ARCHIVOS LATINO AMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 70 N °3 (2020) pp. 317-325

Efectos de la nutrición del agua vegetal y la construcción de edificios en los microorganismos del suelo

Effects of Plant Water Nutrition and Building Construction on Soil Microorganisms

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Resumen
Los microorganismos en el suelo juegan un papel muy importante en la descomposición del material. Como parte importante del ecosistema, los actinomicetos del suelo, las bacterias y los hongos son muy sensibles a los cambios ambientales. El número de microorganismos del suelo determina la transformación de los nutrientes del suelo y la formación de estructuras agregadas del suelo, y tiene un impacto importante en la absorción de la fertilidad de las plantas, el transporte de materiales y la transformación. El documento analiza los efectos de la nutrición del agua de las plantas y la construcción de edificios en los microorganismos del suelo. El impacto de la construcción del proyecto en los tres microorganismos del suelo tiene diferentes grados de impacto, y tiene un gran impacto en la reducción de bacterias y hongos de 0-40 cm en el suelo de la superficie Los tres microorganismos principales son los más abundantes en diferentes hábitos perturbados. ats, y hay pocos hongos y actinomicetos. Hubo diferencias obvias de distribución vertical en el número de microorganismos del suelo en los hábitats perturbados y no perturbados. Excepto que la cantidad total de microorganismos en el patio de escoria abandonado aumentó a medida que la capa de suelo se profundizó, el total La cantidad de microorganismos en los otros cuatro hábitats disminuyó a medida que aumentó la profundidad de la capa de suelo.

Palabras clave: Eutrofización del cuerpo de agua; Purificación de plantas; Construcción de ingeniería; Microorganismo del suelo

Abstract
Microorganisms in the soil play a very important role in material decomposition. As an important part of the ecosystem, soil actinomycetes, bacteria and fungi are very sensitive to environmental changes. Soil microorganisms play a huge role in biodegradation in the material cycle and transformation, and are an indispensable part of maintaining the ecological balance in the entire biosphere. The number of soil microorganisms determines the transformation of soil nutrients and the formation of soil aggregate structures, and has an important impact on plant fertility absorption, material transport, and transformation. This paper analyzes the effects of plant water nutrition and building construction on soil microorganisms. The impact of project construction on the three soil microorganisms has different degrees of impact, and it has a huge impact on the reduction of 0-40cm bacteria and fungi in surface soil. The three major microorganisms are the most abundant in different disturbed habitats, and there are few fungi and actinomycetes. There were obvious vertical distribution differences in the number of soil microorganisms in the disturbed and undisturbed habitats. Except that the total amount of microorganisms in the abandoned slag yard increased as the soil layer deepened, the total amount of microorganisms in the other four habitats decreased as the depth of the soil layer increased.

Key words: Eutrophication of water body; Plant purification; Engineering construction; Soil microorganism

1. Introduction

Researchers generally believe that dry and hot valleys are ecologically fragile and hostile environments. The main reasons for this environment are the scarce rainfall, the dry environment, and the uneven hydrothermal resources [1]. At present, the development of hydropower facilities is considered to have a small impact on the environment. Due to the renewable resources, it can be used for a long time. It is currently an energy source that can be better used, and has been highly valued. However, when constructing hydropower facilities, large-scale landform vegetation will be destroyed [2]. If the development is not reasonable, it will cause damage to ecologically fragile areas such as dry and hot river valleys in Yunnan Province [3]. Therefore, it is of great significance to study how to rationally develop water resources and reduce damage. Among them, the research on the impact of hydropower project construction interference is particularly important.

Microorganisms in the soil play a very important role in material decomposition. As an important part of the ecosystem, soil actinomycetes, bacteria and fungi are very sensitive to environmental changes. Soil microorganisms play a huge role in biodegradation in the material cycle and transformation, and are an indispensable part of maintaining the ecological balance in the entire biosphere [4-5]. The number of soil microorganisms determines the transformation of soil nutrients and the formation of soil aggregate structures, and has an important impact on plant fertility absorption, material transport, and transformation [6]. Therefore, in soil quality evaluation, microorganisms, one of the most sensitive indicators of soil change, have been paid more and more attention by researchers.

This study studies the effects of disturbances on the construction of hydropower projects in ecologically fragile dry and hot valleys on the number and total number of soil microorganisms (bacteria, fungi, and actinomycetes), with a view to exploring soil microorganisms in their native habitats under the disturbance of the project The change in quantity provides a scientific basis for soil microbiology for the restoration and reconstruction of the ecosystem in the hydropower construction zone, and provides microdata for the change and prediction of soil microorganisms in the ecosystem in the construction zone [7].

2. Materials and Methods

2.1 Plant Cultivation

22 kinds of plants are selected by the streams and ponds in the suburbs. The soil is washed, planted in the plant pre-cultivation container Logatainer (Germany), and the Logatainer is placed in a plastic box. 20 cm deep water (about 10 kg) is cultured and replaced once a week. Water [8]. After 2 to 4 weeks of planting, 14 species of plants were found to grow well, and the remaining species with poor growth were removed. Due to the difference in the initial quality of the individual plant materials, after two months of adaptive cultivation in water, the species Biomass is still different due to different growth capabilities. However, the planting and growth density of each species is basically the same. Calculating the removal rate of pollutants by different plants in the same area makes the test results comparable, and this is comparable to that in ecological engineering. The selection of materials in actual cultivation is consistent [9].

Considering that plants have different problems in purifying water bodies with different levels of eutrophication, two treatments were designed: (1) Totally eutrophic water, total nitrogen (TN) 0.9-4.57mg L-1, total phosphorus (TP) 0.2-0.60mg L-1, Kjeldahl nitrogen (TN-NO3-) 04-052mg L-1; (2) Severe eutrophic water, TN: 55.01mg L-1, TP: 10.86mg L-1, LNO3-22.76mg L-1 ,.

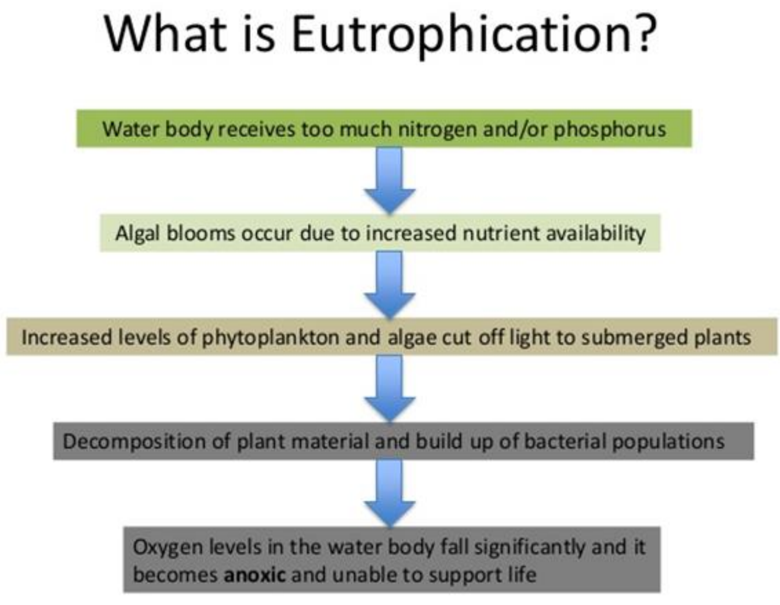

Figure 1. Eutrophication of Water Body

2.2 Plant Purification Eutrophic Water Test

The test was started when the water was changed on July 7, 1997. The Logatainer and the plants planted therein were washed with water (without damaging the root system), air-dried (10 min), and weighed; 10 kg of water was added to each box. Water samples were taken on the 3rd and 5th degrees of eutrophic water, and water samples were taken on the 4th and 6th days of heavy eutrophic water, and the weight of the water in the box was used to convert the total amount of TN, TP, NO_3^- and Moisture reduction.

Water samples were measured on the same day. Among them, TN and TP were measured simultaneously by potassium persulfate oxidation method [6], and NOF was measured by electrode method. The formula for the removal rate is: removal rate (%) = $(C_0 \cdot V_0 - C_i \cdot V_i) \div (C_0 \cdot V_0) \times 100\%$. Where Co is the initial concentration, Vo is the initial volume, and Ci is the i-th Day concentration, Vi is the volume of water on day i.

In the past static experiments, some have added distilled water or tap water to keep the water volume constant, thereby observing the decrease in the concentration of the measured index. However, this method has certain problems: on the one hand, the water volume reduction caused by water evaporation and plant transpiration is a naturally occurring process, and artificial water addition cannot reflect the process under natural conditions; on the other hand, after adding water, the water where the plants are located The nutritional concentration of the plant is artificially diluted, and the absorption behavior of the plant changes [10-11]. The absorption capacity in the diluted nutrient concentration is weakened, which affects the purification effect. Considering the above reasons, this experiment simulates the situation in the natural state without adding water. Instead, the removal rate is calculated by weighing the water and converting the total amount of the observed indicators. Therefore, the purification effect of the water in this test is more consistent with the natural state [12].

3. Discussion

There is no corresponding relationship between the quality of plants and the removal rate of pollutants. If the indicators of removal rate of pollutants are compared using unit mass plants, it is found that the removal rate of eutrophic water per unit area by plants with high removal rate per unit weight is Not high because the quality cannot be improved per unit area [13].

In mildly eutrophic waters, it is impossible for plants to obtain sufficient amounts of N and P required for growth, growth is inhibited, and biomass is low, so it is necessary to choose to be able to grow in poor conditions and have high purification capacity Plants [14]. The purification effect of heavily eutrophic water is better than that of light eutrophic water. Whether the purification ability is reduced due to poor growth in light eutrophic water should be further studied.

Water hyacinth and water spinach are recognized as plants with good purification effect on eutrophic water. In this experiment, these two kinds of plants were selected as reference species [15]. The experiments show that the water purification effect of water spinach is consistent with the existing research rules.

Further analysis of the biological and ecological characteristics of various plants, water hyacinth is aquatic plants, its purification ability is very strong, but the expansion ability is too strong and easy to flood, causing harm, it needs to be controlled in water. Anemone, amaranth, leaf sorrel, three annual plants with larger leaves, the available time in the central subtropical region is from March to November; the iris, hemerocallis, rhizome, and carex dome are perennial linear leaves Or strip-shaped plants, although the purification effect is slightly worse than the previous plants, but can be used in all seasons. The purification effect of celery is also good, but it is only suitable for short-term use [16]. The plant can stand upright under high density, has a good appearance, and is more suitable for planting in water.

Figure 2. Purification of Eutrophic Water by Plants

4. Regional Profile and Research Methods

4.1 Research Site Overview

A ground hydropower station construction area [17]. The installed capacity of the hydropower station is 240MW, which is a medium-sized power station with an altitude between 2060-2640m. It is a typical dry and hot valley area, and the vegetation covered in most areas is sparse grass shrubs and dry heat valleys and mulberry shrubs. Only a small amount of dry and hot valley hard-leaved evergreen oak forest and mountain jute remain in the valley Mixed forest [18]. The total area of the project is 714.9hm^2, of which the construction area is 392.10hm^2, and the reservoir submerged area is 322.80hm^2. The main types of land occupation are farmland, shrubland and woodland [19]. Temporary land occupation during construction is mainly abandoned slag yards and construction access roads. Therefore, the two types of construction disturbances selected in this paper are abandoned slag yards and construction access roads, and the three types of uncontrolled habitats are farmland, shrubland, and woodland.

4.2 Research Method

4.2.1 Collecting soil samples

In the above two types of construction interference areas and three types of undisturbed original landforms, a five-point mixing method was used to collect soil samples at three levels of 0-20, 20-40, and 40-60 cm, and three points of soil samples were randomly selected for layering and mixing. 10 mixed soil samples were taken from each layer of each habitat type, for a total of 150 soil samples. Remove the excess soil sample according to the quarter method, leave about 1kg in a sterile polyethylene bag, seal it, and bring it back to the laboratory quickly. Keep it in a refrigerator at -4 ℃ (no more than 24h), and then immediately isolate various types of microorganisms. And counting asked [20].

4.2.2 Microbiological method

(1) Determination of the number of bacteria. Bacterial culture was carried out by Xu Guanghui and other methods. The specific operation process is as follows: Weigh 10g of fresh soil sample, prepare 10-1, 10-2 gradient suspension with sterile water, take 50 L of these two concentrations of suspension, inoculate in the culture medium, each The concentration was repeated 3 times. The inoculated medium was incubated at 28 °C for 3 days, and the number of colonies was counted.

(2) Determination of the number of fungi. Martin-Bengali red medium was used to count the surface of the plate. Except for 5-7 days of constant temperature (25 ℃) culture, other methods are the same as the method for determining the number of bacteria [21]. The above method and formula are used to count the number of colonies and calculate the number of fungi.

(3) Determination of the number of actinomycetes. The modified Gaucher's No. 1 medium was used to count the surface of the plate. The method is the same as the method for determining the number of bacteria, except that 50 L of soil suspensions with dilutions of 10-3 and 10-4 are each taken and inoculated in sterilized modified Gao 1 medium. Cultivate at a constant temperature (28 ℃) for 7-10 days. Count the number of colonies and calculate the number of actinomycetes according to the above method and formula.

4.3 Statistical Analysis Methods

LSD single factor analysis of variance (ANOVA) was used to compare the differences in the number of bacteria, fungi, and actinomycetes between the layers of soil in five habitats. The above statistical tests were performed using SPSS13.0 (Chicago, IL, USA) software. All statistical analysis significance levels were set at $P < 0.05$.

4.4 Results and analysis

4.4.1 Distribution of soil bacteria in disturbed and undisturbed habitats

Because soil bacteria play an important role in soil material cycling, it is one of the most important groups of soil microorganisms. Through the measurement, it was found that the disturbance of engineering construction significantly reduced the number of soil bacteria in 0-60cm (Table 1). In the 0-20cm soil layer, the largest number of bacteria is undisturbed forest land, 15.392 $\times 10^4$ / g, followed by shrub land 13.240 $\times 10^4$ / g, farmland 5.129$\times 10^4$ / g; abandoned slag disturbed by construction The number of bacteria in the field and the construction access road were only 1.321 $\times 10^4$ / g and 1.691 $\times 10^4$ / go20-40cm soil layers, and the distribution of the number of bacteria was consistent with the 0-20cm soil layer. The number of bacteria in the 40-60cm soil construction road was significantly lower than the other four habitats, and there was no significant difference in the number of bacteria between the other four habitats. The reason may be that the construction access road has a greater impact on the deep soil, and the abandoned slag yard has little impact on the deep soil [22].

Table 1: Number of Soil Bacteria in 0-60 cm of Disturbed and Disturbed Habitats

	0-20(cm)/ (10^4/g)	20-40(cm) (10^4/g)	40-60(cm) (10^4/g)

Spoil yard	1.6	2.0	4.0
Construction access road	2.1	0.8	4.5
Woodland	15.6	7.8	4.0
Shrubland	13.8	7.6	4.0
Farmland	5.8	4.0	4.0

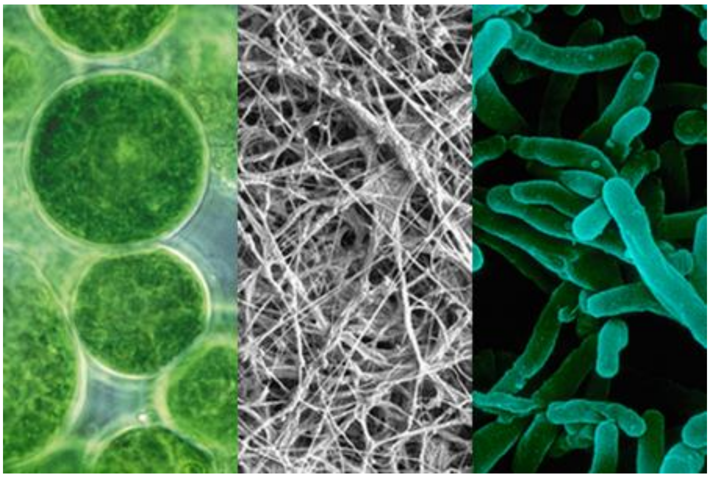

Figure 3. Soil Microorganism

4.4.2 Distribution of soil fungi in disturbed and undisturbed habitats

Soil fungi are a class of eukaryotic microorganisms that exist in the form of mycelia and spores in the soil. They are numerous and widely distributed. Fungal diversity has played an important role in maintaining the ecological balance of the biosphere and providing humans with a large amount of untapped biological resources. Fungi constitute most of the microbial biomass in the soil, have the function of decomposing organic matter and providing nutrients for plants, and are indicators of ecosystem health. Through the measurement, it was found that the disturbance of the project construction significantly reduced the number of 0-20 cm soil fungi (Table 2). In the 0-20cm soil layer, the largest number of fungi is undisturbed forest land, 23.433x102 pcs / g, followed by shrub land 20.917×10^2 pcs / g, farmland 12.655×10^2 pcs / g; abandoned slag yards disturbed by engineering construction The number of fungi in the construction road is only 1.082×10^2 / g and 0.597×10^2 / g. In the 20-40cm soil layer, the number of fungi in woodland and shrubs is the largest, but the difference between the two is not significant; there is no significant difference in the number of fungi in farmland, spoil grounds and construction access roads, but they are significantly lower than those of woodland and shrubs. There was no significant difference in the number of fungi in the farmland of 40-60cm soil layer, abandoned slag yard and construction access road, which were also significantly lower than those in the forest land and shrub, but the number of fungi in the forest land was significantly higher than that of the shrub [23].

Table 2: Number of Soil Fungi in the Disturbed and Disturbed Habitats 0-60cm

	0-20(cm)/(10^2/g)	20-40(cm)/ (10^2/g)	40-60(cm)/(10^2/g)
Spoil yard	1.6	0.3	0.2
Construction access road	0.6	0.8	0.2
woodland	24.8	5.1	4.6
Shrubland	21.3	4.7	2.5
Farmland	13.6	1.5	0.4

4.4.3 Distribution of actinomycetes in disturbed and undisturbed habitats

Actinomycetes are also widely distributed in the soil. They are a class of microorganisms with important economic value and multiple uses. They are widely distributed in nature. Most of them are saprophytic, and a few are parasitic. They have unique synthetic complex structures. The ability of secondary metabolites is the main source of many antibiotics and other biologically active substances. Through the measurement, it was found that the influence of project construction disturbance on the quantity of actinomycetes in each layer of soil was different. In the 0-20cm soil layer, the number of actinomycetes in the woodland was 2.387×10^2 / g, which was significantly higher than the other four habitats, and the difference in the number of actinomycetes between the four habitats was not significant. The number of actinomycetes in the 20-40cm soil layer was not significantly different among the abandoned slag yard, construction access road, and forest land, which were all higher than that of shrubs and farmland. The difference in the number of actinomycetes in the 5 habitats in the 40-60cm soil layer is consistent with the change in the 20-40cm soil layer, Table 3.

Table 3: Number of Actinomycetes in the Soil from 0 to 60 cm of Disturbance

	0-20(cm)/(10^2/g)	20-40(cm)/ (10^2/g)	40-60(cm)/(10^2/g)
Spoil yard	1.0	1.8	1.9
Construction access road	1.1	2.1	2.6
Woodland	2.4	2.3	1.7
Shrubland	1.4	1.3	0.8
Farmland	1.2	0.8	0.6

The above research results on bacteria, fungi and actinomycetes also show that soil fungi and bacteria are mostly distributed in the soil surface layer in each habitat, and decrease with the increase of soil depth. Disturbed interference. As for actinomycetes, the disturbance of project construction only reduces the number of actinomycetes in the surface 0-20cm soil, and has little effect on the deep 20-60cm.

4.4.4 Total number distribution of three major microorganisms in disturbed and undisturbed habitats

The comparison of the total number of three soil microorganisms in five different disturbance habitats is shown in Table 4. It can be obtained from Table 4 that in the 0-60cm soil layer, the total number of soil bacteria, the abandoned slag yard disturbed by the construction is 6.603 ×104 pieces / g, and the construction access road is 2.545 × 10^4 pieces / g, which is much lower than that of the undisturbed ones. Forest land 27.382× 10^4 pcs / g, shrubs 24.420 × 10^4 pcs / g, farmland 12.410 × 10^4 pcs / g; total soil fungi are also 1.346 × 10^2 pcs / g in abandoned slag yards disturbed by engineering construction, and construction access roads are 1.750 × 10^2 / G, which is much lower than 33.620 × 10^2 pcs / g of undisturbed forest land, 27.977 × 10^2 pcs / g of shrubland, 13.717 × 10^2 pcs / g of farmland; the total number of soil actinomycetes is the waste slag yard disturbed by construction 4.791 × 102 pcs / g, construction access road is 5.788×10^2 pcs / g, lower than undisturbed forest land of 6.337 × 10^2 pcs / g, but higher than undisturbed shrub land of 3.483 × 10^2 pcs / g and farmland of 2.527×10^2 pcs / g.

Table 4: Total Amount of Three Major Microorganisms in the Soil from 0 to 60 cm

	Bacteria / (10^4 / g)	Fungi / (10^2 / g)	Actinomycetes (10^2 / g)
Spoil yard	8.0	2.5	4.3
Construction access road	3.2	2.5	5.5
Woodland	28.5	33.6	6.1
Shrubland	26.5	28.5	3.8
Farmland	13.5	12.5	3.4

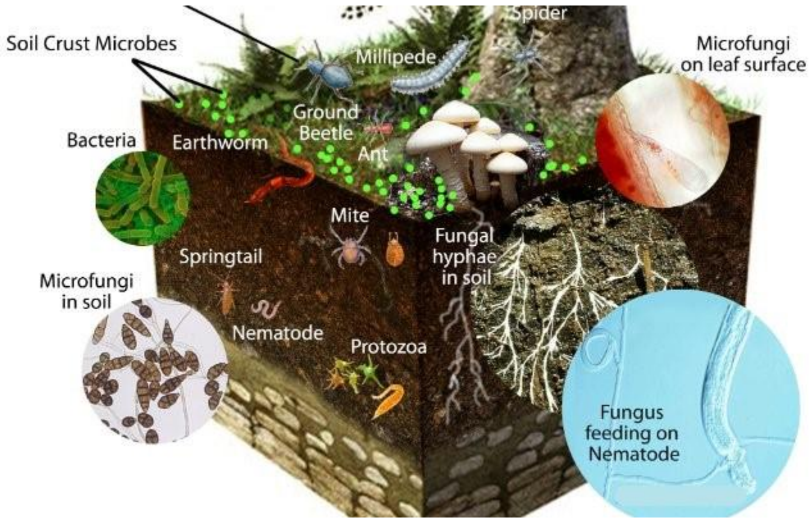

Figure 4. Distribution of Soil Microorganism

The vertical distribution of the total number of three major microorganisms in each layer of soil under five different disturbance habitats. Except that the total amount of microorganisms in the abandoned slag yard increased with the deepening of the soil layer, the total number of microorganisms in the other four habitats increased with the depth of the soil layer. Increase and decrease. The habitats disturbed by the project construction (abandoned slag yards, construction access roads) have a small amount of soil microorganisms in the surface layer; while in the undisturbed habitats (forest land, shrubland, farmland), most of the soil microorganisms are distributed on the surface layer, which deepens with the soil Its number decreases.

In the 0-60cm soils of 5 different habitats, no matter whether the project construction disturbed the habitat or the undisturbed habitat, the number of bacteria was the largest, accounting for more than 97%, and the number of fungi and actinomyces accounted for only a small proportion (Table 5).

Table 5: Percentage of Bacteria, Fungi, and Actinomycetes in 0-60 cm Soils in Disturbed and Undisturbed Habitats

Environment type	Bacterial	Fungus	Actinomycetes
Spoil yard	99.020	0.262	0.719
Construction access road	97.126	0.667	2.207
Woodland	98.562	1.210	0.228
Shrubland	98.728	1.131	0.141
Farmland	98.708	1.091	0.201

5. Conclusion

(1) The impact of project construction disturbance on the three soil microorganisms varies in degree, and it has a huge impact on the reduction of bacteria and fungi in surface soil 0-40cm. The three major microorganisms are the most abundant in different disturbed habitats, and there are few fungi and actinomycetes. The number of bacteria accounts for more than 97%, which basically determines the total number of three major microorganisms in the soil. In the 0-20cm soil layer, the bacteria that do not disturb the habitat are 11.2 times that of the disturbed habitat, the fungi that do not interfere with the habitat are 34.0 times that that interfere with the habitat, and the actinomycetes that do not interfere with the habitat are 2.2 times that that interfere with the habitat; at 20-40cm In the soil layer, the bacteria that did not disturb the habitat were 8.0 times that of the disturbed habitat, the fungi that did not interfere with the habitat were 9.3 times that disturbed the habitat, and the actinomycetes that did not disturb the habitat were 1.1 times that disturbed the habitat; in the 40-60cm soil layer, The bacteria that did not disturb the habitat were 3.1 times that of the disturbed habitat, the fungi that did not disturb the habitat were 11.5 times that disturbed the habitat, and the actinomycetes that did not disturb the habitat were 0.7 times that disturbed the habitat. While large-scale hydropower projects benefit mankind, its construction has also caused a serious impact on the surrounding ecological environment. Under the disturbance of construction, the soil microbial ecosystem has been degraded to varying degrees, and the number of three major microorganisms has been greatly reduced. In order to change the status quo, it is necessary to improve the matrix of the construction disturbance area, increase the vegetation cover, gradually improve the physical and chemical properties of the soil, improve the soil fertility quality, and then restore the soil microbial community, and reduce the impact of hydropower construction on it.

(2) There are obvious vertical distribution differences in soil microbial populations in disturbed and undisturbed habitats. Except that the total amount of microorganisms in the abandoned slag yard increased as the soil layer deepened, the total amount of microorganisms in the other four habitats decreased as the depth of the soil layer increased. The habitats disturbed by the project construction (abandoned slag yards, construction access roads) have a small amount of soil microorganisms in the surface layer; while in the undisturbed habitats (forest land, shrubland, farmland), most of the soil microorganisms are distributed on the surface layer. The deepening of the number decreases. The vertical distribution of bacteria and actinomycetes showed a gradual decrease with increasing soil depth, with the highest number of fungi on the surface layer. This research result is consistent with the reports of many researchers. The reason is that the uneven distribution of light, temperature, water and air in the soil caused the soil surface layer to have abundant light, temperature, water and air resources and sufficient nutrients for reproduction. Different soil microorganisms have different divisions of labor. Fungi are responsible for the decomposition of organic matter in the soil. The role of actinomycetes is to decompose some difficult-to-decompose substances of animals and plants to form humus, while bacteria mainly decompose simpler and easily-decomposable substances. . Due to changes in the soil material, nutrients and the like gradually decrease as the depth of the soil deepens, forming a vertical difference in the number of microorganisms as the surface soil is more and the depth is less.

(3) The study of microorganisms in the dry and hot valley area under human disturbance is worthy of further research. The Jinsha River dry and hot valley is a typical ecologically fragile region in southwest China. The region has a dry climate and extreme imbalance in water and heat. In recent years, under the disturbance of human activities, the regional ecological function has degraded significantly, and it has become one of the regions where the ecological environment has been seriously degraded. Soil is the core area of material circulation, energy flow and information transmission in terrestrial ecosystems, and its physical, chemical and

biological characteristics are the material basis for ecosystem stability and development. Among them, soil microorganisms directly participate in many ecological processes such as nutrient cycling and organic matter decomposition, which are the driving forces for soil ecosystem material transformation and nutrient cycling. The quantity, distribution, and composition of soil microorganisms greatly affect and determine the soil biological activity, organic matter decomposition, humus synthesis, soil aggregate formation, and soil nutrient transformation. Therefore, soil microbiological characteristics are often used to evaluate soil quality and reflect changes in the status and function of microbial communities. At present, the research work around the dry-hot valley mainly focuses on the effects of vegetation restoration measures, vegetation types, land use methods, etc. on the soil ecosystem; and from the perspective of soil microorganisms, the effects of different human disturbances on the soil ecosystem are discussed Relatively few studies have been conducted, especially regarding the number of soil microorganisms and their characteristics under the disturbance of hydropower construction. Therefore, the dry and hot valley itself, a very fragile ecosystem, coupled with the impact of human engineering construction on the microbial ecosystem, should be given more attention.

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