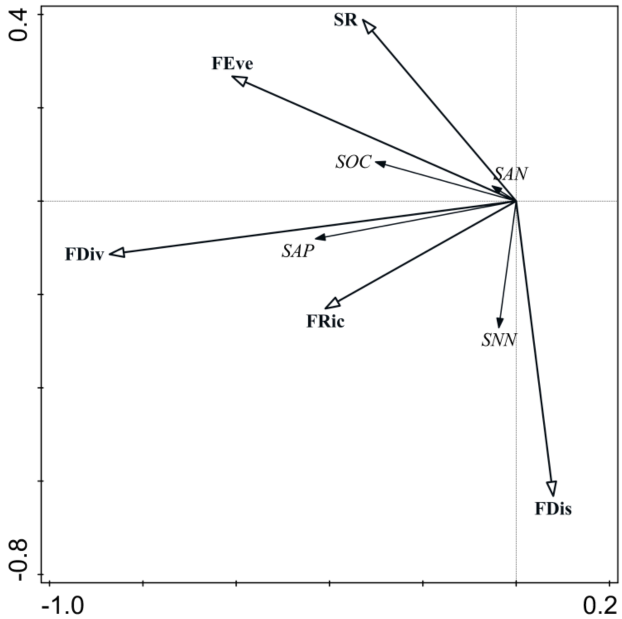

Figure 3. RDA sequence diagram of dominant species *Nitraria* abundance, functional diversity, and ecosystem function. Note: SR, FEve, FDiv, Fric, FDis, SNN, SAN, SOC, and SAP respectively represent Nitraria tangutorum abundance, function uniformity, function dispersion, function richness, function dispersion index, soil nitrate nitrogen, soil ammonium nitrogen, soil organic matter, and soil available phosphorus.

Table 3. Ranking of the importance of dominant species *Nitraria* abundance and plant functional diversity on ecosystem functions.

Impact Factor	Explanatory Quantity%	*p*
FDiv	41.6	0.02
FEve	24.3	0.094
FDis	20.7	0.174
SR	16.3	0.228
FRic	11.1	0.42

Note: SR, FEve, FDiv, FRic, and FDis respectively represent *Nitraria tangutorum* multiplicity, functional uniformity, functional dispersion, functional richness, and functional dispersion index.

3.4. The Action of Dominant Species Richness and Functional Diversity on Ecosystem Functions

The results of the fitted structural equation model (SEM) showed that the effects of species richness and species functional diversity of dominant species on ecosystem functions were different (Figure 4). Figure 4a shows the direct relationship between dominant species richness and functional diversity and soil organic matter; Figure 4b shows the direct relationship between dominant species richness and functional diversity and soil available phosphorus and Figure 4c shows the direct relationship between dominant species richness and functional diversity, plant functional traits (specific leaf area), and soil available phosphorus. Dominant species richness had a significant direct positive effect on FRic ($p < 0.05$), with a direct effect of 0.253. The direct effect of species richness of dominant species on FEve and FDiv was not significant ($p > 0.05$). FEve had a highly significant ($p < 0.05$) direct positive effect on ecosystem function–soil available phosphorus content, and its direct effect was 0.228. FRic also had a highly significant positive effect on FDiv ($p < 0.05$) with a direct effect of 0.451. There was no significant direct effect between FEve and FRic and FDiv ($p > 0.05$). FEve also had a highly significant effect on soil organic matter content ($p < 0.05$) with a direct effect of 0.226; There was a highly significant ($p < 0.05$) negative effect between specific leaf area and FDiv, and its direct effect was −0.641; FDiv had a highly significant positive effect on soil available phosphorus ($p < 0.05$), and its direct effect was 0.422.

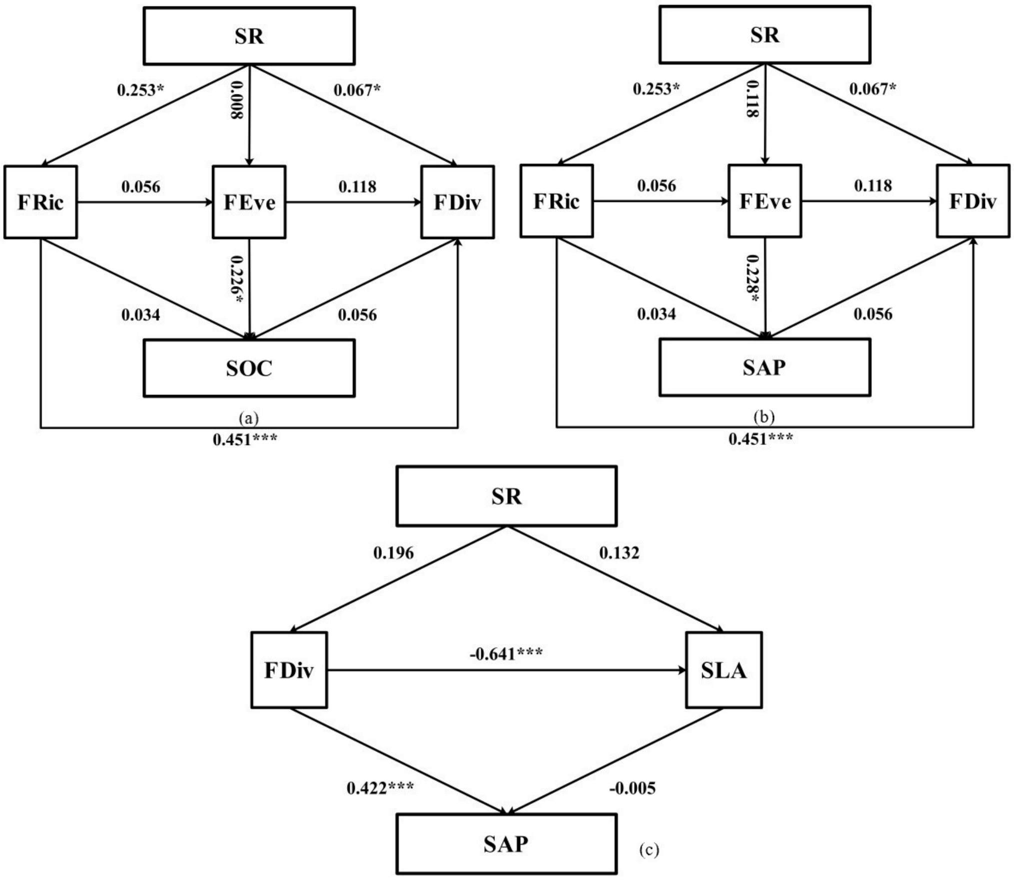

Figure 4. The abundance and functional diversity of dominant species *Nitraria* and the functional mechanism equation of a single ecosystem. Note: SR, FEve, FDiv, Fric, SOC, and SAP respectively represent *Nitraria tangutorum* abundance, functional uniformity, functional dispersion, functional richness, soil organic matter, and soil available phosphorus. Negative value of the path coefficient in the figure indicates a negative effect, and the number next to the arrow is the standardized path coefficient. "***", $p < 0.001$; "*", $p < 0.05$.

4. Discussion

4.1. Relationship between Functional Diversity, Plant Characters, and the Soil Environment

Plant functional traits determine the growth and survival of plants, which is a concrete manifestation of plant response to the environment. We found a significant negative correlation between plant height, LCC, and soil moisture content, which is contrary to the positive correlation between plant functional traits and soil moisture obtained previously [43]. The factors limiting plant growth in the Ebinur Lake Basin may be determined by the combination of soil moisture and salt, rather than soil moisture alone, and this combination affects plant growth and survival. We found a positive correlation between soil nitrate nitrogen and ammonium nitrogen and soil moisture content, which is consistent with the influence of soil moisture on soil nitrate nitrogen and ammonium nitrogen seen in other studies [44]. Because soil nitrogen content changes with the movement of soil internal moisture, soil moisture directly determines the content of soil nitrogen. There was a significant relationship between soil organic matter and soil salt content, which is consistent with the results of Fang et al. [45]. This indicates that soil salt and soil organic matter jointly affect the soil function in the arid area of Ebinur Lake Basin.

In the process of evolution, plant characteristics respond to the environment through the coordination of various functional traits. There are many correlations among plant functional traits, and trade-offs are the most common. In the process of plant evolution, plant adaptation to the whole environment will be formed through trade-offs and functional changes [46]. There was a significant correlation between plant functional traits in this study which is consistent with previous research. For example, in resource-rich areas, larger specific leaf area, higher plant height and higher photosynthetic rate and productivity correspond to each other, so as to adapt to the competitive environment of multi-species coexistence [47]. The negative correlation between specific leaf area and leaf dry matter content was highly significant, which is consistent with the research conclusions of Zhang et al. [48]. To sum up, plants adjust their strategies of resource utilization and allocation through the mutual balance or synergistic changes among functional traits to adapt to specific habitats [49].

4.2. Functions of Functional Diversity and Dominant Species on Ecosystem Functions

The multi-functions of ecosystem are the result of many factors, and ecosystem functions are complementary or relative [50], As such, it is necessary to discuss the functions of multiple ecosystems. Functional diversity can predict ecosystem function better than species diversity. The higher the functional diversity of a community, the higher the degree of intermediate variation of plant functional traits and the stronger the niche differentiation. This allows the plant community to make full use of environmental resources. A high richness index indicates that the functional characters of the whole community will become richer after the superposition of individual species characters. The niche will then be fully occupied and the ecosystem function will be more stable [51]. In this study, there was a highly significant correlation between FDiv and soil available phosphorus, which indicates that, in arid areas, the main factors affecting plant traits are available nutrients, and the available nutrients of phosphorus are restrictive. This finding is consistent with the results of other studies demonstrating that the main components affecting plant functional traits are available nutrients. The functional uniformity index FEve measures the distribution of plant characters in the occupied character space. The higher the index, the stronger the distribution regularity of plant characters and the similar the utilization degree of various natural resources [35]. In this study, there was a highly significant correlation between FEve and soil organic matter, indicating that community functional diversity has a positive impact on ecosystem versatility. This is consistent with the significant relationship between functional richness and soil organic matter in the Xishuangbanna tropical rain forest [52]. The results indicate that soil organic matter content has a significant impact on functional diversity in both arid and tropical rain forest areas.

There is no single specific and effective method to measure all components of biodiversity so research on biodiversity and ecosystem versatility focuses on species richness, functional diversity, and phylogenetic diversity, and explores other diversity indicators to reveal the potential mechanisms of ecosystem function (selective effect and niche complementary effect). This study showed that the richness of dominant species had no significant effect on ecosystem function, which is consistent with previous results [53]. Our data indicated that the complementary effect is stronger than the selective effect in an arid region ecosystem and arid region plants maintained higher biodiversity to maximize their uptake of environmental resources. We found no significant correlation between the richness of dominant species and the specific leaf area of plants in the community, but there was a significant correlation between the specific leaf area and FDiv. FDiv is significantly related to the content of available phosphorus in the soil, which is related to other studies, in which only the specific area of leaves provides a strong explanation for ecosystem functions [54].

5. Conclusions

The relationship between desert plants and ecosystem functions in arid areas was evaluated from the perspectives of dominant species richness and community functional diversity. There was no obvious relationship between the richness of the dominant species, *Nitraria tangutorum*, and four ecosystem functions, and the correlation between species richness and ecosystem was limited. The data showed that the effect of functional diversity on ecosystem functions was greater than the richness of dominant species. When considering multiple ecosystem functions, the selective effect may not have an advantage. Therefore, when exploring ecosystem functions, functional diversity is more important than dominant species. This means that the utilization of plant resources in arid areas is complementary and the complementary effect is more important in arid areas. Among desert plants in arid areas, species with different traits contribute more to the multi-functioning of the ecosystem than species with similar functions. This is conducive to maximizing the utilization of resources by plants in arid areas under the condition of limited resources.

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