• 森林动态监测样地专题 •

河南宝天曼落叶阔叶林木本植物 单物种–面积关系

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摘要: 单物种–面积关系(ISAR)方法可判定单个物种在不同空间尺度下对邻域生物多样性的影响作用是促进、抑制或中性。尽管已有研究尝试分析了不同径级大小个体对邻域植物多样性的影响, 但这方面仍缺乏较系统的研究, 对不同径级植株在维持森林群落植物多样性方面的作用差异仍不清楚。本研究以河南宝天曼国家级自然保护区1 ha落叶阔叶林固定样地为例, 通过对全部树(包括大树和小树)分别对全部树/大树/小树, 大树分别对全部树/大树/小树, 小树分别对全部树/大树/小树9种类型的ISAR进行比较分析, 拟验证如下假设: (1)大树相比小树来说对邻域植物多样性的影响更大, (2)同一物种或同一径级个体对邻域小树比对邻域大树的影响要强, (3)宝天曼落叶阔叶林木本植物中中性物种占主体。结果显示不同大小的树木个体对邻域植物多样性的影响作用也因空间尺度、邻域植物个体大小而有所差别: 支持同一物种或同一径级个体对邻域小树比对邻域大树的影响要强的假设, 没有检测到大树比小树对邻域植物多样性更大的影响作用; 中性物种在所研究森林群落中1–10 m尺度上均占绝对优势, 促进种的数量在全部树对全部树, 全部树对小树, 小树对全部树以及小树对小树情况下随着尺度的增加呈先升高后下降的趋势, 抑制种在少数小尺度下被少量检测到。本研究结果有助于我们更好地认识和理解森林群落中物种作用及群落维持机制, 但该结果还需在更大尺度样地以及其他类型的森林中进行检验。

关键词: 单物种–面积关系, 中性种, 生物多样性, 径级, 森林动态监测样地, 宝天曼国家级自然保护区

Individual woody species–area relationship in a deciduous broad-leaved forest in Baotianman, Henan Province

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Abstract: The individual species–area relationship (ISAR) can be used to estimate the effects of individual species (accumulator, repeller, or neutral) on neighboring biodiversity at different spatial scales. The effects of individual species with different sizes (diameter at breast height classes, DBH classes) on neighboring species diversity are still an unresolved question although several papers have addressed this question by using the ISAR. In this study, we compared ISARs of nine types (all to all, all to adult, all to young, adult to all, adult to adult, adult to young, young to all, young to adult and young to young); “young to adult” represents that ISAR of young individuals of target species to adult individuals of neighboring species in a 1 ha deciduous broad-leaved forest in Baotianman National Nature Reserve, Henan Province. We tested the following hypotheses: (1) the adult individuals (DBH ≥ 10 cm) of target species have greater influence on the biodiversity of their neighbors than the young (DBH < 10 cm); (2) the individuals of the same species or the same size class have greater influence on neighboring young tree diversity than adult tree diversity; (3) most spe-

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cies are neutral in the Baotianman deciduous broad-leaved forest. The results showed that the effects of tree species with different sizes on neighboring tree diversity are scale-based and also affected by the size of the neighbor tree. The results supported the hypothesis that individuals of the same species or the same size have greater influence on neighboring young tree diversity than on neighboring adult tree diversity; but did not support that the adult individuals of focal species have greater influence on neighboring tree diversity than young individuals. The results also indicated that most species are neutral at spatial scales of 1–10 m in the Baotianman forest; multiple accumulator or repeller species were detected at some scales. The results will contribute to our understanding of the role of specific species on biodiversity and community maintenance mechanism.

Key words: individual species–area relationship, neutral species, biodiversity, DBH classes, forest dynamics plot, Baotianman National Nature Reserve

理解群落中的物种分布及其共存机制是群落生态学研究的基本目标之一(Ricklefs, 1987; Chesson, 2000)。以往研究中生态学家已提出一些植物多样性维持机制的假说, 如生态位理论强调物种之间的差异和权衡(Matthew, 1995), 中性理论认为物种之间的差异对群落物种共存并不重要(Hubbell, 2001), Janzen (1970)和Connell (1971)提出的Janzen-Connell假说描述了密度制约在生物多样性维持中的作用。然而, 关于生物多样性维持机制的研究仍然面临诸多挑战, 需进一步深入研究。已有研究发现, 物种之间的差异影响种群的空间分布(Condit *et al.*, 2006), 邻域植物的个体密度、同种个体密度、植株相对大小和物种相对丰富度都能够显著影响目标物种的生长(Hubbell *et al.*, 2001; Stoll & Newbery, 2005)。Wiegand等(2007)提出的单物种-面积关系(individual species–area relationship, ISAR)方法从个体的角度出发, 判定单个物种在不同空间尺度下对邻域植物多样性的影响(促进、抑制或中性)。此方法既考虑了个体的空间格局, 同时兼顾了物种数、物种分布和空间尺度, 把种-面积关系(Plotkin *et al.*, 2000; He & Legendre, 2002)和点格局分析(Lieberman & Lieberman, 2007)有机结合在一起, 为探讨物种共存机制提供了新途径(Wiegand *et al.*, 2007)。

ISAR方法已用于群落多样性格局描述以及生态过程和维持机制的研究(Wiegand *et al.*, 2007; 宫贵权等, 2011; Rayburn & Wiegand, 2012; Yang *et al.*, 2013; Zhang *et al.*, 2014)。如Wiegand等(2007)对Barro Colorado Island (BCI)和Sinharaja两个森林样地进行ISAR研究时分析了DBH ≥ 10 cm (后文简称为大树)且多度大于70的物种, 结果表明, 在大于

20 m的尺度范围内大部分物种为多样性中性种, 小于20 m尺度范围内随着森林类型的不同目标种呈现不同的作用类型; 森林生物多样性的维持并不依赖于少数物种的特性, 而是取决于群落内所有物种的整体相互作用。Yang等(2013)利用ISAR方法研究了全球范围内从温带到热带不同纬度上的9个样地, 结果显示在整个研究尺度内(1–50 m)多样性中性种所占比例均最大。森林群落中DBH < 10 cm的个体(后文简称为小树)所占的比例较大并对整个群落的稳定至关重要, 群落的更新也以小树为主(Hubbell *et al.*, 2008), 宫贵权等(2011)和Yang等(2013)进行ISAR分析时就包括了小树个体。根据竞争不对称理论, 大树在其邻域范围内比小树控制更多的地上和地下资源(如营养物质、光照、水分等), 会对小树产生不对称竞争作用(Weiner, 1990; Luu *et al.*, 2013), 范春雨等(2014)、魏彦波等(2014)用修正的单物种-面积关系(modified individual species–area relationship, mISAR)分析了单物种大径级个体对邻域小径级个体植物多样性的影响, 但研究结果因样地的不同而不同。

邻域竞争并不是严格意义上的单向竞争, 小植株同样也会在一定程度上影响较大的植株(Hara, 1988), 因此有必要加强小植株对邻域植物多样性影响的研究。目前已有几例研究尝试分析不同大小或径级个体(此处简称大树/小树)对邻域物种多样性的影响作用(宫贵权等, 2011; Yang *et al.*, 2013; Zhang *et al.*, 2014; 魏彦波等, 2014), 但关于不同大小植株(如大树/小树)对邻域物种多样性的影响仍缺乏较系统的研究, 不同大小的树木在维持森林群落植物多样性方面的作用差异仍不清楚。

基于以上分析, 本研究拟参考以往研究的径级

划分策略, 以在河南宝天曼国家级自然保护区建立的1 ha落叶阔叶林动态监测样地为例验证如下假设: (1)不同个体大小的树木对邻域木本植物多样性的影响有显著差异, 且大树相比小树来说对邻域植物多样性的影响更大; (2)同一物种或同一径级个体对邻域小树比对邻域大树的影响要强; (3)宝天曼落叶阔叶林中中性物种占主体。具体地, 通过对1 ha落叶阔叶林动态监测样地不同径级(此处为大树和小树)和不同空间尺度上的ISAR比较分析探讨以下问题: (1)单物种所有个体对邻域植物多样性(小树个体、大树个体、全部个体)有什么影响? (2)单物种大树个体对邻域植物多样性(小树个体、大树个体、全部个体)有什么影响? (3)单物种小树个体对邻域植物多样性(小树个体、大树个体、全部个体)有什么影响? (4)不同空间尺度内上述各个类型ISAR有什么差异?

1 方法

1.1 研究区域概况

宝天曼国家级自然保护区(33.42°–33.55° N, 111.88°–112° E)位于河南省西南部的秦岭东段伏牛山南坡, 山势呈东南–西北走向, 总面积约5,412.5 ha, 最高峰宝天曼海拔1,830 m。该保护区地处南亚热带向北亚热带过渡区, 是我国同纬度森林生态系统中保存较为完整、物种最丰富的地区之一。保护区内岩石主要为花岗岩, 有少量的石灰岩和砂岩。该区土壤垂直分布明显, 低海拔地区为山地棕黄壤和褐土, 高海拔地区为山地棕壤。本区属季风型大陆性气候, 四季分明, 年平均气温15.2℃, 年降雨量885.6 mm, 年蒸发量991.6 mm, 相对湿度68%, 极端最高温41.2℃, 极端最低温–14.8℃。在植被区划上属于暖温带落叶阔叶林地带, 植被垂直分布比较明显, 自下而上依次分布有常绿落叶阔叶混交林、落叶阔叶林、针阔混交林、高山针叶林、山顶矮曲林和高山灌丛等(宋朝枢, 1994; 史作民等, 1996)。

1.2 样地设置和调查方法

2012年, 在宝天曼国家级自然保护区海拔1,370 m处参照BCI 50 ha样地(Condit, 1998)建立了面积为1 ha (100 m × 100 m)的落叶阔叶林动态监测样地, 该样地由25个20 m × 20 m的连续样方组成, 每个样方进一步划分成16个5 m × 5 m的小样方, 于生长季完成样方内所有DBH ≥ 1 cm的木本植物

个体(藤本除外)的鉴定、DBH测量和位置测定, 并给每个植株挂上有编号的铝牌以便进行永久监测。群落内共有DBH ≥ 1 cm的个体2,309株, 分属29科52属69种, 优势物种为锐齿槲栎(*Quercus aliena* var. *acutiserrata*)和臭常山(*Orixa japonica*)。宝天曼1 ha森林样地内木本植物径级及个体空间分布如图1所示。

1.3 ISAR计算方法和分析策略

Wiegand等(2007)提出的ISAR方法是计算以目标物种*t*的个体为圆心、*r*为半径的圆内物种数的期望值, 首先计算其他物种*j*在以目标物种*t*的个体为圆心、*r*为半径的圆内不出现的概率 $p_{ij}(0, r)$, 然后将所有*N*个物种的 $1 - p_{ij}(0, r)$ 相加, 公式如下:

$$ISAR(r) = \sum_{j=1}^N [1 - p_{ij}(0, r)]$$

由于某些物种个体可能分布在距离样地边缘*r*的范围内, 如果这些个体作为目标物种*t*就无法计算半径*r*范围内的物种丰富度, 所以分析中需要设置缓冲区, 即目标物种*t*只能从非缓冲区范围内选取, 而整个样地内的个体都能当作其他物种*j*。由于本研究的样地面积(100 m × 100 m)相对较小, 缓冲区过大可能造成某些物种个体全部分布在缓冲区内, 因此本研究设计的研究尺度为1–10 m、步长为1 m、缓冲区设置为10 m。

植物间相互作用、植物与环境相互作用以及目标物种*t*的空间分布格局均能影响ISAR值(Wiegand et al., 2007), 因此利用ISAR方法分析植物的空间分布格局时需要使用合适的零模型来检验目标物种*t*对其他物种*j*的影响, 本研究参照Wiegand等(2007)的方法选择异质泊松零模型(heterogeneous Poisson null model)。为了确定局域物种与随机物种组成之间是否存在差异, 我们计算了199次异质泊松零模型的Monte Carlo置信区间。如果实际ISAR(*r*)值大于95%的模拟值, 那么该物种在 $\alpha = 0.05$ 的显著水平上, 在半径*r*尺度范围内具有更多的邻域物种多样性, 该物种称之为促进种(accumulator); 如果实际ISAR(*r*)值小于95%的模拟值, 那么该物种在 $\alpha = 0.05$ 的显著水平上, 在半径*r*尺度范围内具有更少的邻域物种多样性, 该物种称之为抑制种(repeller); 如果实际ISAR(*r*)值位于零模型95%置信区间内, 那么该物种称之为中性种(neutral)。最后利用基于Miser方法的Gof检验(Goodness-of-fit) (Loosmore &

图1 宝天曼1 ha森林动态监测样地内木本植物径级结构(上)及个体空间分布(下)(所有个体、个体数 ≥ 10 的大树、个体数 ≥ 30 的小树)

Fig. 1 DBH classes distribution (top) and spatial distribution (down) of woody species for all individual, adult tree (individuals ≥ 10 , DBH ≥ 10 cm), young tree (individuals ≥ 30 , DBH < 10 cm) in the 1 ha Baotianman Forest Dynamics Plot

Ford, 2006; Perry *et al.*, 2006; Wiegand *et al.*, 2007) 去除统计I型错误, 消除ISAR(r)估计值的极小偏差对结果的影响。

Wiegand等(2007)进行ISAR分析时只选取了DBH ≥ 10 cm的物种个体, 而宫贵权等(2011)、Yang等(2013)进行ISAR分析时把样地内DBH ≥ 1 cm的树木个体纳入在内。本文参照以往研究中径级的划分方法, 把DBH ≥ 10 cm的物种个体称之为大树, $1 \text{ cm} \leq \text{DBH} < 10 \text{ cm}$ 的物种个体称之为小树。Wiegand等(2007)只选取了个体数大于70的物种进行研究, Yang等(2013)分别对个体数 ≥ 70 和不限个体数进行分析。宝天曼1 ha样地内的物种个体数(特别是大树个体)相对较小, 故在研究中我们选取个体数 ≥ 30 的全部树和小树物种为目标种, 目标种大树个体数限制为 ≥ 10 。最后得到全部树目标种22个, 大树目标种10个, 小树目标种20个。

第一步分析单物种所有个体(包括大树和小树)对邻域全部个体(以下简称全部树对全部树, all to all)、单物种所有个体对邻域大树个体(以下简称为全部树对大树, all to adult)、单物种所有个体对邻域

小树个体(以下简称为全部树对小树, all to young)多样性的影响。第二步分析单物种大树个体(个体数 ≥ 10)对邻域全部树(以下简称大树对全部树, adult to all)、单物种大树个体对邻域大树(以下简称大树对大树, adult to adult)和单物种大树个体对邻域小树(以下简称大树对小树, adult to young)多样性的影响。第三步分析单物种小树个体(个体数 ≥ 30)对邻域全部树(以下简称小树对全部树, young to all)、单物种小树个体对邻域大树(以下简称小树对大树, young to adult)和单物种小树个体对邻域小树(以下简称小树对小树, young to young)多样性的影响。第四步检验不同尺度下各类别间ISAR比例值均值差异的显著性, 首先计算各类型ISAR的比例值, 对于对全部树的3种类型(all to all, adult to all, young to all)分别除以样地内所有的物种数69, 对于对大树的3种类型(all to adult, adult to adult, young to adult)分别除以样地内所有的大树物种数39, 对于对小树的3种类型(all to young, adult to young, young to young)分别除以样地内所有的小树物种数66, 以此得到9种类型的ISAR比例值; 利用方差分析检验

各个尺度下ISAR比例值组间的差异显著性,并对数据进行方差齐性、正态分布检验,最后利用多重比较Scheffe方法在 $\alpha = 0.05$ 水平下检验各个类型在研究尺度内ISAR比例值的差异显著性(Steel *et al.*, 1996)。

2 结果

2.1 单物种所有个体对邻域植物多样性的影响

首先对宝天曼1 ha森林动态监测样地内个体数大于30的22个物种的所有个体(DBH ≥ 1 cm)进行分析,发现单物种所有个体对邻域全部树、大树和小树的ISAR曲线趋势相似,都随着面积的增加而增加(图2)。其次分析了尺度依赖效应,分别统计分析22个物种在1–10 m的空间尺度内对邻域植物多样性的促进、抑制和中性作用的物种数,结果如图3

所示:全部树对全部树、全部树对大树、全部树对小树在所研究的尺度内均是中性物种数量占主体,在全部树对全部树和全部树对小树情况下促进种数量都随着尺度的增加呈先升高后下降的趋势,只在个别尺度下存在多样性抑制种。如元宝枫(*Acer truncatum*)全部树对邻域全部树在1–3 m尺度上、全部树对邻域小树在2–4 m尺度上为促进种,多毛樱桃(*Cerasus polytricha*)全部树对邻域大树在1–2 m尺度上为抑制种,不同尺度下的各物种作用类型见附录1。

2.2 单物种大树个体对邻域植物多样性的影响

宝天曼1 ha森林样地中共有DBH ≥ 1 cm的个体2,309株,其中小树个体有1,839株,占全部个体的79.64%,大树个体数较少(图1)。单物种大树个体在1–10 m的空间尺度范围内对邻域全部树、大树和

图2 九种类型((a)全部树对全部树、(b)全部树对大树、(c)全部树对小树、(d)大树对全部树、(e)大树对大树、(f)大树对小树、(g)小树对全部树、(h)小树对大树和(i)小树对小树)的单物种面积关系曲线(ISAR)。黑线代表例子物种杈叶枫。

Fig. 2 The individual species–area relationship (ISAR) of nine types ((a) all to all, (b) all to adult, (c) all to young, (d) adult to all, (e) adult to adult, (f) adult to young, (g) young to all, (h) young to adult, and (i) young to young). Black line: an example species of *Acer ceriferum*.

图3 九种类型((a)全部树对全部树、(b)全部树对大树、(c)全部树对小树、(d)大树对全部树、(e)大树对大树、(f)大树对小树、(g)小树对全部树、(h)小树对大树和(i)小树对小树)的单物种面积关系在不同尺度下多样性促进种、中性种或抑制种的数量
Fig. 3 Species number of significant diversity accumulator, neutral and repeller at different spatial scales from individual species-area relationships of nine types ((a) all to all, (b) all to adult, (c) all to young, (d) adult to all, (e) adult to adult, (f) adult to young, (g) young to all, (h) young to adult, and (i) young to young).

小树的ISAR曲线趋势类似,均随着尺度的增加而增加(图2);单物种大树个体对邻域(全部树、小树、大树)植物多样性的影响基本上是中性的,仅在个别尺度下有少量的多样性抑制种和促进种被检测到(图3),如三桠乌药(*Lindera obtusiloba*)大树对邻域大树在5 m尺度上为促进种,毛茛(*Cornus walteri*)大树对全部树在1-2 m尺度上为抑制种,各物种在不同尺度下的作用类型见附录2。

2.3 单物种小树个体对邻域植物多样性的影响

选取小树(DBH < 10 cm)个体数 ≥ 30的物种共20个,研究小树个体在1-10 m空间尺度下对邻域全部树、大树和小树植物多样性的影响。结果表明:各

物种小树的ISAR曲线总体趋势相似,在小尺度下急剧上升,随着尺度的增大上升速率变缓(图2)。统计20个物种的小树个体在1-10 m的空间尺度内对邻域全部树、大树和小树多样性的促进种、抑制种和中性种的数量:单物种小树个体对邻域全部树和小树物种多样性的影响,在1-7 m尺度内多样性促进种的数量先升高后下降,在1-10 m整个研究尺度下仅有臭常山表现出抑制作用,中性种数量在整个研究尺度内最多并随着尺度的增大先减少后增加;而在研究尺度内单物种小树个体对邻域大树植物多样性的影响仅检测到少量多样性促进种和抑制种(图3),如在1-5 m尺度上杈叶枫(*Acer ceriferum*)

为促进种, 在1–2 m尺度上臭常山为抑制种, 各物种在不同尺度下的作用类型见附录3。

2.4 不同类型ISAR比例值差异比较

分别计算各尺度内9种类型的ISAR比例值的均值以及范围(比例值的最大值与最小值之差), 结果如图4所示。9种类型的ISAR曲线比例值间存在一定程度的分异, 不同类型ISAR的多尺度多重比较结果显示: (1)对邻域全部树来说: 小树对全部树的ISAR比例值在邻域2 m、6–10 m尺度上分别显著低于、高于全部树对全部树的比值, 在其他研究尺度上二者没有显著差别, 同时在邻域1 m尺度上显著高于大树对全部树的比值, 而在所研究的其他尺度上二者没有显著差别; 大树对全部树的ISAR

比例值在1–2 m、7–10 m尺度上分别显著低于、高于全部树对全部树的比值, 在3–6 m尺度上二者没有显著差别。(2)对邻域小树来说: 小树对小树的ISAR比例值在邻域1–10 m尺度上均显著大于全部树对小树的比值, 同时在邻域1 m尺度显著大于大树对小树的比值, 而在所研究的其他尺度内无显著差别; 大树对小树的ISAR比例值在整个研究尺度内均显著大于全部树对小树的比值。(3)对邻域大树来说: 小树对大树的ISAR比例值在1–10 m尺度内均显著高于全部树对大树的比值, 同时在1–10 m尺度范围内均与大树对邻域大树的比值无显著差异; 大树对大树的ISAR比例值在1–6 m尺度内与全部树对大树的比值没有显著差别, 而

图4 不同尺度下9种类型(全部树对全部树、全部树对大树、全部树对小树、大树对全部树、大树对大树、大树对小树、小树对全部树、小树对大树和小树对小树)的物种面积关系(ISAR)比例值(A) (平均值±标准误)及其范围(最大值和最小值之差) (B)
Fig. 4 Values of ratio for individual species-area relationship (ISAR) of nine types (all to all, all to adult, all to young, adult to all, adult to adult, adult to young, young to all, young to adult, and young to young) (A) (mean $\pm$ SE) and their ranges (the difference between maximum and minimum of ISAR ratio) (B) at different spatial scales.

表1 不同空间尺度下9种类型的单物种面积关系(ISAR)比例值的均值比较(Scheffe方法)。相同字母表示差异不显著, 不同字母表示差异显著($P < 0.05$)。

Table 1 Comparisons on the mean values of individual species-area relationship (ISAR) ratios of 9 types at different spatial scales (Scheffe method). The same letters mean no significant difference, different letters mean significant difference ($P < 0.05$).

类型 Type	尺度 Scales (m)									
	1	2	3	4	5	6	7	8	9	10
全部树对全部树 All to all	0.020 ^{ab}	0.047 ^a	0.071 ^{ab}	0.093 ^a	0.120 ^b	0.137 ^b	0.157 ^b	0.175 ^b	0.191 ^b	0.206 ^b
全部树对大树 All to adult	0.003 ^c	0.010 ^c	0.021 ^c	0.033 ^c	0.045 ^d	0.057 ^e	0.069 ^e	0.082 ^d	0.095 ^d	0.108 ^d
全部树对小树 All to young	0.006 ^{de}	0.022 ^d	0.043 ^{cd}	0.065 ^b	0.086 ^c	0.106 ^c	0.126 ^c	0.144 ^c	0.162 ^c	0.180 ^c
大树对全部树 Adult to all	0.006 ^{de}	0.024 ^{cd}	0.055 ^{bc}	0.089 ^a	0.124 ^{ab}	0.159 ^{ab}	0.195 ^a	0.228 ^a	0.264 ^a	0.296 ^a
大树对大树 Adult to adult	0.006 ^{de}	0.018 ^{de}	0.030 ^{de}	0.044 ^{bc}	0.063 ^{cd}	0.080 ^{de}	0.100 ^d	0.123 ^c	0.143 ^c	0.160 ^c
大树对小树 Adult to young	0.015 ^{bc}	0.045 ^{ab}	0.072 ^{ab}	0.097 ^a	0.136 ^{ab}	0.162 ^a	0.199 ^a	0.231 ^a	0.264 ^a	0.298 ^a
小树对全部树 Young to all	0.022 ^a	0.033 ^{bc}	0.064 ^{ab}	0.098 ^a	0.133 ^{ab}	0.166 ^a	0.199 ^a	0.231 ^a	0.263 ^a	0.295 ^a
小树对大树 Young to adult	0.009 ^{cd}	0.023 ^{cd}	0.038 ^d	0.051 ^b	0.072 ^c	0.087 ^d	0.106 ^d	0.127 ^c	0.164 ^c	0.167 ^c
小树对小树 Young to young	0.022 ^a	0.050 ^a	0.078 ^a	0.106 ^a	0.141 ^a	0.168 ^a	0.200 ^a	0.235 ^a	0.264 ^a	0.295 ^a

在7–10 m尺度内均高于全部树对大树的比例值。(4)对于大树对邻域全部树、小树、大树来说: 大树对大树的ISAR比例值在邻域1–10 m尺度内均显著低于大树对小树的比例值, 在邻域1–2 m尺度内与大树对全部树的比例值无显著差别, 在邻域3–10 m尺度内均显著低于大树对全部树的比例值; 大树对小树的ISAR比例值在邻域1–2 m尺度内显著低于大树对全部树的比例值, 在3–10 m尺度内与大树对全部树的比例值无显著差别。(5)对于小树对邻域全部树、小树、大树来说: 小树对小树的ISAR比例值在邻域1–10 m尺度内均显著高于小树对大树的比例值, 在邻域2 m尺度内显著高于小树对全部树的比例值, 在其他研究尺度内与小树对全部树的比例值无显著差别; 小树对大树的ISAR比例值在1 m、3–10 m空间尺度上均显著低于小树对全部树的比例值, 在2 m尺度两者无显著差别。(6)对于全部树对邻域全部树、小树、大树来说: 所有全部树对小树、全部树对大树的ISAR比例值在邻域1–10 m尺度内均显著低于全部树对全部树的比例值; 全部树对小树的ISAR比例值在邻域1 m尺度内与全部树对大树的比例值无显著差别, 在2–10 m尺度内均显著高于全部树对大树的比例值。各类型不同尺度下的多重比较结果见表1。

各尺度下9种类型ISAR比例值的范围(最大值与最小值之差)显示其ISAR曲线是有差别的, 具体如下: 大树对邻域小树和大树对邻域全部树趋势相似, ISAR比例值范围随着尺度的增加先增大后减小; 小树对邻域小树和小树对邻域全部树的趋势相

似, ISAR比例值范围在研究尺度内先增大后基本维持在一定水平; 全部树对邻域全部树和全部树对邻域小树的趋势相似, ISAR比例值范围在研究尺度内先增大后减小; 大树对邻域大树和小树对邻域大树的趋势相似, ISAR比例值范围在研究尺度内波动增大; 而全部树对邻域大树的ISAR值范围在研究尺度内缓慢上升。

3 讨论

Wiegand等(2007)提出的ISAR方法综合了种-面积关系(Gleason, 1922; Plotkin *et al.*, 2000)和点格局分析(Diggle, 2003; Wiegand & Moloney, 2004), 能从植物个体的角度出发评估每个物种在群落中对邻域其他植物多样性的作用; 依据其定义, $ISAR(r)$ 是一个从0 m到 r m的累积结果。那么树木个体大小不同对邻域木本植物多样性的影响是否有显著差异? 大树相比小树来说对邻域植物多样性的影响是否更大? 同一物种或同一径级个体对邻域大树比对邻域小树的影响是否要弱? 本研究对宝天曼1 ha森林样地的9种不同类型ISAR比较分析结果显示, 树木个体大小对邻域植物多样性的影响因不同空间尺度、邻域植物不同个体大小而不同, 这支持同一物种或同一径级个体对邻域小树比对邻域大树的影响要强的假设, 该结果也支持竞争不对称理论, 即目标种小径级个体会对邻域大径级个体产生不对称的作用(Weiner, 1990); 不支持大树相比小树来说对邻域植物多样性的影响更大的假设(图4, 表1), 这表明小树在此群落中起着不可忽视

的作用。宫贵权等(2011)研究结果显示, 小树个体会对邻域植物多样性产生促进作用, 随着个体的变大促进作用会变成抑制作用。Zhang等(2014)利用mISAR方法对两个温带森林样地进行研究发现, 在小尺度范围大部分单物种大径级个体促进邻域小径级植物多样性。这些研究结果差异的原因可能来源于研究方法以及群落本身的不同。宫贵权等(2011)和Yang等(2013)的研究中也注意到不同个体大小对邻域植物多样性的作用不同的现象, 他们主要分析了所研究森林群落同一径级内(如DBH > 1 cm、DBH > 10 cm、DBH > 20 cm和DBH > 30 cm)的比较以及全部树对全部树的情形。本研究分析了宝天曼1 ha森林样地的大树和小树分别对邻域全部树、大树、小树的作用, 有助于对比分析不同个体大小对邻域植物多样性的影响, 但本研究也受到样地面积的限制, 研究结果还需在更大尺度上以及更多森林类型里进行检验。

ISAR方法能够判定单个物种在不同空间尺度下对邻域植物多样性的影响是促进、抑制还是中性。那么宝天曼森林群落中中性物种、促进物种、抑制物种哪类占优势? 我们的结果显示中性物种在所研究的1–10 m尺度上均占绝对优势(图3, 附录1–3), 这和Sinharaja森林样地(Wiegand *et al.*, 2007)及鼎湖山森林样地大径级树木(宫贵权等, 2011)的分析结果类似, 支持森林生物多样性的维持并不依赖于少数物种的特性, 而取决于群落内所有物种的整体相互作用这一观点(Wiegand *et al.*, 2007)。同时, 本研究发现树木不同个体大小对邻域植物多样性影响作用还因不同空间尺度、邻域植物不同个体大小而有所差别。促进种数量在全部树对全部树、全部树对小树、小树对全部树和小树对小树情况下随着尺度的增加都呈现先升高后下降的趋势, 抑制种在少数尺度下被少量检测到(图3, 附录1–3)。物种在群落中的作用类型是否与其生物学特性、性状等因素相关以及如何相关仍需进一步深入研究, 如漆树(*Toxicodendron vernicifluum*) (McPherson & Thompson, 1972)、胡桃楸(*Juglans mandshurica*) (林武星等, 2005)等物种的化感作用, 元宝枫的菌根现象(唐明等, 1993)等。

本研究分析了宝天曼1 ha森林样地里单物种所有个体、大树和小树个体对邻域(所有个体、大树和小树)植物多样性的影响, 结果表明不同大小的树

木个体对邻域植物多样性的影响作用因空间尺度、邻域植物个体大小而有所差别; 同一物种或同一径级个体对邻域小树较大树的影响要强; 不支持大树比小树对邻域植物多样性影响作用更大的假设; 中性种在整个研究尺度(1–10 m)范围内都占绝对优势。同时, 由于本研究受样地面积限制以及大树个体较少等原因, 其结果仍需在更大尺度、不同的森林类型里进行检验。Wiegand等(2007)指出ISAR曲线主要受物种之间的相互作用、目标物种的空间格局、生境关联等因素的影响。进一步的研究还需综合考虑环境因素如地形和土壤、物种的功能特征(Cornelissen *et al.*, 2003)、密度制约(Volkov *et al.*, 2005; 王婷等, 2014)、进化时间尺度上的谱系结构(Webb *et al.*, 2002)等。

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附录 Supplementary Material

附录1 宝天曼1 ha森林动态监测样地不同物种全部树对邻域全部树、大树和小树植物多样性的影响

Appendix 1 Influences of all individuals of different species on neighbor diversity of all, adult and young tree at different scales in the 1 ha Baotianman Forest Dynamics Plot

<http://www.biodiversity-science.net/fileup/PDF/w2015-031-1.pdf>

附录2 宝天曼1 ha森林样地单物种大树个体对邻域全部树、大树和小树植物多样性的影响

Appendix 2 The influences of adult individuals of different species on neighbor diversity of all, adult and young tree at different scales in the 1 ha Baotianman Forest Dynamics Plot

<http://www.biodiversity-science.net/fileup/PDF/w2015-031-2.pdf>

附录3 宝天曼1 ha森林样地单物种小树个体对邻域全部树、大树和小树植物多样性的影响

Appendix 3 The influences of young individuals of different species on neighbor diversity of all, adult and young tree at different scales in the 1 ha Baotianman Forest Dynamics Plot

<http://www.biodiversity-science.net/fileup/PDF/w2015-031-3.pdf>

附录1 宝天曼森林动态监测样地土壤细菌名录(-表示相应分类水平上没有明确分类名称信息; []表示分类信息存在争议)
Appendix 1 Soil bacteria list in the Baotianman Forest Dynamics Plot. - means without specific names at the relative classification levels;
[] means with controversial names.

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Planctomycetes	Planctomycetia	Pirellulales	Pirellulaceae	A17
Proteobacteria	Betaproteobacteria	Burkholderiales	Alcaligenaceae	<i>Achromobacter</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	<i>Acidiphilium</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	<i>Acidisoma</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	<i>Acidocella</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Acidovorax</i>
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	<i>Acinetobacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Streptosporangiaceae	<i>Acrocarpospora</i>
Actinobacteria	Actinobacteria	Actinomycetales	Thermomonosporaceae	<i>Actinoallomurus</i>
Actinobacteria	Actinobacteria	Actinomycetales	Thermomonosporaceae	<i>Actinocorallia</i>
Actinobacteria	Actinobacteria	Actinomycetales	Thermomonosporaceae	<i>Actinomadura</i>
Actinobacteria	Actinobacteria	Actinomycetales	Pseudonocardiaceae	<i>Actinomycetospora</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Actinoplanes</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Adhaeribacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Nocardiodaceae	<i>Aeromicrobium</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Rhodobiaceae	<i>Afifella</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	<i>Afipia</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Rhizobiaceae	<i>Agrobacterium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Agromyces</i>
Firmicutes	Bacilli	Bacillales	Alicyclobacillaceae	<i>Alicyclobacillus</i>
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	<i>Alkanindiges</i>
Proteobacteria	Alphaproteobacteria	Rhodobacterales	Rhodobacteraceae	<i>Amaricoccus</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Phyllobacteriaceae	<i>Aminobacter</i>
Firmicutes	Bacilli	Bacillales	Paenibacillaceae	<i>Ammoniphilus</i>
Actinobacteria	Actinobacteria	Actinomycetales	Pseudonocardiaceae	<i>Amycolatopsis</i>
Chloroflexi	Anaerolineae	Anaerolineales	Anaerolinaceae	<i>Anaerolinea</i>
Proteobacteria	Deltaproteobacteria	Myxococcales	Myxococcaceae	<i>Anaeromyxobacter</i>
Firmicutes	Bacilli	Bacillales	Bacillaceae	<i>Anoxybacillus</i>
Proteobacteria	Gammaproteobacteria	Legionellales	Coxiellaceae	<i>Aquicella</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae	<i>Arthrobacter</i>
Tenericutes	Mollicutes	Anaeroplasmatales	Anaeroplasmataceae	<i>Asteroleplasma</i>
Proteobacteria	Alphaproteobacteria	Caulobacterales	Caulobacteraceae	<i>Asticcacaulis</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Azohydromonas</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Azospira</i>
Firmicutes	Bacilli	Bacillales	Bacillaceae	<i>Bacillus</i>
Proteobacteria	Deltaproteobacteria	Bdellovibrionales	Bacteriovoracaceae	<i>Bacteriovorax</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	<i>Balneimonas</i>
Proteobacteria	Deltaproteobacteria	Bdellovibrionales	Bdellovibrionaceae	<i>Bdellovibrio</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Xanthobacteraceae	<i>Blastochloris</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	<i>Blastomonas</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	<i>Bosea</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Brachymonas</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	<i>Bradyrhizobium</i>
Firmicutes	Bacilli	Bacillales	Paenibacillaceae	<i>Brevibacillus</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Burkholderiaceae	<i>Burkholderia</i>
Chloroflexi	Anaerolineae	Caldilineales	Caldilineaceae	<i>Caldilinea</i>
Firmicutes	Clostridia	Clostridiales	Clostridiaceae	<i>Caloramator</i>
Bacteroidetes	Cytophagia	Cytophagales	[Amoebophilaceae]	<i>Candidatus Amoebophilus</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Burkholderiaceae	<i>Candidatus Glomeribacter</i>
Acidobacteria	Acidobacteriia	Acidobacteriales	Koribacteraceae	<i>Candidatus Koribacter</i>
Chlamydiae	Chlamydiia	Chlamydiales	Parachlamydiaceae	<i>Candidatus Protochlamydia</i>
Chlamydiae	Chlamydiia	Chlamydiales	Rhabdochlamydiaceae	<i>Candidatus Rhabdochlamydia</i>
Acidobacteria	Solibacteres	Solibacterales	Solibacteraceae	<i>Candidatus Solibacter</i>
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	<i>Candidatus Xiphinematobacter</i>
Firmicutes	Bacilli	Lactobacillales	Carnobacteriaceae	<i>Carnobacterium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Catellatospora</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Catenuloplanes</i>
Proteobacteria	Alphaproteobacteria	Caulobacterales	Caulobacteraceae	<i>Caulobacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Cellulomonadaceae	<i>Cellulomonas</i>
Proteobacteria	Gammaproteobacteria	Alteromonadales	Alteromonadaceae	<i>Cellvibrio</i>
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	<i>Chitinophaga</i>
Bacteroidetes	Flavobacteriia	Flavobacteriales	[Weeksellaceae]	<i>Chryseobacterium</i>
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	<i>Chthoniobacter</i>
Firmicutes	Clostridia	Clostridiales	Clostridiaceae	<i>Clostridium</i>
Firmicutes	Bacilli	Bacillales	Paenibacillaceae	<i>Cohnella</i>
Actinobacteria	Thermoleophilia	Solirubrobacterales	Conexibacteraceae	<i>Conexibacter</i>
Firmicutes	Clostridia	Clostridiales	Lachnospiraceae	<i>Coprococcus</i>
Proteobacteria	Gammaproteobacteria	Legionellales	Coxiellaceae	<i>Coxiella</i>
Proteobacteria	Gammaproteobacteria	Methylococcales	Crenotrichaceae	<i>Crenothrix</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Cryocola</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	<i>Cupriavidus</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Cytophaga</i>
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	<i>DA101</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Dactylosporangium</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Dechloromonas</i>
Firmicutes	Clostridia	Clostridiales	Peptococcaceae	<i>Dehalobacter_Syntrophobotul</i>
[Thermi]	Deinococci	Deinococcales	Deinococcaceae	<i>Deinococcus</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Delftia</i>
Actinobacteria	Actinobacteria	Actinomycetales	Dermacoccaceae	<i>Dermacoccus</i>
Proteobacteria	Deltaproteobacteria	Desulfarculales	Desulfarculaceae	<i>Desulfarculus</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Deltaproteobacteria	Desulfobacterales	Desulfobulbaceae	<i>Desulfobulbus</i>
Proteobacteria	Deltaproteobacteria	Syntrophobacterales	Syntrophaceae	<i>Desulfomonile</i>
Firmicutes	Clostridia	Clostridiales	Peptococcaceae	<i>Desulfosporosinus</i>
Proteobacteria	Deltaproteobacteria	Desulfovibrionales	Desulfovibrionaceae	<i>Desulfovibrio</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	<i>Devosia</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Dok59</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	<i>Dokdonella</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Dyadobacter</i>
Bacteroidetes	Bacteroidia	Bacteroidales	Porphyromonadaceae	<i>Dysgonomonas</i>
Acidobacteria	Acidobacteriia	Acidobacteriales	Acidobacteriaceae	<i>Edaphobacter</i>
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	<i>Ellin506</i>
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	<i>Enhydrobacter</i>
Firmicutes	Clostridia	Clostridiales	Lachnospiraceae	<i>Epulopiscium</i>
Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae	<i>Erwinia</i>
Chloroflexi	Ktedonobacteria	Ktedonobacterales	Ktedonobacteraceae	<i>FFCH10602</i>
Armatimonadetes	[Fimbriimonadia]	[Fimbriimonadales]	[Fimbriimonadaceae]	<i>Fimbriimonas</i>
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	<i>Flaviumibacter</i>
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	<i>Flavisolibacter</i>
Bacteroidetes	Flavobacteriia	Flavobacteriales	Flavobacteriaceae	<i>Flavobacterium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Frankiaceae	<i>Frankia</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Frigoribacterium</i>
Proteobacteria	Betaproteobacteria	Gallionellales	Gallionellaceae	<i>Gallionella</i>
Planctomycetes	Planctomycetia	Gemmatales	Gemmataceae	<i>Gemmata</i>
Gemmatimonadetes	Gemmatimonadetes	Gemmatimonadales	Gemmatimonadaceae	<i>Gemmatimonas</i>
Firmicutes	Bacilli	Bacillales	Bacillaceae	<i>Geobacillus</i>
Proteobacteria	Deltaproteobacteria	Desulfuromonadales	Geobacteraceae	<i>Geobacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Geodermatophilaceae	<i>Geodermatophilus</i>
Acidobacteria	Holophagae	Holophagales	Holophagaceae	<i>Geothrix</i>
Nitrospirae	Nitrospira	Nitrospirales	[Thermodesulfovibrionaceae]	<i>GOUTA19</i>
Proteobacteria	Deltaproteobacteria	Myxococcales	Haliangiaceae	<i>Haliangium</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	<i>Hermiimonas</i>
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	<i>heteroC45_4W</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Hydrogenophaga</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Hylemonella</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Hymenobacter</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	<i>Hyphomicrobium</i>
Actinobacteria	Acidimicrobiia	Acidimicrobiales	Iamiaceae	<i>Iamia</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	<i>Inquilinus</i>
Actinobacteria	Actinobacteria	Actinomycetales	Intrasporangiaceae	<i>Janibacter</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	<i>Janthinobacterium</i>
Nitrospirae	Nitrospira	Nitrospirales	Nitrospiraceae	<i>JG37-AG-70</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Alphaproteobacteria	Rhizobiales	Rhizobiaceae	<i>Kaistia</i>
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	<i>Kaistobacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Actinosynnemataceae	<i>Kibdelosporangium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Kineosporiaceae	<i>Kineosporia</i>
Chloroflexi	Chloroflexi	[Roseiflexales]	[Kouleothrixaceae]	<i>Kouleothrix</i>
Actinobacteria	Actinobacteria	Actinomycetales	Nocardiodaceae	<i>Kribbella</i>
Actinobacteria	Actinobacteria	Actinomycetales	Actinosynnemataceae	<i>Kutzneria</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Xanthobacteraceae	<i>Labrys</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Larkinella</i>
Proteobacteria	Gammaproteobacteria	Legionellales	Legionellaceae	<i>Legionella</i>
Spirochaetes	[Leptospirae]	[Leptospirales]	Leptospiraceae	<i>Leptonema</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Leucobacter</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	<i>Luteibacter</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	<i>Luteimonas</i>
Verrucomicrobia	Verrucomicrobiae	Verrucomicrobiales	Verrucomicrobiaceae	<i>Luteolibacter</i>
Firmicutes	Bacilli	Bacillales	Planococcaceae	<i>Lysinibacillus</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	<i>Lysobacter</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	<i>Magnetospirillum</i>
Proteobacteria	Gammaproteobacteria	Oceanospirillales	Oceanospirillaceae	<i>Marinomonas</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Phyllobacteriaceae	<i>Mesorhizobium</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Methylibium</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylobacteriaceae	<i>Methylobacterium</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Beijerinckiaceae	<i>Methyloferula</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylocystaceae	<i>Methylopila</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylocystaceae	<i>Methylosinus</i>
Proteobacteria	Betaproteobacteria	Methylophilales	Methylophilaceae	<i>Methylotenera</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Microbacterium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Geodermatophilaceae	<i>Modestobacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Mycobacteriaceae	<i>Mycobacterium</i>
Proteobacteria	Alphaproteobacteria	Caulobacterales	Caulobacteraceae	<i>Mycoplana</i>
Proteobacteria	Deltaproteobacteria	Myxococcales	Myxococcaceae	<i>Myxococcus</i>
Proteobacteria	Deltaproteobacteria	Myxococcales	Nannocystaceae	<i>Nannocystis</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Sinobacteraceae	<i>Nevskia</i>
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	<i>Niastella</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	<i>Nitrobacter</i>
Proteobacteria	Betaproteobacteria	Nitrosomonadales	Nitrosomonadaceae	<i>Nitrosovibrio</i>
Nitrospirae	Nitrospira	Nitrospirales	Nitrospiraceae	<i>Nitrospira</i>
Actinobacteria	Actinobacteria	Actinomycetales	Nocardiaceae	<i>Nocardia</i>
Actinobacteria	Actinobacteria	Actinomycetales	Nocardiodaceae	<i>Nocardioidea</i>
Actinobacteria	Actinobacteria	Actinomycetales	Streptosporangiaceae	<i>Nonomuraea</i>
Planctomycetes	Planctomycetia	Gemmatales	Isosphaeraceae	<i>Nostocoida</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	<i>Novosphingobium</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Brucellaceae	<i>Ochrobactrum</i>
Verrucomicrobia	Opitutae	Opitutales	Opitutaceae	<i>Opitutus</i>
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	<i>OR-59</i>
Acidobacteria	Solibacteres	Solibacterales	Other	Other
Acidobacteria	Acidobacteriia	Acidobacteriales	Acidobacteriaceae	Other
Acidobacteria	Other	Other	Other	Other
Acidobacteria	Acidobacteriia	Acidobacteriales	Koribacteraceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Geodermatophilaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Other	Other
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Intrasporangiaceae	Other
Actinobacteria	Thermoleophilia	Solirubrobacterales	Other	Other
Actinobacteria	Actinobacteria	Actinomycetales	Actinosynnemataceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Streptomyetaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Streptosporangiaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Pseudonocardiaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Kineosporiaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Cryptosporangiaceae	Other
Actinobacteria	Acidimicrobiia	Acidimicrobiales	Iamiaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Thermomonosporaceae	Other
Actinobacteria	Actinobacteria	Actinomycetales	Cellulomonadaceae	Other
Actinobacteria	Thermoleophilia	Gaiellales	Other	Other
Actinobacteria	Acidimicrobiia	Acidimicrobiales	Other	Other
Actinobacteria	Actinobacteria	Actinomycetales	Frankiaceae	Other
AD3	Other	Other	Other	Other
Armatimonadetes	Chthonomonadetes	Chthonomonadales	Other	Other
Armatimonadetes	Other	Other	Other	Other
Armatimonadetes	Chthonomonadetes	Chthonomonadales	Chthonomonadaceae	Other
Armatimonadetes	[Fimbriimonadia]	[Fimbriimonadales]	[Fimbriimonadaceae]	Other
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	Other
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	Other	Other
Bacteroidetes	Other	Other	Other	Other
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	Other
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	Sphingobacteriaceae	Other
Bacteroidetes	Flavobacteriia	Flavobacteriales	Cryomorphaceae	Other
Chlamydiae	Chlamydiia	Chlamydiales	Parachlamydiaceae	Other
Chlamydiae	Chlamydiia	Chlamydiales	Other	Other
Chlamydiae	Chlamydiia	Other	Other	Other

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Chlamydiae	Chlamydiia	Chlamydiales	Waddliaceae	Other
Chlamydiae	Chlamydiia	Chlamydiales	Simkaniaceae	Other
Chloroflexi	Other	Other	Other	Other
Chloroflexi	Anaerolineae	Other	Other	Other
Chloroflexi	TK10	B07_WMSP1	Other	Other
Chloroflexi	Anaerolineae	A31	Other	Other
Chloroflexi	Anaerolineae	Anaerolineales	Anaerolinaceae	Other
Firmicutes	Bacilli	Bacillales	Planococcaceae	Other
Firmicutes	Clostridia	Clostridiales	Peptostreptococcaceae	Other
Firmicutes	Bacilli	Bacillales	Bacillaceae	Other
Firmicutes	Bacilli	Bacillales	Thermoactinomycetaceae	Other
Firmicutes	Clostridia	Clostridiales	Other	Other
Firmicutes	Bacilli	Bacillales	Other	Other
Firmicutes	Bacilli	Bacillales	Sporolactobacillaceae	Other
Gemmatimonadetes	Gemmatimonadetes	Other	Other	Other
Gemmatimonadetes	Gemmatimonadetes	Gemmatimonadales	Other	Other
Nitrospirae	Nitrospira	Nitrospirales	Nitrospiraceae	Other
Other	Other	Other	Other	Other
Planctomycetes	Phycisphaerae	Phycisphaerales	Other	Other
Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	Other
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	Other
Proteobacteria	Betaproteobacteria	Other	Other	Other
Proteobacteria	Alphaproteobacteria	Other	Other	Other
Proteobacteria	Betaproteobacteria	Burkholderiales	Burkholderiaceae	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Rhizobiaceae	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Other	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	Other
Proteobacteria	Gammaproteobacteria	Other	Other	Other
Proteobacteria	Deltaproteobacteria	Myxococcales	Polyangiaceae	Other
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	Other
Proteobacteria	Deltaproteobacteria	Myxococcales	Other	Other
Proteobacteria	Gammaproteobacteria	Legionellales	Other	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Beijerinckiaceae	Other
Proteobacteria	Betaproteobacteria	Burkholderiales	Other	Other
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Sinobacteraceae	Other
Proteobacteria	Gammaproteobacteria	Legionellales	Legionellaceae	Other
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	Other
Proteobacteria	Alphaproteobacteria	Caulobacteriales	Caulobacteraceae	Other
Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Phyllobacteriaceae	Other

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Alphaproteobacteria	Rickettsiales	mitochondria	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylocystaceae	Other
Proteobacteria	Alphaproteobacteria	Rhodobacterales	Rhodobacteraceae	Other
Proteobacteria	Other	Other	Other	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Brucellaceae	Other
Proteobacteria	Betaproteobacteria	Methylophilales	Other	Other
Proteobacteria	Deltaproteobacteria	Other	Other	Other
Proteobacteria	Betaproteobacteria	Burkholderiales	Alcaligenaceae	Other
Proteobacteria	Betaproteobacteria	Methylophilales	Methylophilaceae	Other
Proteobacteria	Gammaproteobacteria	Alteromonadales	Alteromonadaceae	Other
Proteobacteria	Alphaproteobacteria	Rhizobiales	Aurantimonadaceae	Other
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	Other
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	Other
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	Other
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Other	Other
Proteobacteria	Deltaproteobacteria	Desulfuromonadales	Other	Other
Proteobacteria	Gammaproteobacteria	Chromatiales	Other	Other
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	Other
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Pseudomonadaceae	Other
Proteobacteria	Betaproteobacteria	Neisseriales	Neisseriaceae	Other
Proteobacteria	Gammaproteobacteria	Legionellales	Coxiellaceae	Other
TM6	SJA-4	Other	Other	Other
TM7	Other	Other	Other	Other
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	Other	Other
Verrucomicrobia	Other	Other	Other	Other
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	Other
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	[Pedosphaeraceae]	Other
WS3	PRR-12	Sediment-1	Other	Other
Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	<i>Oxalobacter</i>
Firmicutes	Bacilli	Bacillales	Paenibacillaceae	<i>Paenibacillus</i>
Firmicutes	Bacilli	Bacillales	Planococcaceae	<i>Paenisporosarcina</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Burkholderiaceae	<i>Pandoraea</i>
Chlamydiae	Chlamydiia	Chlamydiales	Parachlamydiaceae	<i>Parachlamydia</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	<i>Parvibaculum</i>
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	Sphingobacteriaceae	<i>Pedobacter</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	<i>Pedomicrobium</i>
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	[Pedosphaeraceae]	<i>Pedosphaera</i>
Proteobacteria	Deltaproteobacteria	Desulfuromonadales	Pelobacteraceae	<i>Pelobacter</i>
Firmicutes	Clostridia	Clostridiales	Veillonellaceae	<i>Pelosinus</i>
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	<i>Perlucidibaca</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	<i>Phaeospirillum</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Alphaproteobacteria	Caulobacterales	Caulobacteraceae	<i>Phenylobacterium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Intrasporangiaceae	<i>Phycococcus</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Phyllobacteriaceae	<i>Phyllobacterium</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Alcaligenaceae	<i>Pigmentiphaga</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Pilimelia</i>
Planctomycetes	Planctomycetia	Pirellulales	Pirellulaceae	<i>Pirellula</i>
Planctomycetes	Planctomycetia	Planctomycetales	Planctomycetaceae	<i>Planctomyces</i>
Firmicutes	Bacilli	Bacillales	Thermoactinomycetaceae	<i>Planifilum</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylocystaceae	<i>Pleomorphomonas</i>
Proteobacteria	Deltaproteobacteria	Myxococcales	Nannocystaceae	<i>Plesiocystis</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Polaromonas</i>
Proteobacteria	Betaproteobacteria	Procabacteriales	Procabacteriaceae	<i>Procabacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Promicromonosporaceae	<i>Promicromonospora</i>
Verrucomicrobia	Verrucomicrobiae	Verrucomicrobiales	Verrucomicrobiaceae	<i>Prostheco bacter</i>
Firmicutes	Clostridia	Clostridiales	Clostridiaceae	<i>Proteiniclasticum</i>
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Pseudomonadaceae	<i>Pseudomonas</i>
Actinobacteria	Actinobacteria	Actinomycetales	Pseudonocardiaceae	<i>Pseudonocardia</i>
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	<i>Psychrobacter</i>
Bacteroidetes	Bacteroidia	Bacteroidales	Rikenellaceae	<i>PW3</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Ramlibacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Rathayibacter</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Rhizobiaceae	<i>Rhizobium</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	<i>Rhodanobacter</i>
Proteobacteria	Alphaproteobacteria	Rhodobacterales	Rhodobacteraceae	<i>Rhodobacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Nocardiaceae	<i>Rhodococcus</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	<i>Rhodoplanes</i>
Proteobacteria	Alphaproteobacteria	Rickettsiales	Rickettsiaceae	<i>Rickettsia</i>
Proteobacteria	Gammaproteobacteria	Legionellales	Coxiellaceae	<i>Rickettsiella</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Roseateles</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	<i>Roseococcus</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Rubrivivax</i>
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	<i>Salinibacterium</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Burkholderiaceae	<i>Salinispora</i>
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	<i>Sediminibacterium</i>
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	<i>Segetibacter</i>
Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae	<i>Serratia</i>
Firmicutes	Bacilli	Bacillales	Thermoactinomycetaceae	<i>Shimazuella</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	<i>Skermanella</i>
Firmicutes	Bacilli	Bacillales	Planococcaceae	<i>Solibacillus</i>
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	Sphingobacteriaceae	<i>Solitalea</i>
Actinobacteria	Actinobacteria	Actinomycetales	Streptosporangiaceae	<i>Sphaerisporangium</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	Sphingobacteriaceae	<i>Sphingobacterium</i>
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	<i>Sphingobium</i>
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	<i>Sphingomonas</i>
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	<i>Sphingopyxis</i>
Spirochaetes	Spirochaetes	Spirochaetales	Spirochaetaceae	<i>Spirochaeta</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Spirosoma</i>
Actinobacteria	Actinobacteria	Actinomycetales	Sporichthyaceae	<i>Sporichthya</i>
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	<i>Sporocytophaga</i>
Firmicutes	Clostridia	Clostridiales	Veillonellaceae	<i>Sporomusa</i>
Firmicutes	Bacilli	Bacillales	Planococcaceae	<i>Sporosarcina</i>
Firmicutes	Bacilli	Bacillales	Staphylococcaceae	<i>Staphylococcus</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	<i>Stenotrophomonas</i>
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Sinobacteraceae	<i>Steroidobacter</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Sterolibacterium</i>
Actinobacteria	Actinobacteria	Actinomycetales	Streptomyetaceae	<i>Streptacidiphilus</i>
Actinobacteria	Actinobacteria	Actinomycetales	Streptomyetaceae	<i>Streptomyces</i>
Actinobacteria	Actinobacteria	Actinomycetales	Streptosporangiaceae	<i>Streptosporangium</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Sulfuritalea</i>
Firmicutes	Clostridia	Clostridiales	Symbiobacteriaceae	<i>Symbiobacterium</i>
Proteobacteria	Deltaproteobacteria	Syntrophobacteriales	Syntrophobacteraceae	<i>Syntrophobacter</i>
Proteobacteria	Gammaproteobacteria	Legionellales	Legionellaceae	<i>Tatlockia</i>
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	<i>Telmatospirillum</i>
Firmicutes	Clostridia	Clostridiales	Peptostreptococcaceae	<i>Tepidibacter</i>
Actinobacteria	Actinobacteria	Actinomycetales	Intrasporangiaceae	<i>Terracoccus</i>
Acidobacteria	Acidobacteriia	Acidobacteriales	Acidobacteriaceae	<i>Terriglobus</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Thauera</i>
Proteobacteria	Betaproteobacteria	Hydrogenophilales	Hydrogenophilaceae	<i>Thiobacillus</i>
Firmicutes	Clostridia	Clostridiales	[Tissierellaceae]	<i>Tissierella_Soehngenia</i>
Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae	<i>Trabulsiella</i>
Spirochaetes	Spirochaetes	Spirochaetales	Spirochaetaceae	<i>Treponema</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>TS34</i>
Firmicutes	Bacilli	Turicibacterales	Turicibacteraceae	<i>Turicibacter</i>
Spirochaetes	[Leptospirae]	[Leptospirales]	Leptospiraceae	<i>Turneriella</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Uliginosibacterium</i>
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	<i>Variovorax</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Verrucosispora</i>
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	<i>Virgisporangium</i>
Chlamydiae	Chlamydiia	Chlamydiales	Waddliaceae	<i>Waddlia</i>
Proteobacteria	Alphaproteobacteria	Rickettsiales	Rickettsiaceae	<i>Wolbachia</i>
Proteobacteria	Alphaproteobacteria	Rhizobiales	Xanthobacteraceae	<i>Xanthobacter</i>
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	<i>Zoogloea</i>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
-	-	-	-	-
Acidobacteria	DA052	Ellin6513	-	-
Acidobacteria	Acidobacteriia	Acidobacteriales	Koribacteraceae	-
Acidobacteria	Solibacteres	Solibacterales	-	-
Acidobacteria	[Chloracidobacteria]	RB41	-	-
Acidobacteria	iii1-8	32-20	-	-
Acidobacteria	Acidobacteriia	Acidobacteriales	Acidobacteriaceae	-
Acidobacteria	Acidobacteria-6	iii1-15	-	-
Acidobacteria	iii1-8	DS-18	-	-
Acidobacteria	Acidobacteria-6	CCU21	-	-
Acidobacteria	Sva0725	Sva0725	-	-
Acidobacteria	[Chloracidobacteria]	RB41	Ellin6075	-
Acidobacteria	[Chloracidobacteria]	42332	-	-
Acidobacteria	-	-	-	-
Acidobacteria	S035	-	-	-
Acidobacteria	RB25	-	-	-
Acidobacteria	Acidobacteria-6	iii1-15	mb2424	-
Acidobacteria	TM1	-	-	-
Acidobacteria	Solibacteres	Solibacterales	Solibacteraceae	-
Acidobacteria	Solibacteres	Solibacterales	PAUC26f	-
Acidobacteria	iii1-8	SJA-36	-	-
Acidobacteria	[Chloracidobacteria]	Ellin7246	-	-
Acidobacteria	[Chloracidobacteria]	DS-100	-	-
Acidobacteria	Acidobacteria-5	-	-	-
Acidobacteria	Solibacteres	JH-WHS99	-	-
Acidobacteria	BPC102	MVS-40	-	-
Acidobacteria	Acidobacteria-6	iii1-15	RB40	-
Acidobacteria	AT-s54	-	-	-
Acidobacteria	[Chloracidobacteria]	PK29	-	-
Acidobacteria	EC1113	-	-	-
Acidobacteria	GAL08	-	-	-
Acidobacteria	Holophagae	Holophagales	Holophagaceae	-
Acidobacteria	Solibacteres	Solibacterales	[Bryobacteraceae]	-
Acidobacteria	PAUC37f	-	-	-
Acidobacteria	Solibacteres	Solibacterales	AKIW659	-
Acidobacteria	BPC102	-	-	-
Acidobacteria	[Chloracidobacteria]	-	-	-
Acidobacteria	iii1-8	-	-	-
Acidobacteria	Acidobacteriia	Acidobacteriales	-	-
Actinobacteria	Thermoleophilia	Gaiellales	Gaiellaceae	-
Actinobacteria	Thermoleophilia	Solirubrobacterales	-	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Actinobacteria	Acidimicrobiia	Acidimicrobiales	EB1017	-
Actinobacteria	Actinobacteria	Actinomycetales	-	-
Actinobacteria	Acidimicrobiia	Acidimicrobiales	-	-
Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae	-
Actinobacteria	MB-A2-108	0319-7L14	-	-
Actinobacteria	Acidimicrobiia	Acidimicrobiales	C111	-
Actinobacteria	Thermoleophilia	Gaiellales	-	-
Actinobacteria	Actinobacteria	Actinomycetales	Frankiaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Micromonosporaceae	-
Actinobacteria	Thermoleophilia	Solirubrobacterales	Conexibacteraceae	-
Actinobacteria	Thermoleophilia	Solirubrobacterales	Solirubrobacteraceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Nocardiodaceae	-
Actinobacteria	Thermoleophilia	Solirubrobacterales	Patulibacteraceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Pseudonocardiaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Nakamurellaceae	-
Actinobacteria	MB-A2-108	-	-	-
Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Streptomycetaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Sporichthyaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Actinospicaceae	-
Actinobacteria	Rubrobacteria	Rubrobacterales	Rubrobacteraceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Kineosporiaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Intrasporangiaceae	-
Actinobacteria	Actinobacteria	Micrococcales	-	-
Actinobacteria	Actinobacteria	Actinomycetales	Thermomonosporaceae	-
Actinobacteria	Thermoleophilia	Gaiellales	AK1AB1_02E	-
Actinobacteria	Actinobacteria	Actinomycetales	Cryptosporangiaceae	-
Actinobacteria	Acidimicrobiia	Acidimicrobiales	AKIW874	-
Actinobacteria	Acidimicrobiia	Acidimicrobiales	Microthrixaceae	-
Actinobacteria	Actinobacteria	Actinomycetales	Actinosynnemataceae	-
Actinobacteria	Acidimicrobiia	Acidimicrobiales	JdFBGBact	-
Actinobacteria	Actinobacteria	Actinomycetales	Geodermatophilaceae	-
Actinobacteria	OPB41	-	-	-
Actinobacteria	Actinobacteria	Actinomycetales	ACK-M1	-
AD3	ABS-6	-	-	-
AD3	JG37-AG-4	-	-	-
AD3	-	-	-	-
Armatimonadetes	Chthonomonadetes	Chthonomonadales	Chthonomonadaceae	-
Armatimonadetes	0319-6E2	-	-	-
Armatimonadetes	[Fimbriimonadia]	[Fimbriimonadales]	[Fimbriimonadaceae]	-
Armatimonadetes	Armatimonadia	FW68	-	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Armatimonadetes	Chthonomonadetes	SJA-22	-	-
Armatimonadetes	Armatimonadia	Armatimonadales	Armatimonadaceae	-
Armatimonadetes	OPB50	-	-	-
Armatimonadetes	[Fimbriimonadia]	[Fimbriimonadales]	-	-
Armatimonadetes	SHA-37	-	-	-
Armatimonadetes	SJA-176	RB046	-	-
Armatimonadetes	SJA-176	-	-	-
Armatimonadetes	SJA-176	GAB-B06	-	-
Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae	-
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	-	-
Bacteroidetes	Sphingobacteriia	Sphingobacteriales	Sphingobacteriaceae	-
Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae	-
Bacteroidetes	[Saprospirae]	[Saprospirales]	-	-
Bacteroidetes	[Saprospirae]	[Saprospirales]	Saprospiraceae	-
Bacteroidetes	At12OctB3	-	-	-
Bacteroidetes	Flavobacteriia	Flavobacteriales	Cryomorphaceae	-
Bacteroidetes	Bacteroidia	Bacteroidales	-	-
Bacteroidetes	Bacteroidia	Bacteroidales	Rikenellaceae	-
Bacteroidetes	Cytophagia	Cytophagales	[Amoebophilaceae]	-
Bacteroidetes	VC2_1_Bac22	-	-	-
Bacteroidetes	Bacteroidia	Bacteroidales	GZKB119	-
Bacteroidetes	Cytophagia	Cytophagales	-	-
BHI80-139	-	-	-	-
BRC1	PRR-11	-	-	-
BRC1	NPL-UPA2	-	-	-
Chlamydiae	Chlamydiia	Chlamydiales	-	-
Chlamydiae	Chlamydiia	Chlamydiales	Parachlamydiaceae	-
Chlamydiae	Chlamydiia	-	-	-
Chlamydiae	Chlamydiia	Chlamydiales	Waddliaceae	-
Chlamydiae	Chlamydiia	Chlamydiales	Chlamydiaceae	-
Chlorobi	-	-	-	-
Chlorobi	SJA-28	-	-	-
Chlorobi	OPB56	-	-	-
Chlorobi	BSV26	A89	-	-
Chlorobi	BSV26	PK329	-	-
Chlorobi	BSV26	C20	-	-
Chlorobi	Ignavibacteria	Ignavibacteriales	Ignavibacteriaceae	-
Chloroflexi	Ellin6529	-	-	-
Chloroflexi	TK10	B07_WMSP1	FFCH4570	-
Chloroflexi	Anaerolineae	SBR1031	oc28	-
Chloroflexi	S085	-	-	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Chloroflexi	Ktedonobacteria	Thermogemmatisporales	Thermogemmatisporaceae	-
Chloroflexi	Anaerolineae	SBR1031	A4b	-
Chloroflexi	Anaerolineae	H39	-	-
Chloroflexi	Chloroflexi	[Roseiflexales]	[Kouleothrixaceae]	-
Chloroflexi	TK17	-	-	-
Chloroflexi	Ktedonobacteria	JG30-KF-AS9	-	-
Chloroflexi	TK10	B07_WMSP1	-	-
Chloroflexi	TK10	AKYG885	5B-12	-
Chloroflexi	C0119	-	-	-
Chloroflexi	Anaerolineae	A31	S47	-
Chloroflexi	Gitt-GS-136	-	-	-
Chloroflexi	Anaerolineae	CFB-26	-	-
Chloroflexi	TK17	mle1-48	-	-
Chloroflexi	Ktedonobacteria	Ktedonobacterales	Ktedonobacteraceae	-
Chloroflexi	TK10	AKYG885	Dolo_23	-
Chloroflexi	Ktedonobacteria	TK10	-	-
Chloroflexi	Anaerolineae	SHA-20	-	-
Chloroflexi	Anaerolineae	envOPS12	-	-
Chloroflexi	Thermomicrobia	JG30-KF-CM45	-	-
Chloroflexi	Anaerolineae	WCHB1-50	-	-
Chloroflexi	TK10	-	-	-
Chloroflexi	Anaerolineae	SB-34	-	-
Chloroflexi	Chloroflexi	[Roseiflexales]	-	-
Chloroflexi	Anaerolineae	Caldilineales	Caldilineaceae	-
Chloroflexi	Thermomicrobia	Ellin6537	-	-
Chloroflexi	Anaerolineae	S0208	-	-
Chloroflexi	Ktedonobacteria	-	-	-
Chloroflexi	Anaerolineae	GCA004	-	-
Chloroflexi	Ktedonobacteria	B12-WMSP1	-	-
Chloroflexi	SHA-26	-	-	-
Chloroflexi	Chloroflexi	AKIW781	-	-
Chloroflexi	SAR202	-	-	-
Chloroflexi	P2-11E	-	-	-
Chloroflexi	Anaerolineae	-	-	-
Chloroflexi	-	-	-	-
Chloroflexi	Thermomicrobia	AKYG1722	-	-
Chloroflexi	Anaerolineae	A31	-	-
Chloroflexi	Anaerolineae	SBR1031	SJA-101	-
Chloroflexi	Anaerolineae	pLW-97	-	-
Chloroflexi	Chloroflexi	Chloroflexales	01D2Z48	-
Chloroflexi	Chloroflexi	Chloroflexales	FFCH7168	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Chloroflexi	Ktedonobacteria	Elev-1554	-	-
Chloroflexi	Anaerolineae	Anaerolineales	Anaerolinaceae	-
Chloroflexi	Thermomicrobia	-	-	-
Chloroflexi	Anaerolineae	SBR1031	SHA-31	-
Chloroflexi	Chloroflexi	Herpetosiphonales	-	-
Cyanobacteria	4C0d-2	MLE1-12	-	-
Cyanobacteria	ML635J-21	-	-	-
Cyanobacteria	Chloroplast	Stramenopiles	-	-
Cyanobacteria	4C0d-2	SM1D11	-	-
Cyanobacteria	Chloroplast	Streptophyta	-	-
Cyanobacteria	Chloroplast	Chlorophyta	-	-
Elusimicrobia	Elusimicrobia	FAC88	-	-
Elusimicrobia	Elusimicrobia	IIb	-	-
Elusimicrobia	Elusimicrobia	Elusimicrobiales	-	-
Elusimicrobia	Endomicrobia	-	-	-
Elusimicrobia	Elusimicrobia	MVP-88	-	-
Elusimicrobia	-	-	-	-
FBP	-	-	-	-
FCPU426	-	-	-	-
Fibrobacteres	Fibrobacteria	258ds10	-	-
Fibrobacteres	SBZC_2415	-	-	-
Firmicutes	Bacilli	Bacillales	Bacillaceae	-
Firmicutes	Bacilli	Bacillales	Planococcaceae	-
Firmicutes	Clostridia	Clostridiales	Ruminococcaceae	-
Firmicutes	Bacilli	Bacillales	-	-
Firmicutes	Clostridia	Clostridiales	Lachnospiraceae	-
Firmicutes	Clostridia	Clostridiales	Peptostreptococcaceae	-
Firmicutes	Clostridia	Clostridiales	Clostridiaceae	-
Firmicutes	Bacilli	Bacillales	Thermoactinomycetaceae	-
Firmicutes	Clostridia	Clostridiales	-	-
Firmicutes	Clostridia	Clostridiales	Gracilibacteraceae	-
Firmicutes	Bacilli	Bacillales	Alicyclobacillaceae	-
Firmicutes	Clostridia	OPB54	-	-
Firmicutes	Bacilli	Bacillales	[Exiguobacteraceae]	-
Firmicutes	Clostridia	Clostridiales	Veillonellaceae	-
Firmicutes	Bacilli	Bacillales	Paenibacillaceae	-
Firmicutes	Clostridia	Clostridiales	Christensenellaceae	-
GAL15	-	-	-	-
Gemmatimonadetes	Gemm-1	-	-	-
Gemmatimonadetes	Gemmatimonadetes	N1423WL	-	-
Gemmatimonadetes	Gemmatimonadetes	Ellin5290	-	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Gemmatimonadetes	Gemmatimonadetes	-	-	-
Gemmatimonadetes	Gemmatimonadetes	Gemmatimonadales	Ellin5301	-
Gemmatimonadetes	Gemmatimonadetes	KD8-87	-	-
Gemmatimonadetes	Gemm-5	-	-	-
Gemmatimonadetes	Gemmatimonadetes	C114	-	-
Gemmatimonadetes	Gemm-2	-	-	-
Gemmatimonadetes	Gemmatimonadetes	Gemmatimonadales	-	-
Gemmatimonadetes	Gemm-3	-	-	-
Gemmatimonadetes	-	-	-	-
GN02	GN07	-	-	-
GN02	3BR-5F	-	-	-
GN02	GKS2-174	-	-	-
GN02	BB34	-	-	-
GN04	MSB-5A5	-	-	-
GN04	-	-	-	-
GOUTA4	-	-	-	-
Kazan-3B-28	-	-	-	-
MVP-21	-	-	-	-
Nitrospirae	Nitrospira	Nitrospirales	0319-6A21	-
Nitrospirae	Nitrospira	Nitrospirales	[Leptospirillaceae]	-
Nitrospirae	Nitrospira	Nitrospirales	Nitrospiraceae	-
Nitrospirae	Nitrospira	Nitrospirales	-	-
Nitrospirae	Nitrospira	Nitrospirales	4-29	-
NKB19	-	-	-	-
NKB19	TSBW08	-	-	-
OD1	ZB2	-	-	-
OD1	SM2F11	-	-	-
OD1	-	-	-	-
OD1	ABY1	-	-	-
OD1	Mb-NB09	-	-	-
OP11	OP11-3	-	-	-
OP11	-	-	-	-
OP11	WCHB1-64	d153	-	-
OP11	OP11-4	-	-	-
OP11	WCHB1-64	-	-	-
OP11	OP11-1	-	-	-
OP3	koll11	-	-	-
OP3	PBS-25	-	-	-
OP3	koll11	GIF10	kpj58rc	-
PAUC34f	-	-	-	-
Planctomycetes	Planctomycetia	Gemmatales	Gemmataceae	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Planctomycetes	Phycisphaerae	WD2101	-	-
Planctomycetes	Planctomycetia	Gemmatales	Isosphaeraceae	-
Planctomycetes	Planctomycetia	Pirellulales	Pirellulaceae	-
Planctomycetes	OM190	agg27	-	-
Planctomycetes	Phycisphaerae	Phycisphaerales	-	-
Planctomycetes	BD7-11	-	-	-
Planctomycetes	Phycisphaerae	CPla-3	-	-
Planctomycetes	vadinHA49	p04_C01	-	-
Planctomycetes	Phycisphaerae	S-70	-	-
Planctomycetes	Phycisphaerae	Pla1	-	-
Planctomycetes	-	-	-	-
Planctomycetes	C6	MVS-107	-	-
Planctomycetes	OM190	CL500-15	-	-
Planctomycetes	Phycisphaerae	mle1-8	-	-
Planctomycetes	Pla3	-	-	-
Planctomycetes	Pla4	-	-	-
Planctomycetes	028H05-P-BN-P5	-	-	-
Planctomycetes	Phycisphaerae	CCM11a	-	-
Planctomycetes	vadinHA49	DH61	-	-
Planctomycetes	Phycisphaerae	Phycisphaerales	Phycisphaeraceae	-
Planctomycetes	Planctomycetia	B97	-	-
Planctomycetes	C6	d113	-	-
Planctomycetes	OM190	-	-	-
Planctomycetes	Phycisphaerae	AKAU3564	-	-
Planctomycetes	ODP123	-	-	-
Planctomycetes	Phycisphaerae	C86	-	-
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Sinobacteraceae	-
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Rhodospirillaceae	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bradyrhizobiaceae	-
Proteobacteria	Deltaproteobacteria	Syntrophobacterales	Syntrophobacteraceae	-
Proteobacteria	Betaproteobacteria	-	-	-
Proteobacteria	Alphaproteobacteria	Ellin329	-	-
Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae	-
Proteobacteria	Deltaproteobacteria	Myxococcales	-	-
Proteobacteria	Betaproteobacteria	A21b	EB1003	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Hyphomicrobiaceae	-
Proteobacteria	Betaproteobacteria	Ellin6067	-	-
Proteobacteria	Betaproteobacteria	SC-I-84	-	-
Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	-	-
Proteobacteria	Alphaproteobacteria	-	-	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	-
Proteobacteria	Betaproteobacteria	Burkholderiales	Comamonadaceae	-
Proteobacteria	Deltaproteobacteria	Myxococcales	Haliangiaceae	-
Proteobacteria	Betaproteobacteria	MND1	-	-
Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	-
Proteobacteria	Gammaproteobacteria	Legionellales	Coxiellaceae	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylocystaceae	-
Proteobacteria	Betaproteobacteria	IS-44	-	-
Proteobacteria	Alphaproteobacteria	Caulobacterales	Caulobacteraceae	-
Proteobacteria	Deltaproteobacteria	Myxococcales	Myxococcaceae	-
Proteobacteria	Alphaproteobacteria	Rhodobacterales	Hyphomonadaceae	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Beijerinckiaceae	-
Proteobacteria	Betaproteobacteria	Burkholderiales	Alcaligenaceae	-
Proteobacteria	Gammaproteobacteria	Thiotrichales	Piscirickettsiaceae	-
Proteobacteria	Gammaproteobacteria	Legionellales	-	-
Proteobacteria	Deltaproteobacteria	MIZ46	-	-
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	-
Proteobacteria	Deltaproteobacteria	Myxococcales	Polyangiaceae	-
Proteobacteria	Deltaproteobacteria	-	-	-
Proteobacteria	Gammaproteobacteria	HTCC2188	HTCC2089	-
Proteobacteria	Deltaproteobacteria	NB1-j	NB1-i	-
Proteobacteria	Deltaproteobacteria	NB1-j	MND4	-
Proteobacteria	Alphaproteobacteria	BD7-3	-	-
Proteobacteria	Deltaproteobacteria	[Entotheonellales]	[Entotheonellaceae]	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Phyllobacteriaceae	-
Proteobacteria	Alphaproteobacteria	Rickettsiales	-	-
Proteobacteria	Gammaproteobacteria	Chromatiales	Ectothiorhodospiraceae	-
Proteobacteria	Deltaproteobacteria	NB1-j	-	-
Proteobacteria	Deltaproteobacteria	Spirobacillales	-	-
Proteobacteria	Betaproteobacteria	A21b	UD5	-
Proteobacteria	Betaproteobacteria	Burkholderiales	-	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Xanthobacteraceae	-
Proteobacteria	Deltaproteobacteria	Myxococcales	OM27	-
Proteobacteria	Betaproteobacteria	Nitrosomonadales	Nitrosomonadaceae	-
Proteobacteria	TA18	CV90	-	-
Proteobacteria	Deltaproteobacteria	FAC87	-	-
Proteobacteria	Betaproteobacteria	Methylophilales	-	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Rhizobiaceae	-
Proteobacteria	Betaproteobacteria	Rhodocyclales	Rhodocyclaceae	-
Proteobacteria	Alphaproteobacteria	Rhodospirillales	-	-
Proteobacteria	Betaproteobacteria	Methylophilales	Methylophilaceae	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	TA18	PHOS-HD29	-	-
Proteobacteria	Gammaproteobacteria	-	-	-
Proteobacteria	Deltaproteobacteria	Myxococcales	Cystobacterineae	-
Proteobacteria	Gammaproteobacteria	Legionellales	Legionellaceae	-
Proteobacteria	Alphaproteobacteria	Sphingomonadales	Erythrobacteraceae	-
Proteobacteria	Gammaproteobacteria	Chromatiales	-	-
Proteobacteria	-	-	-	-
Proteobacteria	Alphaproteobacteria	Rickettsiales	Rickettsiaceae	-
Proteobacteria	Betaproteobacteria	Procabacteriales	Procabacteriaceae	-
Proteobacteria	Deltaproteobacteria	Myxococcales	0319-6G20	-
Proteobacteria	Betaproteobacteria	Burkholderiales	Burkholderiaceae	-
Proteobacteria	Betaproteobacteria	SBla14	-	-
Proteobacteria	Deltaproteobacteria	Bdellovibrionales	Bdellovibrionaceae	-
Proteobacteria	Betaproteobacteria	Nitrosomonadales	-	-
Proteobacteria	Gammaproteobacteria	Alteromonadales	OM60	-
Proteobacteria	Betaproteobacteria	Neisseriales	Neisseriaceae	-
Proteobacteria	Deltaproteobacteria	Syntrophobacterales	Syntrophaceae	-
Proteobacteria	Gammaproteobacteria	Acidithiobacillales	-	-
Proteobacteria	Deltaproteobacteria	Bdellovibrionales	Bacteriovoracaceae	-
Proteobacteria	Alphaproteobacteria	Sphingomonadales	-	-
Proteobacteria	Betaproteobacteria	Thiobacterales	-	-
Proteobacteria	Deltaproteobacteria	Sva0853	JTB36	-
Proteobacteria	Deltaproteobacteria	NB1-j	JTB38	-
Proteobacteria	Alphaproteobacteria	Rhodobacterales	Rhodobacteraceae	-
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Moraxellaceae	-
Proteobacteria	Gammaproteobacteria	Alteromonadales	125ds10	-
Proteobacteria	Deltaproteobacteria	Desulfobacterales	Desulfobulbaceae	-
Proteobacteria	Deltaproteobacteria	Desulfovibrionales	Desulfovibrionaceae	-
Proteobacteria	Deltaproteobacteria	AF420338	-	-
Proteobacteria	Deltaproteobacteria	PB19	-	-
Proteobacteria	Gammaproteobacteria	PYR10d3	-	-
Proteobacteria	Alphaproteobacteria	Kiloniellales	-	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Methylobacteriaceae	-
Proteobacteria	Gammaproteobacteria	Aeromonadales	Aeromonadaceae	-
Proteobacteria	Gammaproteobacteria	Alteromonadales	211ds20	-
Proteobacteria	Gammaproteobacteria	Pseudomonadales	Pseudomonadaceae	-
Proteobacteria	Gammaproteobacteria	Thiotrichales	-	-
Proteobacteria	Gammaproteobacteria	[Marinicellales]	[Marinicellaceae]	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Aurantimonadaceae	-
Proteobacteria	Alphaproteobacteria	Rhizobiales	Bartonellaceae	-
Proteobacteria	Alphaproteobacteria	Rickettsiales	mitochondria	-

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
Proteobacteria	Deltaproteobacteria	GMD14H09	-	-
Proteobacteria	Deltaproteobacteria	NKB15	-	-
Proteobacteria	Zetaproteobacteria	Mariprofundales	Mariprofundaceae	-
SBR1093	-	-	-	-
Spirochaetes	Spirochaetes	Spirochaetales	Spirochaetaceae	-
Spirochaetes	[Brevinematae]	[Brevinematales]	-	-
Spirochaetes	GN05	-	-	-
Tenericutes	Mollicutes	-	-	-
TM6	SJA-4	-	-	-
TM6	SBRH58	-	-	-
TM6	SJA-4	S1198	-	-
TM7	TM7-1	-	-	-
TM7	SC3	-	-	-
TM7	TM7-3	-	-	-
TM7	TM7-3	EW055	-	-
TM7	-	-	-	-
TM7	MJK10	-	-	-
TM7	TM7-3	I025	-	-
TM7	TM7-3	Blgi18	-	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	Ellin515	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	-	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	auto67_4W	-
Verrucomicrobia	[Methylacidiphilae]	S-BQ2-57	-	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	Ellin517	-
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	[Chthoniobacteraceae]	-
Verrucomicrobia	[Methylacidiphilae]	Methylacidiphilales	-	-
Verrucomicrobia	Verrucomicrobiae	Verrucomicrobiales	Verrucomicrobiaceae	-
Verrucomicrobia	Opitutae	Opitutales	Opitutaceae	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	R4-41B	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	OPB35	-
Verrucomicrobia	[Pedosphaerae]	[Pedosphaerales]	[Pedosphaeraceae]	-
Verrucomicrobia	-	-	-	-
Verrucomicrobia	Verruco-5	LD1-PB3	-	-
Verrucomicrobia	Opitutae	[Cerasicoccales]	[Cerasicoccaceae]	-
Verrucomicrobia	Verruco-5	WCHB1-41	-	-
Verrucomicrobia	Opitutae	-	-	-
Verrucomicrobia	[Methylacidiphilae]	Methylacidiphilales	LD19	-
Verrucomicrobia	[Spartobacteria]	[Chthoniobacterales]	01D2Z36	-
WPS-2	-	-	-	-
WS2	SHA-109	-	-	-
WS2	Kazan-3B-09	-	-	-

闫满玉, 杜晓军, 赵爱花, 彭明春. 河南宝天曼落叶阔叶林木本植物单物种 - 面积关系. 生物多样性, 2015, 23(5): 630-640.
<http://www.biodiversity-science.net/CN/10.17520/biods.2015031>

门 Phylum	纲 Class	目 Order	科 Family	属 Genus
WS3	PRR-12	Sediment-1	PRR-10	-
WS3	PRR-12	Sediment-1	-	-
WS3	PRR-12	LD1-PA13	-	-
WS3	PRR-12	-	-	-
WS3	PRR-12	Sediment-1	CV106	-
WS3	PRR-12	wb1_H11	-	-
WS4	-	-	-	-
ZB3	BS119	-	-	-

附录2 宝天曼森林动态监测样地31个土壤样品中检测到的不同分类水平上细菌优势类群及其相对丰度。其中Unknown代表未鉴定出的类群; Others代表丰度低于1%的类群; []代表分类信息有争议。

Appendix 2 Relative abundances of the dominant bacteria at different taxonomic levels in the 31 soil samples in the Baotianman Forest Dynamics Plot. Unknown means the taxa that can not be identified; Others represent the taxa whose relative abundances are less than 1%; [] means with controversial names..

附录3 宝天曼1 ha森林样地单物种小树个体对邻域全部树、大树和小树植物多样性的影响

Appendix 3 The influences of young individuals of different species on neighbor diversity of all, adult and young tree at different scales in the 1 ha Baotianman Forest Dynamics Plot

[illegible]