Incubator PCoA, PCA, NMDS, RDA

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### Background

This data is from a bottle incubation experiment. Water was collected from Maumee Bay, North Lake Erie, Green Bay and the mouth of the Ford River, placed into clear bottles and treated with NH4, PO4 and trace metals (Fe, Mo, Mn, Ni, Zn, Co) in replicate of 4 for each treatment. The control had no nutrients added, and the ‘chelex’ treatment removed trace metals via chelation with ‘chelex’. For these analyses I remove the chelex and initial treatments. After a 72 hour incubation, water was sampled and analyzed for ash free dry mass, chl-a, microcystin and community composition. Community composition was comepleted by counting 400 natural units per sample and identifying down to lowest taxonomic unit, or labelled as a morphospecies.

Load packages, data

Rarefy? and Calculate Bray Curtis Distance

#[,y1:y2] indicates the columns with species count data in them within the larger dataset... essentially subsets the counts from the other info  
#Maumee  
maum.bc=vegdist(maumcounts[,4:70], method="bray")  
maum.bc

## 2 3 4 5 6 7  
## 3 0.24663677   
## 4 0.23364486 0.15439430   
## 5 0.24032825 0.19189511 0.11332503   
## 6 0.22538293 0.22888889 0.17129630 0.17537747   
## 7 0.25231481 0.22352941 0.22358722 0.22564735 0.22247706   
## 8 0.22183508 0.13105077 0.19112207 0.24009901 0.27042578 0.27228327  
## 9 0.26840317 0.21749137 0.20768307 0.20481928 0.25701459 0.22711058  
## 10 0.25581395 0.23877069 0.17283951 0.20446097 0.19815668 0.23227384  
## 11 0.27699531 0.21002387 0.18952618 0.22152691 0.22093023 0.17037037  
## 12 0.35185185 0.26352941 0.24324324 0.28729963 0.29357798 0.26520681  
## 13 0.24000000 0.25282167 0.22823529 0.23730815 0.17621145 0.15151515  
## 14 0.19163763 0.16883117 0.17139334 0.11386139 0.17606444 0.21611722  
## 15 0.22272727 0.21709007 0.21686747 0.17775091 0.23198198 0.28639618  
## 16 0.25991189 0.29306488 0.24941725 0.20935673 0.20305677 0.24711316  
## 17 0.26927374 0.29171396 0.26863905 0.27078385 0.22923588 0.21688159  
## 18 0.22905028 0.16004540 0.19763314 0.16152019 0.20708749 0.18640094  
## 19 0.18959913 0.22332233 0.18900344 0.15862069 0.12781955 0.16004540  
## 20 0.20366133 0.18372093 0.12864078 0.09622412 0.16553288 0.22115385  
## 21 0.22197309 0.18451025 0.12589074 0.14421931 0.20222222 0.19764706  
## 22 0.36277603 0.37459979 0.34961154 0.36525612 0.35349322 0.31793179  
## 23 0.32964602 0.32134831 0.24590164 0.31844888 0.30701754 0.30162413  
## 24 0.17633675 0.13988439 0.15078408 0.19612591 0.20405862 0.24014337  
## 25 0.34083240 0.15885714 0.17759237 0.20334928 0.28874025 0.23966942  
## 26 0.31243243 0.27552141 0.26628571 0.30275229 0.27545552 0.28652322  
## 27 0.00000000 0.24663677 0.23364486 0.24032825 0.22538293 0.25231481  
## 28 0.32406417 0.29858849 0.26101695 0.33106576 0.31283139 0.30571109  
## 29 0.28104575 0.24778761 0.21889401 0.28554913 0.22462203 0.22831050  
## 30 0.40540541 0.45554336 0.43771429 0.47706422 0.41264737 0.39750849  
## 31 0.34816463 0.36045198 0.36866902 0.42553191 0.36493936 0.31855309  
## 32 0.28980527 0.29220023 0.26609964 0.28536585 0.28490352 0.24187726  
## 33 0.22209436 0.20701754 0.15995116 0.19852941 0.19726340 0.24546554  
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## 9 0.21957041   
## 10 0.21717791 0.14695341   
## 11 0.27633209 0.27382388 0.25806452   
## 12 0.28205128 0.32699168 0.26894866 0.19753086   
## 13 0.28421053 0.29076397 0.23419204 0.17257683 0.22377622   
## 14 0.21078431 0.21479714 0.22208589 0.24163569 0.33089133 0.23508772  
## 15 0.26467066 0.25087515 0.26858513 0.30750605 0.36515513 0.30205950  
## 16 0.33719583 0.31073446 0.27610209 0.25292740 0.34872979 0.25942350  
## 17 0.37176471 0.30733945 0.29799764 0.24613555 0.32239156 0.23284589  
## 18 0.20941176 0.21559633 0.22025913 0.24613555 0.32942556 0.23284589  
## 19 0.25968109 0.17555556 0.15849487 0.24280783 0.32803632 0.19083969  
## 20 0.24969843 0.23149236 0.22463768 0.23170732 0.31250000 0.23271889  
## 21 0.19480519 0.15304948 0.16075650 0.26014320 0.30588235 0.24379233  
## 22 0.42384106 0.46336207 0.41215470 0.28428094 0.26732673 0.29947090  
## 23 0.32712456 0.37343927 0.30769231 0.22588235 0.24825986 0.28507795  
## 24 0.14868106 0.23598131 0.22208884 0.21696970 0.28315412 0.26231386  
## 25 0.18483412 0.21939954 0.24080664 0.30299401 0.29161747 0.30690827  
## 26 0.30227273 0.32594235 0.28100114 0.22388060 0.20271801 0.26877040  
## 27 0.22183508 0.26840317 0.25581395 0.27699531 0.35185185 0.24000000  
## 28 0.27415730 0.28289474 0.23959505 0.29398411 0.22508399 0.29386437  
## 29 0.21878580 0.21787709 0.16972477 0.27314815 0.25570776 0.21710526  
## 30 0.46818182 0.50554324 0.46985210 0.32261768 0.41336353 0.40369967  
## 31 0.37704918 0.38127854 0.32239156 0.27810651 0.30921820 0.29451288  
## 32 0.35990338 0.36235294 0.32285369 0.16727717 0.24909747 0.23414072  
## 33 0.26941748 0.25295508 0.20048603 0.16564417 0.21402660 0.25840093  
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## 15 0.11616766   
## 16 0.18424102 0.17460317   
## 17 0.25411765 0.23590334 0.16833891   
## 18 0.13882353 0.18987342 0.22630992 0.28506787   
## 19 0.13439636 0.17279822 0.18486486 0.20394737 0.15131579   
## 20 0.12424608 0.18160377 0.19406393 0.24449594 0.15411356 0.14029181  
## 21 0.15702479 0.20554273 0.26398210 0.29398411 0.15777526 0.14631463  
## 22 0.39293598 0.41837838 0.33473242 0.27446809 0.40425532 0.36157025  
## 23 0.36437718 0.39179954 0.39514349 0.31914894 0.35722284 0.33984799  
## 24 0.15587530 0.19812427 0.28036322 0.30184332 0.16129032 0.19642857  
## 25 0.18720379 0.23290846 0.32659933 0.35763098 0.17084282 0.24061810  
## 26 0.32272727 0.36373749 0.34843581 0.32822757 0.31291028 0.29511677  
## 27 0.19163763 0.22272727 0.25991189 0.26927374 0.22905028 0.18959913  
## 28 0.35730337 0.37733773 0.40021345 0.40692641 0.34415584 0.30462185  
## 29 0.28980527 0.31165919 0.32826087 0.32965821 0.25248071 0.22139037  
## 30 0.47727273 0.49944383 0.40021575 0.38512035 0.42669584 0.43949045  
## 31 0.42857143 0.45933562 0.37402886 0.31531532 0.38288288 0.35807860  
## 32 0.30676329 0.31523022 0.25028571 0.19489559 0.31090487 0.28764045  
## 33 0.20388350 0.22657177 0.23076923 0.27505828 0.23076923 0.20316027  
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## 21 0.14883721   
## 22 0.35364527 0.38954109   
## 23 0.33256881 0.28764045 0.21390938   
## 24 0.19008264 0.13757225 0.35714286 0.25199544   
## 25 0.21586931 0.15885714 0.40685225 0.32807215 0.19721578   
## 26 0.32362822 0.28869374 0.28865979 0.19176598 0.25389755 0.35903084  
## 27 0.20366133 0.22197309 0.36277603 0.32964602 0.17633675 0.34083240  
## 28 0.34219269 0.25081433 0.33265306 0.25830654 0.26651982 0.27450980  
## 29 0.27990971 0.20575221 0.38940810 0.30567686 0.20538721 0.25638180  
## 30 0.46248600 0.45773875 0.25154639 0.26110509 0.37416481 0.53744493  
## 31 0.43021915 0.38079096 0.19915254 0.22630992 0.35091743 0.41950113  
## 32 0.29131986 0.33643772 0.18300654 0.21928817 0.29078014 0.37850467  
## 33 0.19952210 0.21403509 0.31728665 0.25951557 0.16389549 0.28403756  
## 26 27 28 29 30 31  
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## 27 0.31243243   
## 28 0.27672956 0.32406417   
## 29 0.27214514 0.28104575 0.18690602   
## 30 0.30508475 0.40540541 0.44234801 0.41942369   
## 31 0.23965142 0.34816463 0.33836207 0.34796926 0.23093682   
## 32 0.21973094 0.28980527 0.32815965 0.34915254 0.25560538 0.18706697  
## 33 0.19594595 0.22209436 0.27839644 0.24631101 0.35810811 0.31786543  
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## 33 0.20334928

#North Erie  
ne.bc=vegdist(necounts[,5:147], method="bray")  
ne.bc

## 2 3 4 5 6 7 8  
## 3 0.3030623   
## 4 0.3635448 0.2354260   
## 5 0.4019293 0.3894231 0.3416856   
## 6 0.4684096 0.4981640 0.3974508 0.4122042   
## 7 0.4974773 0.4674157 0.3589744 0.4063927 0.3658537   
## 8 0.3380282 0.3034714 0.2928647 0.4061433 0.3657407 0.2358591   
## 9 0.3064039 0.3019694 0.2625000 0.3955556 0.3717514 0.3736952 0.2424558  
## 10 0.5048026 0.3612440 0.3650794 0.4476886 0.5415118 0.4863636 0.4450736  
## 11 0.4579439 0.3805104 0.3546256 0.4858491 0.6326531 0.5894040 0.5335534  
## 12 0.4406605 0.4400922 0.3194748 0.4426230 0.3849821 0.3464912 0.2786885  
## 13 0.3358634 0.4459601 0.3193193 0.4888179 0.3874459 0.4924774 0.4360000  
## 14 0.4775161 0.4645858 0.3469852 0.4407814 0.3706468 0.2611174 0.2363636  
## 15 0.5464602 0.5143213 0.3875147 0.3840304 0.3540052 0.3553719 0.3811765  
## 16 0.4548872 0.4205607 0.2943508 0.4499473 0.4282655 0.4021847 0.3326733  
## 17 0.5207547 0.4723670 0.3393035 0.4941799 0.4387097 0.3080758 0.3061630  
## 18 0.4089936 0.3949580 0.2992036 0.4652015 0.2835821 0.3021665 0.2522727  
## 19 0.4766949 0.4424674 0.3520810 0.4234017 0.3611794 0.3010147 0.2741573  
## 20 0.2963753 0.3500597 0.3091733 0.4240583 0.2920792 0.3439274 0.2375566  
## 21 0.4488698 0.4202899 0.2883295 0.3906634 0.3516896 0.1995413 0.1931429  
## 22 0.4304388 0.4041237 0.2834646 0.4225941 0.4346440 0.4201183 0.3549656  
## 23 0.3150685 0.3219316 0.3211538 0.4632653 0.4404145 0.4951830 0.3640730  
## 24 0.2502210 0.3708738 0.2825279 0.4488189 0.4725275 0.4748603 0.3964717  
## 25 0.4249513 0.3989189 0.2996910 0.4226125 0.4620536 0.4716202 0.4094650  
## 26 0.4238342 0.4074074 0.4043956 0.5317647 0.5113772 0.5440529 0.4489572  
## 27 0.4411765 0.3513514 0.3244147 0.4289128 0.5450122 0.5329609 0.4766147  
## 28 0.3881857 0.3270366 0.2519597 0.3949580 0.4327628 0.4186308 0.3646532  
## 29 0.4745587 0.3549884 0.3700441 0.5589623 0.5966387 0.5496689 0.4345435  
## 30 0.4239130 0.3186813 0.3109827 0.4161491 0.5215190 0.4530707 0.4157044  
## 31 0.4486486 0.2864078 0.3402299 0.4543210 0.5094340 0.4239631 0.3731343  
## 32 0.4659459 0.2912621 0.3747126 0.4592593 0.5823899 0.4377880 0.4282434  
## 33 0.3389474 0.3875147 0.3765363 0.4946108 0.4926829 0.5229563 0.4553571  
## 9 10 11 12 13 14 15  
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## 10 0.4579646   
## 11 0.4924731 0.3262911   
## 12 0.3418803 0.3939394 0.4683258   
## 13 0.3868756 0.3764581 0.4262126 0.2841026   
## 14 0.3895671 0.4702309 0.5712603 0.2748538 0.4404255   
## 15 0.4282434 0.4955864 0.5848596 0.3963636 0.4549451 0.3012658   
## 16 0.2803104 0.5047219 0.5260470 0.4111675 0.4355140 0.4021053 0.4130435  
## 17 0.3943525 0.5363541 0.5733333 0.3496432 0.4784240 0.2854123 0.4497817  
## 18 0.2830189 0.4459295 0.5406360 0.3029240 0.3765957 0.2902439 0.3898734  
## 19 0.3238200 0.5126050 0.6088475 0.3664740 0.4947368 0.2891566 0.3575000  
## 20 0.2397790 0.4679565 0.5638921 0.3853318 0.3771186 0.3689320 0.3929471  
## 21 0.3370536 0.4278729 0.5308057 0.2611765 0.4395722 0.1803681 0.3452229  
## 22 0.3159923 0.2812500 0.3529412 0.2177419 0.2516249 0.3876698 0.4174757  
## 23 0.3088512 0.2947154 0.3524752 0.3641732 0.2788374 0.4841998 0.5226078  
## 24 0.3843352 0.3509804 0.3365201 0.3859316 0.2137203 0.4650934 0.5055724  
## 25 0.3856999 0.2765027 0.3347503 0.3157339 0.2500000 0.4539474 0.4580499  
## 26 0.4420601 0.3442623 0.4363636 0.5056433 0.3676622 0.5041128 0.5468940  
## 27 0.4036997 0.2080856 0.2733564 0.3654066 0.3361169 0.4916468 0.5148515  
## 28 0.3092896 0.2640382 0.3719583 0.2911392 0.2893082 0.3932854 0.4253731  
## 29 0.4322581 0.2840376 0.3895216 0.4909502 0.4344685 0.5170789 0.5848596  
## 30 0.3844419 0.4338690 0.4586826 0.4744352 0.5140389 0.4838710 0.5231959  
## 31 0.4439462 0.3194103 0.3904762 0.4255319 0.4264232 0.4303329 0.4596671  
## 32 0.4529148 0.4004914 0.4047619 0.5295508 0.5338346 0.4919852 0.4724712  
## 33 0.4285714 0.4159714 0.4520231 0.4925373 0.3577406 0.4928230 0.4937965  
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## 17 0.3587361   
## 18 0.3515789 0.2980973   
## 19 0.3541667 0.3054393 0.2192771   
## 20 0.3291405 0.3494737 0.1990291 0.2494005   
## 21 0.3417989 0.2284803 0.2245399 0.1975758 0.2527473   
## 22 0.4075437 0.3998153 0.3605016 0.4374354 0.4318418 0.3592437   
## 23 0.3825383 0.4742547 0.3537207 0.4550959 0.3218274 0.4487705 0.2754919  
## 24 0.4141238 0.4540682 0.3706981 0.4566699 0.3555338 0.4189723 0.2599653  
## 25 0.4222649 0.4450867 0.3969298 0.4750542 0.4148472 0.4046307 0.1744519  
## 26 0.4413863 0.5209826 0.4242068 0.5075494 0.4105263 0.4964539 0.4028340  
## 27 0.4896694 0.5207469 0.4606205 0.5400943 0.4869359 0.4525810 0.2369231  
## 28 0.4024896 0.4479167 0.3453237 0.4194313 0.3532220 0.3462002 0.2440783  
## 29 0.4177732 0.5015385 0.4204947 0.5064028 0.4349355 0.4739336 0.3752535  
## 30 0.4166667 0.4291845 0.3697270 0.4289216 0.3876543 0.4107366 0.4422057  
## 31 0.4558980 0.4983991 0.4303329 0.4811206 0.4380368 0.4143921 0.4008439  
## 32 0.4814028 0.5240128 0.4401973 0.4640682 0.4576687 0.4540943 0.4767932  
## 33 0.3995859 0.4864865 0.4162679 0.4940898 0.3928571 0.4536703 0.4532374  
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## 24 0.2088285   
## 25 0.2227400 0.2281335   
## 26 0.2628458 0.3263359 0.3764581   
## 27 0.3273273 0.3082126 0.2193548 0.4108170   
## 28 0.3185930 0.3152279 0.2591793 0.4890173 0.2042254   
## 29 0.2693069 0.3709369 0.3687566 0.2522727 0.3287197 0.3650058   
## 30 0.4250259 0.3818544 0.4253898 0.4647551 0.3665049 0.3829268 0.4251497  
## 31 0.3477366 0.3789683 0.3776301 0.4346793 0.3220748 0.3115152 0.3761905  
## 32 0.4279835 0.4186508 0.4640089 0.4655582 0.3872135 0.3769697 0.3690476  
## 33 0.3119358 0.2875121 0.4288793 0.3702422 0.3934426 0.4117647 0.3849711  
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## 31 0.3149310   
## 32 0.3023839 0.2019950   
## 33 0.3819951 0.3542926 0.3784764

#Green Bay  
gb.bc=vegdist(gbcounts[,5:52], method="bray")  
gb.bc

## 2 3 4 5 6 7 8  
## 3 0.2281498   
## 4 0.2206969 0.2066277   
## 5 0.4090909 0.4273224 0.3965341   
## 6 0.2229167 0.2338787 0.2054299 0.5311871   
## 7 0.3256039 0.3357271 0.2627119 0.2609916 0.3679799   
## 8 0.3857143 0.3324775 0.3893491 0.5068120 0.3799534 0.4297964   
## 9 0.2284644 0.2795455 0.3932347 0.4155689 0.3284672 0.4274662 0.3533619  
## 10 0.1935081 0.2454545 0.2790698 0.2934132 0.3201251 0.2998066 0.3390558  
## 11 0.3161132 0.3363229 0.3757829 0.1806375 0.4026777 0.3001912 0.4345992  
## 12 0.3012346 0.2373453 0.2376963 0.3104265 0.3202479 0.3020134 0.2683616  
## 13 0.3682927 0.2436040 0.2580311 0.3395785 0.3271984 0.3789174 0.3286908  
## 14 0.3260437 0.2294931 0.2927889 0.4019231 0.3247423 0.3075061 0.4424779  
## 15 0.3001186 0.3362256 0.3198381 0.1311288 0.4465534 0.1877323 0.4278003  
## 16 0.1587678 0.3001083 0.2173913 0.2824601 0.3253493 0.2311978 0.4366577  
## 17 0.2737430 0.2327044 0.2915215 0.3840000 0.3066362 0.3551106 0.2019544  
## 18 0.2367257 0.2492370 0.2240229 0.3091684 0.2824859 0.1855761 0.3690773  
## 19 0.4865672 0.3210332 0.3756522 0.3358999 0.3860705 0.3021002 0.4485050  
## 20 0.3409350 0.3179916 0.3639922 0.3830955 0.3507246 0.3639640 0.3754839  
## 21 0.3266833 0.2531215 0.3474129 0.5311005 0.2729167 0.4647343 0.2828571  
## 22 0.3798257 0.2789116 0.3143460 0.3859020 0.3132154 0.3783784 0.3124108  
## 23 0.3241758 0.2515489 0.3035510 0.3805774 0.3453725 0.3673257 0.2204473  
## 24 0.3739837 0.3219094 0.4609287 0.4637306 0.4464286 0.5015448 0.3270440  
## 25 0.2570755 0.1952535 0.2265861 0.3809524 0.2942346 0.2691952 0.3136729  
## 26 0.3868132 0.3043478 0.3345972 0.2711864 0.3333333 0.2913386 0.4257426  
## 27 0.2734082 0.2704545 0.3594080 0.4994012 0.2909281 0.3926499 0.2532189  
## 28 0.1910903 0.2682403 0.3507014 0.4227734 0.3471810 0.3591160 0.4300932  
## 29 0.3390453 0.2790179 0.3555094 0.3772033 0.3558974 0.3980952 0.3790210  
## 30 0.2296296 0.2755906 0.3591623 0.3791469 0.3326446 0.3940556 0.3333333  
## 31 0.2666667 0.3565804 0.3738220 0.3317536 0.3925620 0.3576222 0.4039548  
## 32 0.1935081 0.2840909 0.3002114 0.4419162 0.2533889 0.2862669 0.3476395  
## 33 0.2294264 0.2849035 0.2861668 0.3086124 0.3687500 0.2753623 0.3800000  
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## 11 0.2857143 0.1576355   
## 12 0.2880099 0.1619283 0.2107186   
## 13 0.3260073 0.2454212 0.2466907 0.1449275   
## 14 0.3950249 0.2437811 0.3018682 0.2682446 0.2636719   
## 15 0.3277910 0.1876485 0.1873536 0.2596945 0.3379791 0.3104107   
## 16 0.3333333 0.1909846 0.2421053 0.2535211 0.3387471 0.2919847 0.1774011  
## 17 0.2727273 0.2223776 0.3204952 0.1933702 0.2588556 0.3652174 0.2813738  
## 18 0.3045404 0.1805094 0.2131148 0.2061404 0.2689805 0.2761733 0.2211640  
## 19 0.4402390 0.3525896 0.2480315 0.2556762 0.2062561 0.2357320 0.3269598  
## 20 0.2990868 0.2488584 0.2409910 0.2180791 0.2268156 0.3154487 0.3638344  
## 21 0.3183521 0.2734082 0.3948339 0.2938272 0.3121951 0.2465209 0.4234875  
## 22 0.3441397 0.3117207 0.2997543 0.1812577 0.1327649 0.3088381 0.4004739  
## 23 0.2874828 0.2737276 0.3477673 0.2418478 0.2761394 0.4163090 0.3263979  
## 24 0.3622795 0.3541384 0.4018692 0.3378016 0.3994709 0.4522293 0.4017972  
## 25 0.3081464 0.2136954 0.3061700 0.1495327 0.2286374 0.2623574 0.2913386  
## 26 0.3707371 0.2321232 0.1400651 0.2113290 0.1918103 0.2118492 0.2702419  
## 27 0.2900000 0.2550000 0.3817734 0.2904821 0.3601954 0.2398010 0.3990499  
## 28 0.2535211 0.2253521 0.3333333 0.3147503 0.3777268 0.3226112 0.3333333  
## 29 0.3406863 0.2965686 0.2946860 0.2460606 0.2814371 0.2654261 0.4102564  
## 30 0.2262052 0.1841780 0.2423873 0.2371638 0.2850242 0.3096647 0.3207991  
## 31 0.2533993 0.1718171 0.2131547 0.2053790 0.3043478 0.3017751 0.2784959  
## 32 0.2600000 0.2925000 0.3645320 0.2954265 0.3772894 0.3850746 0.3349169  
## 33 0.2459426 0.1435705 0.2324723 0.1580247 0.2682927 0.2942346 0.2052195  
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## 19 0.3810888 0.3928183 0.2863595   
## 20 0.3928183 0.2869785 0.2870276 0.2907407   
## 21 0.4146919 0.2486034 0.3871681 0.4427861 0.3204105   
## 22 0.3964497 0.2719665 0.3215470 0.2166998 0.2574032 0.3125778   
## 23 0.3506494 0.1090343 0.3084337 0.4264232 0.3175592 0.2747253 0.3251029  
## 24 0.4102564 0.2730061 0.4142857 0.4452710 0.4391144 0.3631436 0.4208390  
## 25 0.2651685 0.2047244 0.2231579 0.3187441 0.2719393 0.2995283 0.2296820  
## 26 0.3277311 0.3422330 0.2648221 0.1608266 0.2182741 0.3252747 0.1920966  
## 27 0.3879004 0.2335664 0.3333333 0.4601594 0.2671233 0.1161049 0.3441397  
## 28 0.2893855 0.3168188 0.3047120 0.4621212 0.2866379 0.3505275 0.3653396  
## 29 0.4388824 0.2886457 0.3884657 0.3607843 0.2107623 0.2337821 0.2298289  
## 30 0.3286385 0.2430939 0.2916667 0.3978282 0.1638418 0.2592593 0.2971640  
## 31 0.2840376 0.3011050 0.2960526 0.3662389 0.2271186 0.3259259 0.3045623  
## 32 0.2360617 0.2419580 0.2137320 0.4183267 0.3652968 0.3732834 0.3142145  
## 33 0.1895735 0.2597765 0.1969027 0.3492537 0.3044470 0.3740648 0.2851806  
## 23 24 25 26 27 28 29  
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## 24 0.2740964   
## 25 0.2532300 0.3724490   
## 26 0.3923445 0.4846336 0.2782427   
## 27 0.2572215 0.3568521 0.2680047 0.3509351   
## 28 0.3427471 0.4068441 0.1902113 0.3610822 0.2816901   
## 29 0.3001346 0.4369190 0.2560834 0.2432432 0.2058824 0.3202765   
## 30 0.2690217 0.3404826 0.2593458 0.3028322 0.2163164 0.2032520 0.2072727  
## 31 0.3423913 0.3860590 0.2453271 0.2570806 0.3176761 0.2148664 0.2727273  
## 32 0.3012380 0.3595658 0.2042503 0.4059406 0.2900000 0.2276995 0.3774510  
## 33 0.3076923 0.3577236 0.1415094 0.2945055 0.3108614 0.1934349 0.3463892  
## 30 31 32  
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## 31 0.2127139   
## 32 0.3102596 0.2558714   
## 33 0.2641975 0.1358025 0.1610487

#Ford  
ford.bc=vegdist(fordcounts[,4:80], method="bray")  
ford.bc

## 2 3 4 5 6 7 8  
## 3 0.4361446   
## 4 0.4361446 0.0000000   
## 5 0.3283582 0.4903226 0.4903226   
## 6 0.3067275 0.3187572 0.3187572 0.4124872   
## 7 0.5617433 0.3178484 0.3178484 0.6112311 0.3317919   
## 8 0.5702326 0.6963449 0.6963449 0.4468085 0.6104129 0.7422389   
## 9 0.5656109 0.3949772 0.3949772 0.6463415 0.3802817 0.2018349 0.8215879  
## 10 0.5212637 0.2613497 0.2613497 0.5276273 0.2807425 0.2256473 0.6698113  
## 11 0.4890511 0.3095823 0.3095823 0.5921909 0.3263647 0.2444444 0.7355996  
## 12 0.5161650 0.3678290 0.3678290 0.5847543 0.3504274 0.2158192 0.7548501  
## 13 0.5962220 0.4278903 0.4278903 0.7001056 0.4582393 0.2838323 0.7933579  
## 14 0.5536585 0.4384236 0.4384236 0.6521739 0.3667055 0.2252475 0.7937559  
## 15 0.5350467 0.2877358 0.2877358 0.5648536 0.3206704 0.2251185 0.6980787  
## 16 0.5876289 0.4034682 0.4034682 0.6258993 0.3684211 0.2706156 0.7909910  
## 17 0.3282443 0.3773377 0.3773377 0.3706981 0.2510460 0.4607735 0.5615251  
## 18 0.4262295 0.3533058 0.3533058 0.4851301 0.2532020 0.2697095 0.6652927  
## 19 0.3869526 0.3933393 0.3933393 0.3158326 0.3264249 0.5031617 0.4646018  
## 20 0.3064833 0.3445545 0.3445545 0.3756708 0.2658467 0.4453280 0.5952191  
## 21 0.4306723 0.2817797 0.2817797 0.4980989 0.2795156 0.3765957 0.7106812  
## 22 0.5004398 0.3959256 0.3959256 0.5230396 0.3928571 0.4986667 0.7001456  
## 23 0.3906511 0.5176471 0.5176471 0.3852080 0.4680679 0.6290051 0.5651568  
## 24 0.4865248 0.5663338 0.5663338 0.4132450 0.5279503 0.6580830 0.4341226  
## 25 0.4466667 0.5402685 0.5402685 0.3615385 0.5221953 0.6649832 0.4544189  
## 26 0.3672055 0.3729604 0.3729604 0.4906832 0.3502762 0.4988290 0.6337262  
## 27 0.3983549 0.2930012 0.2930012 0.5688749 0.2741573 0.3301549 0.7334559  
## 28 0.5154091 0.4469453 0.4469453 0.6637848 0.3959184 0.3907427 0.8132428  
## 29 0.4600232 0.3847953 0.3847953 0.6053998 0.3813747 0.4289072 0.7363636  
## 30 0.3733804 0.5457788 0.5457788 0.4984194 0.4459459 0.6463560 0.7053407  
## 31 0.3700108 0.5146899 0.5146899 0.5092502 0.4451346 0.6196721 0.6872852  
## 32 0.3785047 0.5330189 0.5330189 0.5083682 0.4614525 0.6540284 0.6980787  
## 33 0.3465578 0.4416961 0.4416961 0.5067921 0.4732143 0.5763314 0.7294333  
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## 13 0.2385218 0.2620192 0.1937425 0.2803532   
## 14 0.2933025 0.3043478 0.2562189 0.2241183 0.2255730   
## 15 0.2350333 0.1296076 0.2142857 0.2612022 0.1976879 0.2768496   
## 16 0.2796518 0.2913753 0.2718786 0.2703863 0.2494331 0.2397661 0.2143659  
## 17 0.4953271 0.3725055 0.4228635 0.4344262 0.5010799 0.4994438 0.3518717  
## 18 0.3189824 0.2778356 0.3166667 0.2425121 0.3299492 0.3089770 0.2313883  
## 19 0.4781116 0.3931159 0.4306437 0.4397284 0.4734043 0.5258856 0.3702726  
## 20 0.4248120 0.3220339 0.3632735 0.3816156 0.4001947 0.4480000 0.3127413  
## 21 0.3627255 0.2465315 0.2863248 0.3056380 0.3465140 0.3640257 0.2391753  
## 22 0.4623838 0.3939394 0.4148082 0.4214047 0.4205934 0.4709562 0.3679654  
## 23 0.5836013 0.5300085 0.5329949 0.5560859 0.5393538 0.6271186 0.5082237  
## 24 0.6373626 0.5756272 0.5681492 0.6065351 0.5856237 0.6494253 0.5574230  
## 25 0.6340289 0.5662447 0.5895270 0.5965052 0.5897436 0.6734349 0.5353038  
## 26 0.5021930 0.3490012 0.3294118 0.4227027 0.3965714 0.5353774 0.3574661  
## 27 0.3712375 0.2846890 0.2287425 0.3032967 0.3581395 0.3469388 0.2865362  
## 28 0.4143870 0.4082073 0.3059459 0.3660000 0.3684211 0.3304442 0.4056309  
## 29 0.4279428 0.4481132 0.3388430 0.3947939 0.3990826 0.4011834 0.4233825  
## 30 0.6558659 0.6019185 0.5462185 0.5925110 0.6526807 0.6173285 0.6101499  
## 31 0.6402878 0.5701754 0.5170143 0.5760649 0.6175214 0.6105611 0.5873016  
## 32 0.6563193 0.5933413 0.5547619 0.5890710 0.6554913 0.6229117 0.6064073  
## 33 0.6013289 0.5439430 0.4744352 0.5393013 0.5842956 0.5733015 0.5451429  
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## 17 0.3277311   
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## 19 0.4194107 0.2353923 0.2887828   
## 20 0.3580247 0.1759344 0.2231834 0.1670516   
## 21 0.2684904 0.2919496 0.2275229 0.2927818 0.1925795   
## 22 0.4334471 0.3930921 0.3662745 0.3526093 0.2908125 0.2837730   
## 23 0.5896188 0.4189507 0.4820359 0.3495605 0.3526851 0.4298780 0.2665331  
## 24 0.6166090 0.4761585 0.5322997 0.3400355 0.4138365 0.4816273 0.3235810  
## 25 0.6356275 0.4542611 0.5142003 0.2856178 0.3811594 0.4764079 0.3675784  
## 26 0.5005549 0.3481481 0.3745020 0.3530950 0.3021033 0.3387755 0.3836910  
## 27 0.3566591 0.4236559 0.3245703 0.4452297 0.3734239 0.2953368 0.4330435  
## 28 0.4159836 0.5549020 0.4328082 0.5531915 0.4790366 0.4236967 0.5016129  
## 29 0.4120267 0.4777070 0.4405594 0.4912587 0.4170662 0.3899693 0.4750430  
## 30 0.6334842 0.5452586 0.5278622 0.5681416 0.5140914 0.4953271 0.5557491  
## 31 0.6507277 0.5347913 0.5136150 0.5562914 0.4941283 0.5024015 0.5236542  
## 32 0.6700337 0.5679144 0.5372233 0.5778364 0.5115830 0.5051546 0.5428571  
## 33 0.6121076 0.5619658 0.5417085 0.5764499 0.5043394 0.4953656 0.5363322  
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## 25 0.2320513 0.1839729   
## 26 0.3670473 0.4450626 0.4022801   
## 27 0.5260116 0.5839775 0.5993405 0.4038680   
## 28 0.5772483 0.6351619 0.6607828 0.5314757 0.3039832   
## 29 0.5290270 0.6153310 0.6391837 0.4725028 0.2990868 0.2712215   
## 30 0.5136476 0.6002815 0.5838150 0.5233751 0.4477958 0.4411765 0.3821510  
## 31 0.4685315 0.5650434 0.5438324 0.4596859 0.4106383 0.4019417 0.3655462  
## 32 0.5082237 0.5994398 0.5648604 0.5000000 0.4407365 0.4306569 0.3688990  
## 33 0.4954807 0.5955213 0.5586546 0.4937853 0.3839080 0.3458333 0.3786848  
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## 31 0.2729211   
## 32 0.1903114 0.2105820   
## 33 0.3248848 0.2198732 0.2868571

Treatment colors

#set colors for each treatment  
colors=ifelse(maumcounts$Treatment=="Control","red",ifelse(maumcounts$Treatment=="Nitrogen","orchid",ifelse(maumcounts$Treatment=="Phosphorus","forestgreen",ifelse(maumcounts$Treatment=="Trace","navy",ifelse(maumcounts$Treatment=="N+Trace","royalblue",ifelse(maumcounts$Treatment=="P+Trace","limegreen",ifelse(maumcounts$Treatment=="N+P","gold",ifelse(maumcounts$Treatment=="N+P+Trace","grey0","maroon"))))))))

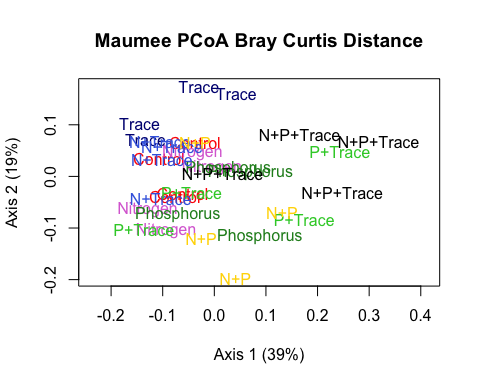
Bray Curtis Distance Principal Coordinates Analysis (PCoA) also known as Metric Multidimensional Scaling (MDS)

MAUMEE PCOA

#not based on euclidean distance format so no need for decostand fuction first  
#gives negative eigenvalues because its not euclidean distance- fix this if need be  
maum.dist.bc=vegdist(maumcounts[,4:70],method="bray")  
maum.bc.pcoa=wcmdscale(maum.dist.bc,eig=TRUE)  
eigenvals(maum.bc.pcoa)/sum(eigenvals(maum.bc.pcoa))

## [1] 0.3933085 0.1867115 0.0960340 0.0815938 0.0551238 0.0516966  
## [7] 0.0456598 0.0423291 0.0335827 0.0228035 0.0202456 0.0185514  
## [13] 0.0113121 0.0106494 0.0082945 0.0074478 0.0035720 0.0023508  
## [19] 0.0005977 -0.0001199 -0.0011765 -0.0019291 -0.0031706 -0.0048011  
## [25] -0.0058900 -0.0095712 -0.0105710 -0.0123243 -0.0189401 -0.0233707

maum.bc.pcoa.scores=scores(maum.bc.pcoa)  
plot(maum.bc.pcoa,type="none",xlab="Axis 1 (39%)",ylab="Axis 2 (19%)",main="Maumee PCoA Bray Curtis Distance")  
text(maum.bc.pcoa.scores[,1:2],labels=maumcounts$Treatment,col=colors)



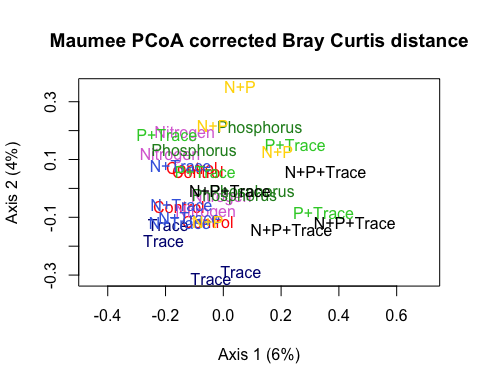
# Bray-Curtis-based PCoA, negative eigenvalues fixed  
eigenvals(maum.bc.pcoa)

## [1] 0.4696417 0.2229485 0.1146723 0.0974295 0.0658222 0.0617298  
## [7] 0.0545214 0.0505443 0.0401005 0.0272292 0.0241749 0.0221518  
## [13] 0.0135076 0.0127162 0.0099043 0.0088933 0.0042653 0.0028070  
## [19] 0.0007137 -0.0001432 -0.0014048 -0.0023035 -0.0037860 -0.0057329  
## [25] -0.0070331 -0.0114288 -0.0126227 -0.0147162 -0.0226160 -0.0279065

maum.dist.bc.noneg=as.matrix(vegdist(maumcounts[,4:70],method="bray",diag=TRUE,upper=TRUE))  
n=nrow(maum.dist.bc.noneg)  
for(i in 1:n){  
 for(j in 1:n){  
 maum.dist.bc.noneg[i,j]=ifelse(i==j,0,sqrt(maum.dist.bc.noneg[i,j]^2+2\*0.488514))  
}}  
maum.bc.noneg.pcoa=wcmdscale(maum.dist.bc.noneg,eig=TRUE)  
eigenvals(maum.bc.noneg.pcoa)/sum(eigenvals(maum.bc.noneg.pcoa))

## [1] 0.05864579 0.04354645 0.03691919 0.03586382 0.03392923 0.03367875  
## [7] 0.03323754 0.03299411 0.03235488 0.03156707 0.03138012 0.03125630  
## [13] 0.03072721 0.03067877 0.03050667 0.03044478 0.03016152 0.03007226  
## [19] 0.02994413 0.02990045 0.02989169 0.02981447 0.02975946 0.02966872  
## [25] 0.02954956 0.02946998 0.02920093 0.02912786 0.02899972 0.02851620  
## [31] 0.02819238

maum.bc.noneg.pcoa.scores=scores(maum.bc.noneg.pcoa)  
plot(maum.bc.noneg.pcoa,type="none",xlab="Axis 1 (6%)",ylab="Axis 2 (4%)",main="Maumee PCoA corrected Bray Curtis distance")  
text(maum.bc.noneg.pcoa.scores[,1:2],labels=maumcounts$Treatment,col=colors)



#corrects for negative values so you can calculate percent variation explained.

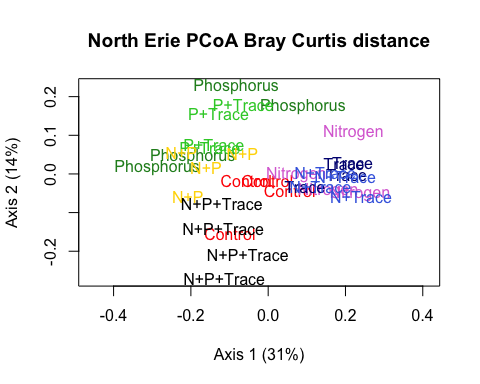
Interpretation: After correcting for negative eigenvalues due to the non-metric Bray-curtis tranformation, this PCoA explains very little variation. There is some clumping of trace metal treatments near the bottom of the ordination, but it’s not consistent for all trace metal treatments. I wouldn’t use this ordination for anything beyond exploration.

NORTH ERIE PCOA

ne.dist.bc=vegdist(necounts[,5:147],method="bray")  
ne.bc.pcoa=wcmdscale(ne.dist.bc,eig=TRUE)  
eigenvals(ne.bc.pcoa)/sum(eigenvals(ne.bc.pcoa))

## [1] 0.31135618 0.13899594 0.12316410 0.08956749 0.06819498  
## [6] 0.04987000 0.04961187 0.04109453 0.03634138 0.02425122  
## [11] 0.02249420 0.02025250 0.01745596 0.01362824 0.01335378  
## [16] 0.01015014 0.00738987 0.00698319 0.00473145 0.00345826  
## [21] 0.00239589 0.00149053 -0.00062470 -0.00279382 -0.00401254  
## [26] -0.00518475 -0.00604663 -0.00758964 -0.00869182 -0.01039237  
## [31] -0.01089543

ne.bc.pcoa.scores=scores(ne.bc.pcoa)  
plot(ne.bc.pcoa,type="none",xlab="Axis 1 (31%)",ylab="Axis 2 (14%)",main="North Erie PCoA Bray Curtis distance")  
text(ne.bc.pcoa.scores[,1:2],labels=necounts$Treatment,col=colors)



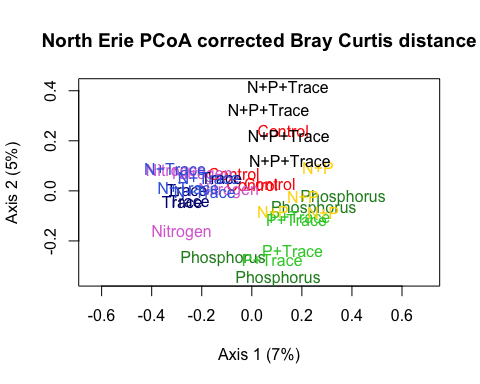
# Bray-Curtis-based PCoA, negative eigenvalues fixed  
eigenvals(ne.bc.pcoa)

## [1] 0.7907789 0.3530203 0.3128108 0.2274825 0.1732008 0.1266593  
## [7] 0.1260037 0.1043714 0.0922994 0.0615930 0.0571305 0.0514371  
## [13] 0.0443345 0.0346128 0.0339158 0.0257792 0.0187687 0.0177358  
## [19] 0.0120169 0.0087833 0.0060850 0.0037856 -0.0015866 -0.0070957  
## [25] -0.0101910 -0.0131682 -0.0153572 -0.0192761 -0.0220754 -0.0263944  
## [31] -0.0276721

ne.dist.bc.noneg=as.matrix(vegdist(necounts[,5:147],method="bray",diag=TRUE,upper=TRUE))  
n=nrow(ne.dist.bc.noneg)  
for(i in 1:n){  
 for(j in 1:n){  
 ne.dist.bc.noneg[i,j]=ifelse(i==j,0,sqrt(ne.dist.bc.noneg[i,j]^2+2\*0.488514))  
}}  
ne.bc.noneg.pcoa=wcmdscale(ne.dist.bc.noneg,eig=TRUE)  
eigenvals(ne.bc.noneg.pcoa)/sum(eigenvals(ne.bc.noneg.pcoa))

## [1] 0.07234296 0.04758807 0.04531426 0.04048901 0.03741943 0.03478754  
## [7] 0.03475047 0.03352718 0.03284452 0.03110810 0.03085575 0.03053379  
## [13] 0.03013214 0.02958239 0.02954298 0.02908286 0.02868642 0.02862801  
## [19] 0.02830461 0.02812175 0.02796917 0.02783914 0.02753534 0.02722381  
## [25] 0.02704877 0.02688042 0.02675663 0.02653502 0.02637672 0.02613248  
## [31] 0.02606023

ne.bc.noneg.pcoa.scores=scores(ne.bc.noneg.pcoa)  
plot(ne.bc.noneg.pcoa,type="none",xlab="Axis 1 (7%)",ylab="Axis 2 (5%)",main="North Erie PCoA corrected Bray Curtis distance")  
text(ne.bc.noneg.pcoa.scores[,1:2],labels=necounts$Treatment,col=colors)

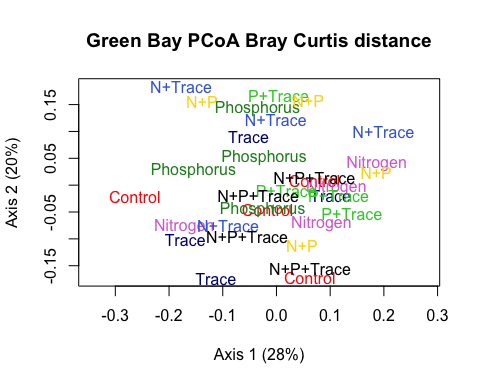
 Interpretation: Again, after correction, the variation explained is very low. There is interesting clustering among the treatments. N+P+trace cluster toward the top of the graph, P+trace, N+P and P treatments cluster near the bottom right and trace, N+trace and N treatments cluster in the center left portion of the ordination. This means that N and trace are having a similar effect on the community composition, which is different from P treatments, while N+P+trace is further different.

GREEN BAY PCOA

gb.dist.bc=vegdist(gbcounts[,5:52],method="bray")  
gb.bc.pcoa=wcmdscale(gb.dist.bc,eig=TRUE)  
eigenvals(gb.bc.pcoa)/sum(eigenvals(gb.bc.pcoa))

## [1] 0.28042321 0.20430805 0.15182202 0.13415393 0.07374898  
## [6] 0.06396760 0.05553120 0.04547270 0.04032168 0.02811204  
## [11] 0.02259742 0.01398961 0.01054169 0.00710157 0.00580555  
## [16] 0.00453229 0.00090776 -0.00068510 -0.00141506 -0.00218031  
## [21] -0.00367332 -0.00542873 -0.00687398 -0.00915880 -0.01038933  
## [26] -0.01125524 -0.01227096 -0.01415129 -0.01984621 -0.02186438  
## [31] -0.02414458

gb.bc.pcoa.scores=scores(gb.bc.pcoa)  
plot(gb.bc.pcoa,type="none",xlab="Axis 1 (28%)",ylab="Axis 2 (20%)",main="Green Bay PCoA Bray Curtis distance")  
text(gb.bc.pcoa.scores[,1:2],labels=gbcounts$Treatment,col=colors)



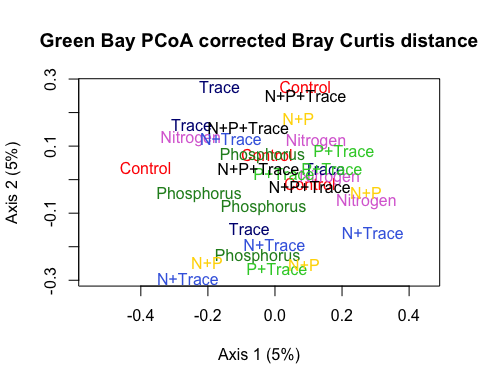
# Bray-Curtis-based PCoA, negative eigenvalues fixed  
eigenvals(gb.bc.pcoa)

## [1] 0.4285047 0.3121958 0.2319938 0.2049958 0.1126932 0.0977466  
## [7] 0.0848553 0.0694852 0.0616141 0.0429570 0.0345303 0.0213770  
## [13] 0.0161084 0.0108517 0.0088713 0.0069256 0.0013871 -0.0010469  
## [19] -0.0021623 -0.0033317 -0.0056131 -0.0082955 -0.0105039 -0.0139952  
## [25] -0.0158756 -0.0171987 -0.0187508 -0.0216241 -0.0303263 -0.0334102  
## [31] -0.0368945

gb.dist.bc.noneg=as.matrix(vegdist(gbcounts[,5:52],method="bray",diag=TRUE,upper=TRUE))  
n=nrow(gb.dist.bc.noneg)  
for(i in 1:n){  
 for(j in 1:n){  
 gb.dist.bc.noneg[i,j]=ifelse(i==j,0,sqrt(gb.dist.bc.noneg[i,j]^2+2\*0.488514))  
}}  
gb.bc.noneg.pcoa=wcmdscale(gb.dist.bc.noneg,eig=TRUE)  
eigenvals(gb.bc.noneg.pcoa)/sum(eigenvals(gb.bc.noneg.pcoa))

## [1] 0.05500353 0.04802723 0.04321664 0.04159728 0.03606089 0.03516439  
## [7] 0.03439115 0.03346925 0.03299713 0.03187806 0.03137262 0.03058368  
## [13] 0.03026766 0.02995236 0.02983357 0.02971687 0.02938467 0.02923867  
## [19] 0.02917177 0.02910163 0.02896479 0.02880390 0.02867144 0.02846202  
## [25] 0.02834924 0.02826987 0.02817678 0.02800444 0.02748247 0.02729750  
## [31] 0.02708851

gb.bc.noneg.pcoa.scores=scores(gb.bc.noneg.pcoa)  
plot(gb.bc.noneg.pcoa,type="none",xlab="Axis 1 (5%)",ylab="Axis 2 (5%)",main="Green Bay PCoA corrected Bray Curtis distance")  
text(gb.bc.noneg.pcoa.scores[,1:2],labels=gbcounts$Treatment,col=colors)

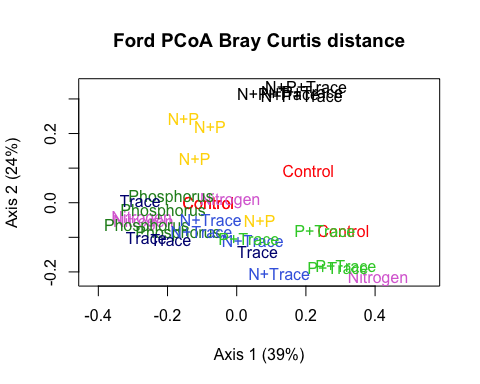
 Interpretation: This ordination is garbage. The variation explained is again very low, and there are no distinguishable patterns in the ordination. All treatments seem randomly dispersed in the ordination space.

FORD PCOA

ford.dist.bc=vegdist(fordcounts[,4:80],method="bray")  
ford.bc.pcoa=wcmdscale(ford.dist.bc,eig=TRUE)  
eigenvals(ford.bc.pcoa)/sum(eigenvals(ford.bc.pcoa))

## [1] 0.3858893 0.2427150 0.0958216 0.0715965 0.0571441 0.0372748  
## [7] 0.0313189 0.0226987 0.0196527 0.0179827 0.0144160 0.0134206  
## [13] 0.0123665 0.0098322 0.0084259 0.0067861 0.0049410 0.0027477  
## [19] 0.0018905 0.0017056 -0.0002818 -0.0012310 -0.0020003 -0.0028157  
## [25] -0.0038740 -0.0063693 -0.0083523 -0.0097699 -0.0105830 -0.0133490

ford.bc.pcoa.scores=scores(ford.bc.pcoa)  
plot(ford.bc.pcoa,type="none",xlab="Axis 1 (39%)",ylab="Axis 2 (24%)",main="Ford PCoA Bray Curtis distance")  
text(ford.bc.pcoa.scores[,1:2],labels=fordcounts$Treatment,col=colors)



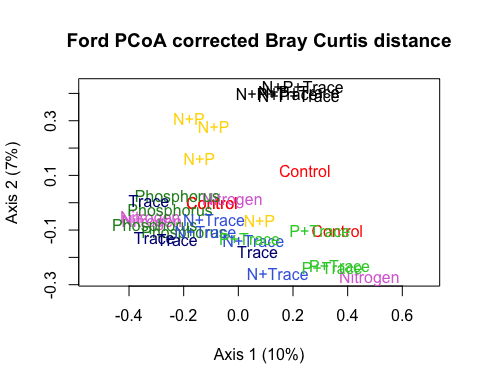
# Bray-Curtis-based PCoA, negative eigenvalues fixed  
eigenvals(ford.bc.pcoa)

## [1] 1.2893379 0.8109621 0.3201601 0.2392189 0.1909304 0.1245430  
## [7] 0.1046432 0.0758411 0.0656639 0.0600839 0.0481670 0.0448412  
## [13] 0.0413190 0.0328515 0.0281527 0.0226737 0.0165091 0.0091807  
## [19] 0.0063167 0.0056987 -0.0009414 -0.0041131 -0.0066834 -0.0094078  
## [25] -0.0129440 -0.0212813 -0.0279068 -0.0326432 -0.0353601 -0.0446018

ford.dist.bc.noneg=as.matrix(vegdist(fordcounts[,4:80],method="bray",diag=TRUE,upper=TRUE))  
n=nrow(maum.dist.bc.noneg)  
for(i in 1:n){  
 for(j in 1:n){  
 ford.dist.bc.noneg[i,j]=ifelse(i==j,0,sqrt(ford.dist.bc.noneg[i,j]^2+2\*0.488514))  
}}  
ford.bc.noneg.pcoa=wcmdscale(ford.dist.bc.noneg,eig=TRUE)  
eigenvals(ford.bc.noneg.pcoa)/sum(eigenvals(ford.bc.noneg.pcoa))

## [1] 0.09617733 0.07029840 0.04374724 0.03936853 0.03675624 0.03316484  
## [7] 0.03208831 0.03053019 0.02997963 0.02967777 0.02903310 0.02885318  
## [13] 0.02866263 0.02820456 0.02795037 0.02765397 0.02732048 0.02692403  
## [19] 0.02676910 0.02673567 0.02642738 0.02637645 0.02620487 0.02606583  
## [25] 0.02591844 0.02572714 0.02527612 0.02491770 0.02466147 0.02451449  
## [31] 0.02401453

ford.bc.noneg.pcoa.scores=scores(ford.bc.noneg.pcoa)  
plot(ford.bc.noneg.pcoa,type="none",xlab="Axis 1 (10%)",ylab="Axis 2 (7%)",main="Ford PCoA corrected Bray Curtis distance")  
text(ford.bc.noneg.pcoa.scores[,1:2],labels=fordcounts$Treatment,col=colors)

 Interpretation: The variation explained is slightly better than for other sites and there are some distinguishable clusters. N+P+trace cluster tightly near the top of the ordination, showing that that treatment caused the community composition to change compared to the other treatments. Three of the four N+P treatments are unique compared to the rest of the treatments. Something about adding N+P and N+P+trace is influencing the communties (in all of the N+P+trace and 3/4 of the N+P replicates) so that their composotion is consistently, markedly different.

Maumee PCA

#MAUMEE  
# Here is a function for the covariance matrix, shortcut  
maum.cov=cov(maumcounts[,4:70])  
maum.cov

## Microcystis.spp. Nitzschia.spp.  
## Microcystis.spp. 1154.19254032 -156.87600806  
## Nitzschia.spp. -156.87600806 171.58770161  
## Pseudoanabaena.spp. 85.51310484 -11.07963710  
## Glaucocystis.spp... 0.88407258 0.64616935  
## morphospecies.10 -0.45564516 -0.76209677  
## Aulacoseria.spp. -425.50100806 12.49495968  
## Filamentous.Chlorophyte -23.23689516 -143.50705645  
## Diatoma.spp... -2.31048387 -6.71370968  
## morphospecies.1 1.33366935 -1.13810484  
## pollen. -2.91733871 -0.16733871  
## Selenastraceae -51.50000000 6.04838710  
## morphospecies.2 -2.87701613 -0.03024194  
## morphospecies.3 4.82056452 -3.63911290  
## Cyclotella.spp. 53.51310484 -1.82157258  
## morphospecies.4 6.25000000 -5.23387097  
## Dolichospermum.spp. 0.46471774 0.64616935  
## Aphanocapsa.spp.. -8.46169355 0.49798387  
## morphospecies.5 -12.91330645 4.88508065  
## Merismopedia.spp. -41.77217742 -0.37701613  
## Scenedesmus.spp. -42.54435484 9.02016129  
## morphospecies.6 -10.78125000 2.51310484  
## morphospecies.7 -6.73286290 1.30342742  
## morphospecies.8 -14.72278226 6.06350806  
## clamydomonadaceae.1 -2.41028226 -4.47076613  
## morphospecies.12 0.00000000 0.00000000  
## morphospecies.11 14.06149194 51.30745968  
## morphospecies.13 -4.43145161 -0.60887097  
## Westella.spp.. -3.44052419 1.11995968  
## Melosira.spp... -770.28830645 140.01008065  
## morphospecies.14 -3.66330645 3.78024194  
## morphospecies.15 -12.91633065 -7.06552419  
## morphospecies.16 5.32762097 -3.81350806  
## Unidentified.13 15.84274194 -0.59274194  
## Spirulina.spp... -7.26713710 -2.04536290  
## Tetraedron.spp. 1.33568548 -0.35383065  
## Cycyotella.spp..2.. 63.67641129 -12.06955645  
## Thalassiosira.spp. -6.12500000 10.08467742  
## Micractinium.spp... 4.82762097 2.68649194  
## morphospecies.17 0.46673387 -0.02116935  
## morphospecies.18 11.59979839 -3.13004032  
## morphospecies.19 4.82661290 0.22983871  
## morphospecies.20 -20.40322581 3.24193548  
## clamydomonadaceae.2 -1.29536290 -0.96068548  
## morphospecies.21 -5.25604839 4.23588710  
## Dinobryon.spp. -3.26612903 -0.13709677  
## morphospecies.22 -6.63810484 -0.41633065  
## morphospecies.23 -5.38608871 -1.12399194  
## morphospecies.24 -0.04939516 -0.18245968  
## morphospecies.25 -11.00907258 -1.23891129  
## morphospecies.26 -2.74596774 0.59274194  
## morphospecies.27 -5.44254032 0.75504032  
## morphospecies.28 -0.64717742 1.34475806  
## morphospecies.29 -11.16431452 7.43649194  
## Tetraselmis.spp... -5.03729839 0.68447581  
## morphospecies.30 -0.72681452 0.91431452  
## morphospecies.31 -16.96975806 11.05443548  
## Kirchneriella.spp. -1.90524194 0.47379032  
## morphospecies.32 -1.37399194 1.29133065  
## Tetraedron.spp..2 -0.72681452 0.43044355  
## Dinobryon.spp..1 -0.82762097 -1.36391129  
## Desmodesmus.spp... 0.06048387 -1.37500000  
## Selenastrum.spp. -0.63608871 2.81955645  
## Unidentified.33 0.96370968 1.07661290  
## Euglena.spp. 0.33366935 1.15221774  
## Phacus.spp. -1.17842742 0.04334677  
## Unidentified.34 -1.73084677 0.92641129  
## Treubaria.spp. -0.63004032 -0.08568548  
## Pseudoanabaena.spp. Glaucocystis.spp...  
## Microcystis.spp. 85.51310484 0.884072581  
## Nitzschia.spp. -11.07963710 0.646169355  
## Pseudoanabaena.spp. 84.70060484 0.974798387  
## Glaucocystis.spp... 0.97479839 0.152217742  
## morphospecies.10 0.02016129 0.020161290  
## Aulacoseria.spp. -49.92237903 -1.067540323  
## Filamentous.Chlorophyte -69.22681452 -1.952620968  
## Diatoma.spp... -0.99596774 0.423387097  
## morphospecies.1 -0.32157258 0.017137097  
## pollen. 1.31250000 -0.042338710  
## Selenastraceae 9.53225806 0.080645161  
## morphospecies.2 0.07862903 0.046370968  
## morphospecies.3 6.23588710 0.010080645  
## Cyclotella.spp. 15.63608871 0.845766129  
## morphospecies.4 6.94354839 -0.056451613  
## Dolichospermum.spp. 0.91028226 0.119959677  
## Aphanocapsa.spp.. 3.96975806 0.195564516  
## morphospecies.5 -1.96572581 -0.030241935  
## Merismopedia.spp. 23.29637097 0.360887097  
## Scenedesmus.spp. -10.40725806 -0.278225806  
## morphospecies.6 -0.37600806 0.285282258  
## morphospecies.7 -1.13407258 -0.021169355  
## morphospecies.8 0.21875000 -0.023185484  
## clamydomonadaceae.1 -2.35987903 0.075604839  
## morphospecies.12 0.00000000 0.000000000  
## morphospecies.11 -2.23487903 0.007056452  
## morphospecies.13 -0.10080645 0.028225806  
## Westella.spp.. 0.48487903 -0.015120968  
## Melosira.spp... -86.99395161 -1.639112903  
## morphospecies.14 0.42943548 -0.054435484  
## morphospecies.15 7.34778226 0.009072581  
## morphospecies.16 3.20866935 -0.033266129  
## Unidentified.13 5.30241935 0.044354839  
## Spirulina.spp... 3.42439516 0.021169355  
## Tetraedron.spp. 1.07157258 -0.009072581  
## Cycyotella.spp..2.. -1.58366935 -0.470766129  
## Thalassiosira.spp. -2.89112903 0.334677419  
## Micractinium.spp... 8.64415323 0.176411290  
## morphospecies.17 -0.24495968 -0.003024194  
## morphospecies.18 1.31552419 -0.023185484  
## morphospecies.19 -1.48790323 -0.036290323  
## morphospecies.20 0.04838710 -0.016129032  
## clamydomonadaceae.2 0.14616935 0.097782258  
## morphospecies.21 5.07056452 0.231854839  
## Dinobryon.spp. -0.86290323 0.104838710  
## morphospecies.22 -0.88205645 -0.027217742  
## morphospecies.23 -2.31955645 0.083669355  
## morphospecies.24 -0.05141129 -0.003024194  
## morphospecies.25 2.35987903 0.150201613  
## morphospecies.26 0.40725806 -0.012096774  
## morphospecies.27 -1.23084677 0.043346774  
## morphospecies.28 0.02620968 0.058467742  
## morphospecies.29 0.76512097 0.136088710  
## Tetraselmis.spp... -1.11189516 0.194556452  
## morphospecies.30 -0.24495968 -0.003024194  
## morphospecies.31 1.47782258 0.381048387  
## Kirchneriella.spp. 0.02620968 -0.006048387  
## morphospecies.32 0.61995968 0.055443548  
## Tetraedron.spp..2 0.17439516 -0.003024194  
## Dinobryon.spp..1 -1.64415323 -0.015120968  
## Desmodesmus.spp... -1.49596774 -0.012096774  
## Selenastrum.spp. -1.00504032 0.011088710  
## Unidentified.33 1.24596774 0.213709677  
## Euglena.spp. 1.29133065 0.146169355  
## Phacus.spp. -0.14818548 -0.003024194  
## Unidentified.34 0.61391129 -0.015120968  
## Treubaria.spp. -0.01915323 -0.003024194  
## morphospecies.10 Aulacoseria.spp.  
## Microcystis.spp. -0.455645161 -425.50100806  
## Nitzschia.spp. -0.762096774 12.49495968  
## Pseudoanabaena.spp. 0.020161290 -49.92237903  
## Glaucocystis.spp... 0.020161290 -1.06754032  
## morphospecies.10 0.177419355 -1.42338710  
## Aulacoseria.spp. -1.423387097 341.96673387  
## Filamentous.Chlorophyte -1.366935484 123.48891129  
## Diatoma.spp... 0.338709677 8.30241935  
## morphospecies.1 0.012096774 -1.39213710  
## pollen. -0.056451613 -3.11088710  
## Selenastraceae -0.161290323 16.72580645  
## morphospecies.2 -0.024193548 0.51008065  
## morphospecies.3 -0.072580645 1.46572581  
## Cyclotella.spp. 0.084677419 -31.59979839  
## morphospecies.4 -0.032258065 -1.33064516  
## Dolichospermum.spp. -0.012096774 -0.87399194  
## Aphanocapsa.spp.. 0.056451613 2.66733871  
## morphospecies.5 -0.008064516 0.89314516  
## Merismopedia.spp. -0.185483871 5.00201613  
## Scenedesmus.spp. 1.241935484 -4.73790323  
## morphospecies.6 -0.028225806 19.78326613  
## morphospecies.7 0.100806452 0.83165323  
## morphospecies.8 0.495967742 -4.38407258  
## clamydomonadaceae.1 0.133064516 -0.29737903  
## morphospecies.12 0.000000000 0.00000000  
## morphospecies.11 -0.334677419 -43.47076613  
## morphospecies.13 -0.048387097 2.24596774  
## Westella.spp.. 0.108870968 -0.81149194  
## Melosira.spp... 2.814516129 267.67943548  
## morphospecies.14 0.024193548 9.36895161  
## morphospecies.15 0.076612903 7.64818548  
## morphospecies.16 0.084677419 -0.04334677  
## Unidentified.13 -0.048387097 -5.80241935  
## Spirulina.spp... 0.221774194 2.36189516  
## Tetraedron.spp. -0.012096774 -0.09979839  
## Cycyotella.spp..2.. -0.165322581 -45.50100806  
## Thalassiosira.spp. -0.177419355 0.42338710  
## Micractinium.spp... -0.076612903 -9.34979839  
## morphospecies.17 -0.004032258 -0.35584677  
## morphospecies.18 -0.052419355 -9.60987903  
## morphospecies.19 0.112903226 -2.59274194  
## morphospecies.20 0.193548387 3.17741935  
## clamydomonadaceae.2 0.044354839 -5.31149194  
## morphospecies.21 -0.024193548 -2.93346774  
## Dinobryon.spp. -0.032258065 1.83064516  
## morphospecies.22 0.221774194 -3.20262097  
## morphospecies.23 0.004032258 1.11391129  
## morphospecies.24 -0.004032258 -0.35584677  
## morphospecies.25 -0.068548387 2.61995968  
## morphospecies.26 -0.016129032 0.22177419  
## morphospecies.27 -0.028225806 3.15423387  
## morphospecies.28 -0.008064516 -0.71169355  
## morphospecies.29 0.116935484 0.01310484  
## Tetraselmis.spp... 0.302419355 -1.85987903  
## morphospecies.30 -0.004032258 -0.35584677  
## morphospecies.31 -0.104838710 1.44959677  
## Kirchneriella.spp. -0.008064516 -0.38911290  
## morphospecies.32 -0.012096774 -0.42237903  
## Tetraedron.spp..2 -0.004032258 -0.03326613  
## Dinobryon.spp..1 -0.020161290 3.18850806  
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## morphospecies.29 0.35685484 -0.256048387  
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## Phacus.spp. -0.001008065 -0.029233871 -0.012096774  
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## Pseudoanabaena.spp. 0.04838710 0.146169355  
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## morphospecies.6 0.423387097 0.238911290 -0.055443548  
## morphospecies.7 -0.028225806 0.029233871 -0.007056452  
## morphospecies.8 -0.020161290 0.176411290 0.035282258  
## clamydomonadaceae.1 0.133064516 0.061491935 0.025201613  
## morphospecies.12 0.000000000 0.000000000 0.000000000  
## morphospecies.11 -0.141129032 0.678427419 0.496975806  
## morphospecies.13 0.048387097 0.004032258 -0.012096774  
## Westella.spp.. -0.020161290 0.039314516 -0.005040323  
## Melosira.spp... -2.056451613 0.816532258 2.163306452  
## morphospecies.14 -0.104838710 -0.026209677 -0.018145161  
## morphospecies.15 0.012096774 0.015120968 0.003024194  
## morphospecies.16 -0.044354839 0.009072581 -0.011088710  
## Unidentified.13 0.080645161 0.020161290 -0.028225806  
## Spirulina.spp... 0.028225806 0.099798387 0.007056452  
## Tetraedron.spp. -0.012096774 0.017137097 -0.003024194  
## Cycyotella.spp..2.. -0.778225806 -0.924395161 -0.501008065  
## Thalassiosira.spp. 0.532258065 0.568548387 0.036290323  
## Micractinium.spp... 0.278225806 0.380040323 -0.027217742  
## morphospecies.17 -0.004032258 -0.005040323 -0.001008065  
## morphospecies.18 -0.052419355 -0.017137097 -0.029233871  
## morphospecies.19 -0.048387097 0.004032258 -0.012096774  
## morphospecies.20 0.000000000 0.145161290 0.016129032  
## clamydomonadaceae.2 0.141129032 0.087701613 0.043346774  
## morphospecies.21 0.362903226 0.397177419 -0.030241935  
## Dinobryon.spp. 0.161290323 0.088709677 -0.008064516  
## morphospecies.22 -0.036290323 0.083669355 0.119959677  
## morphospecies.23 0.133064516 0.053427419 -0.015120968  
## morphospecies.24 -0.004032258 -0.005040323 -0.001008065  
## morphospecies.25 0.221774194 0.132056452 0.039314516  
## morphospecies.26 -0.016129032 -0.020161290 -0.004032258  
## morphospecies.27 0.068548387 0.061491935 -0.007056452  
## morphospecies.28 0.088709677 0.054435484 -0.002016129  
## morphospecies.29 0.181451613 0.226814516 -0.019153226  
## Tetraselmis.spp... 0.302419355 0.313508065 0.011088710  
## morphospecies.30 -0.004032258 -0.005040323 -0.001008065  
## morphospecies.31 0.572580645 0.441532258 -0.034274194  
## Kirchneriella.spp. -0.008064516 -0.010080645 0.030241935  
## morphospecies.32 0.084677419 0.049395161 -0.003024194  
## Tetraedron.spp..2 -0.004032258 -0.005040323 -0.001008065  
## Dinobryon.spp..1 -0.020161290 -0.025201613 -0.005040323  
## Desmodesmus.spp... -0.016129032 -0.020161290 -0.004032258  
## Selenastrum.spp. 0.004032258 -0.003024194 0.025201613  
## Unidentified.33 0.306451613 0.205645161 -0.004032258  
## Euglena.spp. 0.205645161 0.200604839 -0.005040323  
## Phacus.spp. -0.004032258 -0.005040323 0.031250000  
## Unidentified.34 -0.020161290 0.136088710 -0.005040323  
## Treubaria.spp. -0.004032258 0.027217742 -0.001008065  
## Unidentified.34 Treubaria.spp.  
## Microcystis.spp. -1.730846774 -0.630040323  
## Nitzschia.spp. 0.926411290 -0.085685484  
## Pseudoanabaena.spp. 0.613911290 -0.019153226  
## Glaucocystis.spp... -0.015120968 -0.003024194  
## morphospecies.10 0.173387097 0.060483871  
## Aulacoseria.spp. -1.779233871 -0.355846774  
## Filamentous.Chlorophyte -4.652217742 -0.478830645  
## Diatoma.spp... 0.318548387 0.141129032  
## morphospecies.1 -0.025201613 -0.005040323  
## pollen. -0.070564516 -0.014112903  
## Selenastraceae -0.338709677 -0.080645161  
## morphospecies.2 -0.030241935 -0.006048387  
## morphospecies.3 -0.090725806 -0.018145161  
## Cyclotella.spp. 0.033266129 -0.148185484  
## morphospecies.4 0.250000000 0.024193548  
## Dolichospermum.spp. -0.015120968 -0.003024194  
## Aphanocapsa.spp.. 0.175403226 0.022177419  
## morphospecies.5 -0.050403226 -0.010080645  
## Merismopedia.spp. 0.106854839 -0.030241935  
## Scenedesmus.spp. 1.471774194 0.552419355  
## morphospecies.6 -0.083669355 0.009072581  
## morphospecies.7 0.158266129 0.057459677  
## morphospecies.8 0.660282258 0.261088710  
## clamydomonadaceae.1 -0.003024194 0.025201613  
## morphospecies.12 0.000000000 0.000000000  
## morphospecies.11 1.130040323 -0.212701613  
## morphospecies.13 -0.060483871 -0.012096774  
## Westella.spp.. 0.168346774 0.059475806  
## Melosira.spp... 6.461693548 1.550403226  
## morphospecies.14 0.070564516 0.014112903  
## morphospecies.15 0.015120968 0.003024194  
## morphospecies.16 0.138104839 0.053427419  
## Unidentified.13 -0.044354839 0.004032258  
## Spirulina.spp... 0.228830645 0.071572581  
## Tetraedron.spp. 0.049395161 -0.003024194  
## Cycyotella.spp..2.. -1.085685484 -0.178427419  
## Thalassiosira.spp. 0.439516129 -0.028225806  
## Micractinium.spp... 0.380040323 -0.027217742  
## morphospecies.17 -0.005040323 -0.001008065  
## morphospecies.18 -0.017137097 -0.029233871  
## morphospecies.19 0.133064516 0.052419355  
## morphospecies.20 0.467741935 0.145161290  
## clamydomonadaceae.2 -0.009072581 0.011088710  
## morphospecies.21 0.364919355 0.034274194  
## Dinobryon.spp. -0.040322581 -0.008064516  
## morphospecies.22 0.341733871 0.119959677  
## morphospecies.23 -0.075604839 -0.015120968  
## morphospecies.24 -0.005040323 -0.001008065  
## morphospecies.25 -0.061491935 -0.025201613  
## morphospecies.26 -0.020161290 -0.004032258  
## morphospecies.27 0.029233871 -0.007056452  
## morphospecies.28 -0.010080645 -0.002016129  
## morphospecies.29 0.226814516 0.045362903  
## Tetraselmis.spp... 0.378024194 0.140120968  
## morphospecies.30 -0.005040323 -0.001008065  
## morphospecies.31 0.086693548 -0.034274194  
## Kirchneriella.spp. -0.010080645 -0.002016129  
## morphospecies.32 -0.015120968 -0.003024194  
## Tetraedron.spp..2 -0.005040323 -0.001008065  
## Dinobryon.spp..1 -0.025201613 -0.005040323  
## Desmodesmus.spp... -0.020161290 -0.004032258  
## Selenastrum.spp. -0.035282258 -0.007056452  
## Unidentified.33 -0.020161290 -0.004032258  
## Euglena.spp. 0.136088710 0.027217742  
## Phacus.spp. -0.005040323 -0.001008065  
## Unidentified.34 0.394153226 0.091733871  
## Treubaria.spp. 0.091733871 0.031250000

# Eigen analysis with R base functions  
maum.eigen=eigen(maum.cov)  
maum.eigen

## eigen() decomposition  
## $values  
## [1] 2.056082e+03 8.077953e+02 2.972443e+02 1.635842e+02 1.244087e+02  
## [6] 9.341539e+01 5.973667e+01 3.772589e+01 3.148920e+01 1.930465e+01  
## [11] 1.417333e+01 1.124392e+01 7.917751e+00 6.299878e+00 4.564863e+00  
## [16] 4.318929e+00 2.845916e+00 2.481813e+00 2.076068e+00 1.934286e+00  
## [21] 1.786608e+00 1.442036e+00 9.531952e-01 7.489877e-01 5.223989e-01  
## [26] 4.516177e-01 4.033854e-01 3.669328e-01 2.433263e-01 1.561945e-01  
## [31] 2.466522e-13 8.210568e-14 5.984451e-14 1.227824e-14 1.175300e-15  
## [36] 1.149206e-15 6.386305e-16 5.963006e-16 2.832529e-16 2.515181e-16  
## [41] 2.101047e-16 2.070208e-16 4.973070e-17 1.578270e-17 1.380868e-17  
## [46] 7.856694e-18 7.480277e-18 3.133162e-18 -2.480396e-17 -3.797039e-17  
## [51] -4.089043e-17 -5.736173e-17 -1.253728e-16 -1.256574e-16 -2.800944e-16  
## [56] -3.167345e-16 -3.916365e-16 -5.984724e-16 -8.366335e-16 -2.068972e-15  
## [61] -2.208519e-15 -6.750344e-15 -7.620460e-15 -1.050973e-14 -1.289369e-14  
## [66] -1.953117e-14 -3.358058e-14  
##   
## $vectors  
## [,1] [,2] [,3] [,4]  
## [1,] 7.041118e-01 0.2302507596 0.5084644695 0.0967148255  
## [2,] -1.135394e-01 0.1969057044 -0.2977810931 -0.3386317832  
## [3,] 6.345704e-02 0.0953895803 -0.1089459845 0.2825655970  
## [4,] 8.623905e-04 0.0025528689 -0.0040680738 0.0034379272  
## [5,] -8.538637e-04 0.0025480516 0.0049204876 -0.0051996644  
## [6,] -2.744592e-01 -0.2980282116 -0.0239825313 0.7062771496  
## [7,] 6.648001e-02 -0.8399842043 0.2712160506 -0.3492321227  
## [8,] -2.932182e-03 -0.0096972946 0.0231369096 0.0450286739  
## [9,] 8.415310e-04 0.0008675796 0.0017469701 -0.0056703361  
## [10,] -1.287226e-04 0.0012901088 -0.0132840400 -0.0111860770  
## [11,] -3.357979e-02 0.0024128019 -0.0025972439 0.0426199085  
## [12,] -1.631021e-03 0.0007799471 -0.0029590150 0.0025013841  
## [13,] 3.131425e-03 -0.0102740332 0.0216512397 0.0293050909  
## [14,] 3.342191e-02 0.0678148158 -0.0388081078 0.0417216455  
## [15,] -3.743587e-04 -0.0005877747 0.0606891362 0.0157110597  
## [16,] 7.509183e-04 0.0009225624 -0.0039795731 0.0015993539  
## [17,] -4.403468e-03 -0.0017348057 -0.0044030951 0.0187989783  
## [18,] -8.645123e-03 0.0037352713 -0.0054918917 -0.0312296589  
## [19,] -1.742797e-02 -0.0007032036 -0.0798677933 0.0714589353  
## [20,] -2.911356e-02 0.0090582683 0.0070606934 -0.1305756089  
## [21,] -9.391182e-03 -0.0052698785 -0.0041528950 0.0785033740  
## [22,] -4.642702e-03 0.0009363700 0.0005299443 -0.0092430129  
## [23,] -1.295115e-02 0.0208319841 0.0141407919 -0.0296833155  
## [24,] 1.202442e-04 -0.0100527178 0.0038748713 -0.0110223871  
## [25,] 0.000000e+00 0.0000000000 0.0000000000 0.0000000000  
## [26,] 5.018802e-04 0.1395540785 -0.1006151415 -0.2625466755  
## [27,] -1.209007e-03 -0.0080735453 -0.0066429672 0.0010709400  
## [28,] -1.850759e-03 -0.0000186665 -0.0024163140 -0.0100275660  
## [29,] -6.272118e-01 0.2624706731 0.5844412369 -0.1696782391  
## [30,] -6.009398e-03 0.0028333044 0.0120492790 0.0315484236  
## [31,] -9.594160e-03 0.0023015211 0.0134307696 0.0698728303  
## [32,] 1.078646e-03 -0.0020765522 0.0323847820 0.0167772480  
## [33,] 8.701690e-03 0.0132264327 0.0071682458 0.0318159114  
## [34,] -6.094549e-03 0.0153883318 -0.0017835159 0.0455340048  
## [35,] 1.664448e-04 0.0011633173 0.0062787160 0.0040868422  
## [36,] 9.750372e-02 -0.0867240820 -0.4402226756 -0.1583358384  
## [37,] -5.436215e-03 0.0176930164 -0.0187544784 -0.0129095311  
## [38,] 3.127686e-03 0.0336687560 -0.0317710399 0.0247556371  
## [39,] 3.106956e-04 0.0004501701 -0.0001683176 -0.0012110828  
## [40,] 9.533777e-03 0.0081867420 -0.0150849577 -0.0130266792  
## [41,] 2.456610e-03 0.0055280347 -0.0004793829 -0.0063461819  
## [42,] -1.505792e-02 0.0180664059 -0.0055482678 0.0065549419  
## [43,] 6.786121e-04 0.0031088162 -0.0077981835 -0.0191624238  
## [44,] -2.767342e-04 0.0160194030 -0.0470689354 0.0181533918  
## [45,] -1.134258e-03 -0.0027924434 -0.0058546476 0.0040894184  
## [46,] -6.369338e-03 0.0075368936 0.0178101011 -0.0280820586  
## [47,] -3.427185e-03 -0.0016069358 0.0033701749 -0.0017054913  
## [48,] 1.684301e-04 -0.0009428212 -0.0001384267 -0.0029333427  
## [49,] -7.351581e-03 0.0109369599 -0.0059003988 0.0335138908  
## [50,] -9.597972e-04 -0.0010614350 -0.0061181377 -0.0010698916  
## [51,] -3.548162e-03 -0.0003981471 -0.0029186102 0.0055451676  
## [52,] -3.259934e-04 0.0024651482 -0.0034136120 -0.0019229496  
## [53,] -7.349061e-03 0.0130885735 -0.0176614894 -0.0082668580  
## [54,] -5.139993e-03 0.0098641659 0.0095414516 -0.0073031472  
## [55,] -4.726403e-04 0.0014401989 -0.0018486879 -0.0030332144  
## [56,] -6.560613e-03 -0.0047737837 -0.0415211694 -0.0375756948  
## [57,] -1.226066e-03 0.0004235782 0.0003107907 -0.0060602570  
## [58,] -1.886074e-04 -0.0002135762 -0.0059514356 -0.0024362252  
## [59,] -1.676272e-04 -0.0006192628 -0.0021932558 -0.0017732450  
## [60,] 1.579106e-04 -0.0090232487 0.0011148372 0.0017777708  
## [61,] 2.049504e-04 -0.0048444043 0.0039264924 -0.0018303521  
## [62,] -1.012173e-03 0.0029446672 -0.0019837802 -0.0118144953  
## [63,] 1.009037e-03 0.0035778182 -0.0056329979 0.0045481920  
## [64,] -9.531252e-05 0.0059964731 -0.0022457066 0.0004522258  
## [65,] -1.058439e-03 0.0010428410 0.0025040464 -0.0042870120  
## [66,] -2.589345e-03 0.0078067695 0.0057264612 -0.0083253182  
## [67,] -6.739387e-04 0.0009195609 0.0020817267 -0.0023539155  
## [,5] [,6] [,7] [,8]  
## [1,] 0.2787210148 9.256887e-02 6.793491e-02 2.604989e-01  
## [2,] 0.5980424604 -3.644364e-01 3.971663e-01 2.273409e-01  
## [3,] -0.3510888434 -5.228157e-01 -2.485606e-02 4.841158e-01  
## [4,] -0.0021205417 -1.191068e-02 8.694788e-04 -8.062181e-03  
## [5,] -0.0136913633 9.935008e-03 6.505049e-03 1.769486e-03  
## [6,] 0.4985488469 1.196065e-01 -4.780501e-02 1.401376e-01  
## [7,] 0.0348234537 -1.971875e-01 -3.349578e-02 1.988174e-01  
## [8,] -0.0090387848 7.062586e-03 7.852315e-03 -6.702349e-02  
## [9,] -0.0023558348 8.054355e-03 -2.974181e-02 -5.637661e-03  
## [10,] -0.0272891681 4.673980e-03 -1.320479e-02 2.027454e-02  
## [11,] -0.0780501857 -1.837800e-01 -1.197607e-02 1.739798e-02  
## [12,] -0.0076074756 2.425368e-04 -2.667380e-03 -4.767656e-03  
## [13,] -0.0222252856 -9.274406e-02 2.809251e-02 9.043873e-03  
## [14,] -0.0351837197 -2.293104e-03 -3.333766e-01 2.461585e-01  
## [15,] -0.0333856330 -1.262770e-01 -2.211588e-02 -6.615736e-03  
## [16,] -0.0031489794 -1.315278e-02 6.212237e-03 -2.488535e-03  
## [17,] -0.0237006941 -6.211885e-02 -1.251986e-05 -1.088993e-02  
## [18,] 0.0061560804 -1.027408e-02 -4.366586e-02 2.258103e-02  
## [19,] -0.2135756391 -1.923722e-01 -2.930688e-04 2.233769e-01  
## [20,] -0.0964854112 1.280614e-01 2.507733e-01 1.343203e-02  
## [21,] 0.0649705865 1.070493e-02 8.744721e-03 5.618210e-02  
## [22,] -0.0092570066 1.191317e-02 3.412807e-02 -5.489544e-03  
## [23,] -0.0454161930 -1.521890e-02 1.301249e-01 -6.116708e-02  
## [24,] -0.0246740964 1.929751e-02 -5.036610e-03 -5.708476e-02  
## [25,] 0.0000000000 0.000000e+00 0.000000e+00 0.000000e+00  
## [26,] 0.2901313260 -1.100703e-01 -7.817630e-01 2.413151e-03  
## [27,] -0.0054276993 -1.138550e-02 -3.135105e-03 -7.300044e-03  
## [28,] -0.0110043396 -8.860721e-03 2.425568e-02 7.630948e-05  
## [29,] -0.0457952441 1.477370e-01 -1.127552e-02 3.515661e-01  
## [30,] 0.0445287121 -1.336482e-02 1.114962e-02 7.982331e-02  
## [31,] -0.0815484788 -2.361700e-02 4.275448e-03 5.619792e-02  
## [32,] -0.0202919243 -4.480701e-02 2.515028e-02 3.189204e-03  
## [33,] -0.0092814316 -3.229885e-02 6.748385e-02 -3.042648e-02  
## [34,] -0.0428193000 -1.279450e-02 -3.894385e-02 -1.962233e-02  
## [35,] -0.0012672284 -1.497172e-02 -6.889184e-03 6.615004e-03  
## [36,] -0.0969436040 6.037070e-01 1.175697e-02 5.482778e-01  
## [37,] 0.0568469601 -1.843035e-02 -2.513548e-02 -5.790557e-02  
## [38,] -0.0439003436 -3.185454e-02 -6.331296e-02 2.490044e-02  
## [39,] 0.0011345319 2.261729e-03 -3.315989e-03 -5.629762e-03  
## [40,] -0.0181406267 1.209274e-02 -7.359981e-02 -6.701180e-02  
## [41,] 0.0074631654 2.735088e-02 -4.368700e-03 -7.115130e-03  
## [42,] -0.0319830525 2.033870e-02 1.634189e-02 -5.220777e-02  
## [43,] -0.0289980253 -1.607763e-03 -2.263435e-02 -4.496197e-02  
## [44,] -0.0234655102 -2.236290e-02 -2.017095e-02 -1.422483e-02  
## [45,] 0.0030107756 1.693801e-03 -3.269480e-03 -3.943296e-02  
## [46,] -0.0299822723 1.021229e-02 -1.570715e-02 -3.933061e-03  
## [47,] -0.0107521051 1.300730e-02 -2.907739e-03 -4.318613e-02  
## [48,] -0.0023942716 -1.312991e-03 -1.916512e-03 8.491909e-04  
## [49,] -0.0362294956 -1.775332e-02 -4.172877e-02 -5.672973e-02  
## [50,] -0.0060519725 -7.540575e-03 1.017330e-02 -7.113332e-03  
## [51,] 0.0073979789 8.069327e-03 -5.547504e-03 -1.793434e-02  
## [52,] 0.0012489746 -5.344744e-03 1.211279e-02 -1.320524e-02  
## [53,] 0.0044382947 -2.677935e-02 4.026333e-02 -4.034861e-02  
## [54,] -0.0236668433 1.939905e-02 3.999635e-02 -2.792791e-02  
## [55,] 0.0016980408 -8.615185e-05 8.365948e-03 -7.579899e-03  
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## [57,] -0.0861645769 0.048178412 -0.069148507 -0.0632891579 -0.027905176  
## [58,] -0.1007340689 0.138772827 -0.497123572 -0.0788271938 -0.080741684  
## [59,] -0.2078214010 0.059995948 -0.076756278 -0.0132008580 -0.051947213  
## [60,] 0.4436506426 0.031279212 0.179485091 0.1047377012 0.007367121  
## [61,] -0.4553010517 0.018178571 0.159995815 -0.1386406395 0.082332288  
## [62,] 0.1703611051 0.057168650 -0.160048732 -0.2331289694 -0.132136021  
## [63,] -0.1841441615 0.097590432 0.322637047 -0.0093255737 -0.147158191  
## [64,] 0.0523832816 -0.089103104 -0.010837228 0.0540375050 -0.008156046  
## [65,] 0.0503933467 0.015131087 -0.084186062 0.0528428094 0.037655109  
## [66,] -0.0111850496 0.160196685 -0.053275176 0.2387308835 -0.135586196  
## [67,] 0.1082431839 -0.034756239 0.008116895 0.0025618418 -0.014254133  
## [,61] [,62] [,63] [,64] [,65]  
## [1,] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
## [2,] -0.010601098 -0.018555226 -0.017696268 0.001198559 -0.014089844  
## [3,] -0.003630036 -0.082908221 -0.023455856 -0.080750855 -0.021091011  
## [4,] -0.045180638 0.025006085 -0.067231692 -0.110363160 -0.056709143  
## [5,] 0.088645043 0.023872977 0.106661228 -0.100667086 0.015772504  
## [6,] -0.001457855 0.002073575 -0.009473303 -0.006694294 0.007727607  
## [7,] 0.002375337 -0.015865087 -0.011228156 -0.026221792 -0.011362011  
## [8,] -0.010141333 -0.022725497 0.053637712 0.080122366 -0.071481969  
## [9,] 0.206664379 -0.245399429 -0.038418360 0.449421176 0.478988832  
## [10,] -0.025223674 -0.436640236 -0.077279909 0.021620163 0.192504572  
## [11,] -0.010269877 -0.051974114 0.156177368 -0.132327272 0.025065773  
## [12,] -0.347936465 -0.153741419 -0.264269209 -0.215185895 -0.090859773  
## [13,] 0.335055925 0.208951061 0.438930437 0.028317876 0.031434467  
## [14,] -0.008208519 0.019183567 0.032130482 -0.006257516 -0.000892430  
## [15,] -0.084293734 -0.043288167 -0.274678462 0.094380478 0.054924145  
## [16,] -0.170284542 -0.074706419 0.228570370 -0.264360102 0.363344302  
## [17,] -0.208051878 0.311237528 0.075617805 0.198245299 0.134229529  
## [18,] 0.054500571 0.168509444 -0.060481736 0.121588596 -0.091845632  
## [19,] 0.002053320 0.104464202 -0.008456163 0.113245931 0.029969065  
## [20,] 0.050466023 -0.119764585 -0.030576614 -0.100784687 0.063610994  
## [21,] 0.026507739 -0.040583851 -0.067078713 -0.034758296 0.025379358  
## [22,] -0.296962473 -0.105955669 0.082937697 0.145111982 -0.018277738  
## [23,] 0.026280447 0.186807048 0.063990135 0.003848802 -0.019435708  
## [24,] -0.358757882 -0.008007729 0.208432871 0.154132832 0.026596949  
## [25,] 0.159124192 -0.471289008 0.230535278 0.300588585 -0.562948238  
## [26,] -0.004386786 0.003767049 0.019717357 -0.028229863 0.018748233  
## [27,] 0.128359193 -0.227075445 0.153271482 -0.206913462 -0.035606144  
## [28,] -0.048016794 0.009427465 -0.032358101 0.233110651 0.117242070  
## [29,] 0.004581974 0.001337565 0.009644646 -0.012952755 -0.005523469  
## [30,] 0.098557723 -0.009011106 0.071542879 0.163290321 0.161529669  
## [31,] 0.012333812 -0.021422628 -0.122254134 0.061510724 -0.100088622  
## [32,] -0.076950816 0.033196072 0.175649887 0.002587741 0.012448687  
## [33,] 0.083038822 0.121203051 -0.072888254 -0.133450209 0.046127896  
## [34,] 0.069700369 -0.103036625 -0.197551076 -0.011614438 -0.055550060  
## [35,] -0.044856188 0.025889568 0.092149138 0.012642919 -0.025117662  
## [36,] 0.006511844 0.036096204 0.022421848 -0.003167356 -0.001414196  
## [37,] 0.066885798 -0.110809706 0.038359174 -0.139385316 -0.011659347  
## [38,] 0.132679732 0.020136015 -0.062130652 -0.066251699 0.036899053  
## [39,] 0.139818890 -0.015954478 0.018335497 -0.074048414 0.064909450  
## [40,] 0.105796472 0.026589366 0.066532131 -0.116036976 -0.081631170  
## [41,] 0.064298387 -0.165639803 0.131317255 -0.165577819 0.087824589  
## [42,] 0.013241452 0.044542857 0.056164093 0.115872623 -0.091197304  
## [43,] 0.166378631 0.024827764 -0.237457034 0.005109612 -0.041721425  
## [44,] -0.092474908 -0.055425118 0.049900195 -0.025624376 -0.034100644  
## [45,] 0.061169039 -0.154520655 0.016999536 0.062876410 0.207256099  
## [46,] 0.064979457 0.129733862 -0.226535832 0.108379864 0.005181841  
## [47,] 0.139470991 -0.156036522 -0.055460716 -0.140925247 0.102424150  
## [48,] -0.003364881 0.005362068 0.003908234 -0.017811049 -0.009102848  
## [49,] -0.032951364 -0.009344826 0.048580621 -0.026124924 -0.013990066  
## [50,] -0.017872200 -0.054313508 -0.049685797 -0.012671320 0.162705576  
## [51,] 0.015359077 0.027554380 0.018520200 -0.036716144 0.022802294  
## [52,] 0.099142952 -0.004901936 0.020480063 -0.016982655 -0.079011205  
## [53,] 0.006159308 -0.026556217 -0.213254975 0.057890774 -0.035329306  
## [54,] 0.060982581 0.003585734 0.032354132 -0.260957994 0.037588408  
## [55,] 0.035540009 0.016625071 0.036906883 -0.021610177 -0.041586503  
## [56,] 0.107415683 0.086382860 -0.002198950 0.167517681 -0.018564461  
## [57,] 0.022403481 -0.015907584 -0.066829286 0.055156109 0.021029850  
## [58,] 0.102312677 -0.056784465 -0.043540042 -0.009754905 0.112132590  
## [59,] 0.018597181 -0.043034851 -0.016727555 0.010834700 0.060005591  
## [60,] 0.290370248 0.162570160 -0.058252105 -0.070859682 -0.013031712  
## [61,] 0.213827208 0.027139462 -0.200351664 -0.014208336 -0.007447733  
## [62,] -0.099362180 0.009902534 -0.102034625 -0.092070584 -0.113964633  
## [63,] 0.137017804 0.024958906 -0.101028792 -0.017043419 -0.065020488  
## [64,] -0.053913446 0.055627093 -0.092551224 0.102359295 -0.099432107  
## [65,] 0.018466476 0.018426904 -0.032407397 -0.032172526 0.009194106  
## [66,] -0.117251649 0.014321510 0.165107340 0.070923041 -0.059943504  
## [67,] -0.016588100 0.009389671 -0.012096358 0.039449407 -0.025810963  
## [,66] [,67]  
## [1,] 0.000000000 -5.291270e-02  
## [2,] 0.002200678 -2.740230e-02  
## [3,] 0.041644280 -5.404264e-02  
## [4,] 0.072696354 -1.436445e-01  
## [5,] -0.506531153 -4.632233e-02  
## [6,] -0.015578599 -8.374587e-02  
## [7,] 0.010484975 -1.475062e-02  
## [8,] -0.011784449 2.007048e-01  
## [9,] -0.018165937 -3.353786e-01  
## [10,] 0.079193274 -2.564257e-02  
## [11,] 0.043582969 -2.215532e-02  
## [12,] -0.084077814 -1.261627e-01  
## [13,] 0.088999786 -8.152492e-02  
## [14,] 0.004249512 5.504023e-03  
## [15,] -0.101661619 1.489257e-01  
## [16,] -0.600103849 2.870059e-02  
## [17,] -0.088191892 -1.971805e-01  
## [18,] -0.212907039 -2.441992e-01  
## [19,] -0.032723487 5.012653e-02  
## [20,] 0.016847412 -1.419344e-01  
## [21,] 0.023969385 1.779694e-01  
## [22,] -0.010618941 -1.709633e-01  
## [23,] -0.002714951 -9.909638e-02  
## [24,] 0.163950585 -3.607583e-02  
## [25,] -0.276707958 -3.391252e-05  
## [26,] 0.007457524 -4.518988e-03  
## [27,] 0.005451602 -5.256475e-02  
## [28,] 0.014295880 2.071939e-01  
## [29,] 0.015463056 -2.034231e-02  
## [30,] 0.085586936 3.074166e-01  
## [31,] -0.031893242 -1.099217e-01  
## [32,] 0.034517007 1.784217e-01  
## [33,] -0.047292913 -2.499734e-02  
## [34,] 0.036113928 -2.009126e-03  
## [35,] 0.005346555 6.092466e-02  
## [36,] 0.002240803 2.940296e-04  
## [37,] 0.038245391 -7.501351e-02  
## [38,] -0.115547861 1.546063e-01  
## [39,] 0.018411227 -8.533237e-02  
## [40,] 0.108145863 -2.006418e-01  
## [41,] 0.111734446 -1.156433e-02  
## [42,] -0.040802652 1.687131e-01  
## [43,] -0.016669493 -2.835936e-01  
## [44,] 0.100837658 -2.379388e-01  
## [45,] 0.114334555 7.255445e-02  
## [46,] -0.201869552 -6.131234e-02  
## [47,] 0.053768958 5.741401e-02  
## [48,] -0.004318935 1.140451e-02  
## [49,] 0.022816685 -2.029691e-01  
## [50,] 0.049315086 1.846451e-02  
## [51,] 0.079241409 -4.865282e-02  
## [52,] -0.018048699 -5.952044e-02  
## [53,] -0.082225177 1.326311e-01  
## [54,] 0.170252402 -5.410276e-02  
## [55,] -0.016968532 -3.481253e-02  
## [56,] 0.004327669 -4.531063e-02  
## [57,] -0.062944340 3.558778e-02  
## [58,] -0.021126219 1.156478e-01  
## [59,] -0.005668908 6.638432e-02  
## [60,] -0.053886539 6.606763e-02  
## [61,] -0.052949522 9.402241e-02  
## [62,] 0.020477928 9.853485e-02  
## [63,] 0.042186749 -8.759214e-02  
## [64,] 0.032216371 -6.252275e-02  
## [65,] -0.043079992 -2.994383e-02  
## [66,] 0.025336777 3.305718e-02  
## [67,] -0.005488685 2.920165e-03

#^yields species scores coefficent for each pairwaise comparison and eigenvalues, one eigenvalue for each eigenvector. Higher eigenvalues tell you that more variation is explained in that axes. vectors are species scores, which are then used to calculate the site location? Values are the axes.   
maum.colsums=apply(maumcounts[,4:70],2,sum)  
maum.propexpl=maum.eigen$values/sum(maum.eigen$values)  
maum.propexpl

## [1] 5.474538e-01 2.150841e-01 7.914446e-02 4.355603e-02 3.312515e-02  
## [6] 2.487285e-02 1.590553e-02 1.004492e-02 8.384337e-03 5.140068e-03  
## [11] 3.773800e-03 2.993815e-03 2.108186e-03 1.677410e-03 1.215443e-03  
## [16] 1.149961e-03 7.577556e-04 6.608092e-04 5.527752e-04 5.150242e-04  
## [21] 4.757036e-04 3.839576e-04 2.537984e-04 1.994260e-04 1.390943e-04  
## [26] 1.202480e-04 1.074057e-04 9.769978e-05 6.478822e-05 4.158846e-05  
## [31] 6.567378e-17 2.186151e-17 1.593424e-17 3.269213e-18 3.129361e-19  
## [36] 3.059884e-19 1.700422e-19 1.587714e-19 7.541910e-20 6.696939e-20  
## [41] 5.594262e-20 5.512150e-20 1.324133e-20 4.202312e-21 3.676708e-21  
## [46] 2.091929e-21 1.991704e-21 8.342379e-22 -6.604320e-21 -1.011002e-20  
## [51] -1.088752e-20 -1.527317e-20 -3.338186e-20 -3.345764e-20 -7.457813e-20  
## [56] -8.433396e-20 -1.042774e-19 -1.593497e-19 -2.227626e-19 -5.508860e-19  
## [61] -5.880418e-19 -1.797351e-18 -2.029029e-18 -2.798327e-18 -3.433082e-18  
## [66] -5.200384e-18 -8.941189e-18

#^tells you the percent variation explained by each axes  
maum.scores=as.matrix(maumcounts[,4:70])%\*%as.matrix(maum.eigen$vectors)  
head(maum.scores)

## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## 2 96.03136 -26.931057 135.92728 -9.453143 52.09884 -19.582700 2.410745  
## 3 123.78879 15.019364 121.36079 -23.262131 72.32302 10.835971 14.010170  
## 4 101.48680 1.379363 104.25352 -27.559015 62.80893 4.017783 -5.757610  
## 5 117.38798 -17.724511 100.89321 -29.117194 61.25176 2.996920 -5.698296  
## 6 92.41901 -33.503444 104.52895 -36.292783 49.19950 -6.334168 -3.166007  
## 7 81.54597 -21.479804 65.96895 -17.567702 59.26978 -11.496977 5.460900  
## [,8] [,9] [,10] [,11] [,12] [,13] [,14]  
## 2 106.37991 9.675301 9.714474 5.968446 6.306843 -5.8692252 4.6546592  
## 3 121.19869 13.766264 14.175889 2.692789 3.047917 -4.3734058 3.1432132  
## 4 98.90899 6.975602 11.649737 3.185563 7.182300 -2.6154968 2.1100117  
## 5 94.53191 15.702159 11.907422 9.770347 5.705037 -6.0617433 0.8540463  
## 6 106.48615 19.533161 25.730614 2.358592 4.856747 0.8576660 -0.4121061  
## 7 104.47702 4.770099 10.703246 6.440783 2.399616 0.7187845 3.5057051  
## [,15] [,16] [,17] [,18] [,19] [,20] [,21]  
## 2 -5.9543725 0.8972907 -6.153453 11.313228 11.801655 -5.867342 2.3669300  
## 3 -0.8865924 1.9501736 -3.506675 10.889312 12.106033 -6.559538 4.3073170  
## 4 -3.6546077 1.3669754 -6.637195 9.657633 14.216040 -5.788379 2.4785014  
## 5 -2.4300317 -0.1691723 -7.135194 10.336495 10.334553 -5.488634 0.7469532  
## 6 -6.3439899 0.6246003 -8.005274 11.192651 12.512980 -4.058901 4.8144797  
## 7 -4.8896219 -3.5605716 -2.192101 9.185927 9.769494 -4.833589 3.1216735  
## [,22] [,23] [,24] [,25] [,26] [,27] [,28]  
## 2 -6.775306 11.92259 -0.67182217 8.911376 2.787545 -1.511431 -10.096669  
## 3 -6.983216 13.01264 -0.18583464 10.111356 2.427090 -1.443763 -10.772322  
## 4 -6.304702 13.16433 -1.08700919 10.021817 2.710190 -1.050653 -8.364595  
## 5 -5.035284 13.80420 -0.79649338 9.618089 1.475263 -2.611918 -11.309690  
## 6 -6.626149 11.49261 0.08523893 8.987623 2.986189 -2.094726 -10.375099  
## 7 -7.273342 11.70552 -0.49246332 9.899425 2.437066 -2.304886 -9.479388  
## [,29] [,30] [,31] [,32] [,33] [,34] [,35]  
## 2 2.1823646 6.782703 -1.916787 1.040397 -0.09665619 0.4647032 -4.579847  
## 3 2.0373988 6.659316 -1.916787 1.040397 -0.09665619 0.4647032 -4.579847  
## 4 0.7244606 6.960096 -1.916787 1.040397 -0.09665619 0.4647032 -4.579847  
## 5 2.1379565 6.882463 -1.916787 1.040397 -0.09665619 0.4647032 -4.579847  
## 6 1.9898734 6.628077 -1.916787 1.040397 -0.09665619 0.4647032 -4.579847  
## 7 2.3365909 6.657953 -1.916787 1.040397 -0.09665619 0.4647032 -4.579847  
## [,36] [,37] [,38] [,39] [,40] [,41] [,42]  
## 2 0.7751268 -2.838437 2.067934 1.432399 1.390366 3.175364 2.013295  
## 3 0.7751268 -2.838437 2.067934 1.432399 1.390366 3.175364 2.013295  
## 4 0.7751268 -2.838437 2.067934 1.432399 1.390366 3.175364 2.013295  
## 5 0.7751268 -2.838437 2.067934 1.432399 1.390366 3.175364 2.013295  
## 6 0.7751268 -2.838437 2.067934 1.432399 1.390366 3.175364 2.013295  
## 7 0.7751268 -2.838437 2.067934 1.432399 1.390366 3.175364 2.013295  
## [,43] [,44] [,45] [,46] [,47] [,48] [,49]  
## 2 0.4698083 -0.5130772 0.6216646 -0.0635675 -0.1281362 -0.459748 1.205423  
## 3 0.4698083 -0.5130772 0.6216646 -0.0635675 -0.1281362 -0.459748 1.205423  
## 4 0.4698083 -0.5130772 0.6216646 -0.0635675 -0.1281362 -0.459748 1.205423  
## 5 0.4698083 -0.5130772 0.6216646 -0.0635675 -0.1281362 -0.459748 1.205423  
## 6 0.4698083 -0.5130772 0.6216646 -0.0635675 -0.1281362 -0.459748 1.205423  
## 7 0.4698083 -0.5130772 0.6216646 -0.0635675 -0.1281362 -0.459748 1.205423  
## [,50] [,51] [,52] [,53] [,54] [,55] [,56]  
## 2 -0.4219609 -0.4223922 -0.4200523 0.9502783 -1.781204 1.756256 -2.632246  
## 3 -0.4219609 -0.4223922 -0.4200523 0.9502783 -1.781204 1.756256 -2.632246  
## 4 -0.4219609 -0.4223922 -0.4200523 0.9502783 -1.781204 1.756256 -2.632246  
## 5 -0.4219609 -0.4223922 -0.4200523 0.9502783 -1.781204 1.756256 -2.632246  
## 6 -0.4219609 -0.4223922 -0.4200523 0.9502783 -1.781204 1.756256 -2.632246  
## 7 -0.4219609 -0.4223922 -0.4200523 0.9502783 -1.781204 1.756256 -2.632246  
## [,57] [,58] [,59] [,60] [,61] [,62] [,63]  
## 2 -1.344934 -0.6300533 1.7328 1.687088 0.6935803 -1.87009 0.1894073  
## 3 -1.344934 -0.6300533 1.7328 1.687088 0.6935803 -1.87009 0.1894073  
## 4 -1.344934 -0.6300533 1.7328 1.687088 0.6935803 -1.87009 0.1894073  
## 5 -1.344934 -0.6300533 1.7328 1.687088 0.6935803 -1.87009 0.1894073  
## 6 -1.344934 -0.6300533 1.7328 1.687088 0.6935803 -1.87009 0.1894073  
## 7 -1.344934 -0.6300533 1.7328 1.687088 0.6935803 -1.87009 0.1894073  
## [,64] [,65] [,66] [,67]  
## 2 -4.202963 -0.9631772 2.696073 -13.42106  
## 3 -4.202963 -0.9631772 2.696073 -13.42106  
## 4 -4.202963 -0.9631772 2.696073 -13.42106  
## 5 -4.202963 -0.9631772 2.696073 -13.42106  
## 6 -4.202963 -0.9631772 2.696073 -13.42106  
## 7 -4.202963 -0.9631772 2.696073 -13.42106

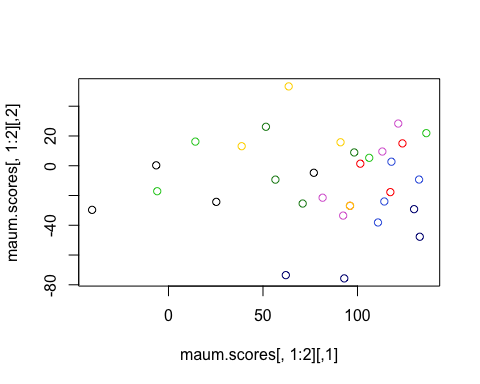
head(maumcounts)

## Lowest.taxonimic.Sample.ID Treatment Total.counted Microcystis.spp.  
## 2 37 Control 453 175  
## 3 38 Control 439 209  
## 4 39 Control 403 170  
## 5 40 Control 400 174  
## 6 41 Nitrogen 461 154  
## 7 42 Nitrogen 411 131  
## Nitzschia.spp. Pseudoanabaena.spp. Glaucocystis.spp... morphospecies.10  
## 2 12 29 0 0  
## 3 35 17 0 0  
## 4 26 10 0 0  
## 5 19 11 0 0  
## 6 21 16 0 0  
## 7 41 28 0 0  
## Aulacoseria.spp. Filamentous.Chlorophyte Diatoma.spp... morphospecies.1  
## 2 15 98 1 0  
## 3 0 63 0 0  
## 4 0 67 0 1  
## 5 0 83 0 0  
## 6 0 102 6 0  
## 7 16 75 0 0  
## pollen. Selenastraceae morphospecies.2 morphospecies.3 Cyclotella.spp.  
## 2 0 9 0 6 16  
## 3 0 1 0 0 15  
## 4 0 3 1 0 22  
## 5 0 1 0 0 12  
## 6 4 4 1 0 11  
## 7 2 2 0 3 20  
## morphospecies.4 Dolichospermum.spp. Aphanocapsa.spp.. morphospecies.5  
## 2 10 0 2 0  
## 3 0 0 0 0  
## 4 2 0 0 1  
## 5 2 0 0 1  
## 6 0 0 5 2  
## 7 0 0 4 1  
## Merismopedia.spp. Scenedesmus.spp. morphospecies.6 morphospecies.7  
## 2 6 0 0 0  
## 3 0 2 4 0  
## 4 0 0 0 0  
## 5 0 4 0 0  
## 6 17 0 4 0  
## 7 4 0 4 0  
## morphospecies.8 clamydomonadaceae.1 morphospecies.12 morphospecies.11  
## 2 2 1 0 5  
## 3 1 0 0 9  
## 4 1 1 0 22  
## 5 1 2 0 24  
## 6 4 1 0 18  
## 7 2 0 0 12  
## morphospecies.13 Westella.spp.. Melosira.spp... morphospecies.14  
## 2 0 0 48 2  
## 3 0 0 45 3  
## 4 0 0 37 1  
## 5 0 0 19 1  
## 6 4 0 38 0  
## 7 1 0 19 2  
## morphospecies.15 morphospecies.16 Unidentified.13 Spirulina.spp...  
## 2 6 4 2 3  
## 3 0 0 0 0  
## 4 0 0 0 3  
## 5 1 0 1 0  
## 6 1 0 0 3  
## 7 3 0 1 4  
## Tetraedron.spp. Cycyotella.spp..2.. Thalassiosira.spp.  
## 2 1 0 0  
## 3 0 33 1  
## 4 0 23 0  
## 5 0 26 3  
## 6 0 27 1  
## 7 0 32 2  
## Micractinium.spp... morphospecies.17 morphospecies.18 morphospecies.19  
## 2 0 0 0 0  
## 3 1 0 0 0  
## 4 0 1 4 3  
## 5 0 0 5 0  
## 6 1 0 5 0  
## 7 0 0 0 0  
## morphospecies.20 clamydomonadaceae.2 morphospecies.21 Dinobryon.spp.  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 2 2 0 0  
## 5 4 1 1 3  
## 6 1 2 2 0  
## 7 0 0 2 0  
## morphospecies.22 morphospecies.23 morphospecies.24 morphospecies.25  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 1 0 0 0  
## 6 0 4 1 1  
## 7 0 0 0 0  
## morphospecies.26 morphospecies.27 morphospecies.28 morphospecies.29  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## 7 0 0 0 0  
## Tetraselmis.spp... morphospecies.30 morphospecies.31 Kirchneriella.spp.  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## 7 0 0 0 0  
## morphospecies.32 Tetraedron.spp..2 Dinobryon.spp..1 Desmodesmus.spp...  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## 7 0 0 0 0  
## Selenastrum.spp. Unidentified.33 Euglena.spp. Phacus.spp.  
## 2 0 0 0 0  
## 3 0 0 0 0  
## 4 0 0 0 0  
## 5 0 0 0 0  
## 6 0 0 0 0  
## 7 0 0 0 0  
## Unidentified.34 Treubaria.spp.  
## 2 0 0  
## 3 0 0  
## 4 0 0  
## 5 0 0  
## 6 0 0  
## 7 0 0

head(maum.eigen$vectors)

## [,1] [,2] [,3] [,4] [,5]  
## [1,] 0.7041118461 0.230250760 0.508464470 0.096714825 0.278721015  
## [2,] -0.1135394269 0.196905704 -0.297781093 -0.338631783 0.598042460  
## [3,] 0.0634570357 0.095389580 -0.108945985 0.282565597 -0.351088843  
## [4,] 0.0008623905 0.002552869 -0.004068074 0.003437927 -0.002120542  
## [5,] -0.0008538637 0.002548052 0.004920488 -0.005199664 -0.013691363  
## [6,] -0.2744592198 -0.298028212 -0.023982531 0.706277150 0.498548847  
## [,6] [,7] [,8] [,9] [,10]  
## [1,] 0.092568873 0.0679349131 0.260498913 0.083639863 0.059906644  
## [2,] -0.364436398 0.3971663086 0.227340880 -0.086342343 0.026081065  
## [3,] -0.522815694 -0.0248560566 0.484115755 0.118075804 -0.192231051  
## [4,] -0.011910679 0.0008694788 -0.008062181 -0.022919568 0.035445867  
## [5,] 0.009935008 0.0065050489 0.001769486 -0.004757618 0.003158754  
## [6,] 0.119606518 -0.0478050072 0.140137628 0.059439873 -0.009526614  
## [,11] [,12] [,13] [,14] [,15]  
## [1,] -0.006731733 0.043425723 -0.03892986 -0.001445841 -0.007934052  
## [2,] -0.059151670 -0.003180043 0.04174863 -0.040083250 -0.076861043  
## [3,] 0.268025338 -0.147703566 0.07176742 -0.007496047 0.176959543  
## [4,] 0.003490957 -0.020380162 0.01455196 0.047817391 0.038518220  
## [5,] 0.061414167 0.030649042 0.03703444 0.029019181 0.008095747  
## [6,] 0.105711026 0.095093693 -0.06129666 -0.026605390 -0.027113545  
## [,16] [,17] [,18] [,19] [,20]  
## [1,] 0.02107299 -0.029141655 0.036363724 0.03586398 -0.020723776  
## [2,] 0.02028539 0.026131821 0.034527157 0.03306436 0.009959793  
## [3,] -0.09711630 0.152126030 -0.055310604 0.01248722 0.074078645  
## [4,] 0.03432821 0.003842859 0.049664942 0.04571962 0.026632932  
## [5,] -0.03287824 0.018671237 0.039825433 0.02491686 -0.006730988  
## [6,] 0.01180694 -0.062856600 0.009655763 0.04745134 -0.005911512  
## [,21] [,22] [,23] [,24] [,25]  
## [1,] 0.009620506 -0.006553896 0.0204097608 -0.0077998944 0.02537983  
## [2,] -0.016056859 -0.062710270 0.0868220975 0.0007750038 0.02596386  
## [3,] 0.032468994 -0.028842882 0.0321742954 -0.0476324406 0.03766515  
## [4,] -0.013353126 0.031366085 0.1015035776 0.0029278114 -0.08955817  
## [5,] 0.041436290 0.017176219 0.0678085459 -0.0790942450 -0.05703497  
## [6,] 0.011146079 -0.026894130 0.0003176849 -0.0126783202 0.01825915  
## [,26] [,27] [,28] [,29] [,30]  
## [1,] 0.009148621 -0.008693842 -0.038618750 0.0078024598 0.008249081  
## [2,] -0.008324853 -0.005928699 -0.007941603 0.0003754861 0.027281562  
## [3,] 0.050039211 -0.004870784 -0.058856724 -0.0291709456 0.018622887  
## [4,] -0.136927099 0.098446463 -0.049906068 0.0160370845 -0.221985469  
## [5,] 0.026494727 -0.057526501 0.050437354 0.0051495342 -0.306295663  
## [6,] 0.028237639 -0.024894577 -0.046948807 0.0060359275 -0.022196466  
## [,31] [,32] [,33] [,34] [,35]  
## [1,] 0.00000000 0.000000000 0.0181144791 0.0000000000 0.000000000  
## [2,] -0.02915456 -0.004093792 -0.0315861542 -0.0366480867 -0.002180794  
## [3,] -0.01650512 -0.023436340 -0.0645065078 -0.0001451478 -0.007171525  
## [4,] 0.60752848 0.640441320 -0.1513322883 -0.1801834339 0.029019648  
## [5,] -0.59136687 0.449876958 0.0002829112 -0.1492295040 0.024898779  
## [6,] 0.00993857 -0.007311632 0.0177828165 0.0210249425 0.019622674  
## [,36] [,37] [,38] [,39] [,40]  
## [1,] 0.0000000000 0.000000000 0.000000000 0.000000000 0.0000000000  
## [2,] -0.0028084569 -0.002239078 0.009516105 0.010811540 -0.0003736471  
## [3,] 0.0031102418 0.016851809 -0.012802820 -0.006872926 -0.0018566020  
## [4,] 0.0004332874 0.018486135 0.002962505 -0.016742963 -0.0047972768  
## [5,] 0.0046216324 -0.024219717 0.004399884 -0.018717408 -0.0177886118  
## [6,] -0.0001629435 0.027459412 -0.006751854 0.012588393 -0.0035473206  
## [,41] [,42] [,43] [,44] [,45]  
## [1,] 0.000000000 0.000000000 0.0000000000 0.0000000000 0.000000e+00  
## [2,] -0.000523214 -0.019762211 -0.0042586778 -0.0009603691 2.856533e-05  
## [3,] 0.021143885 0.005645169 0.0045508423 -0.0012848691 -5.705140e-03  
## [4,] 0.012202142 0.004042202 0.0007216855 -0.0068281236 -3.184179e-03  
## [5,] 0.048281220 0.034873255 0.0068665500 0.0065402212 -7.180335e-03  
## [6,] -0.020477862 -0.012525800 0.0021047508 -0.0023130772 -7.833927e-04  
## [,46] [,47] [,48] [,49] [,50]  
## [1,] 0.000000e+00 0.0000000000 0.0000000000 0.000000000 0.000000e+00  
## [2,] 5.757963e-05 -0.0002144235 0.0005355046 0.003622107 2.303549e-03  
## [3,] -1.578477e-03 0.0001208981 -0.0008028892 -0.003648453 6.039007e-03  
## [4,] 7.903240e-04 -0.0034661585 0.0025357131 -0.004245501 -8.572781e-03  
## [5,] -8.692189e-04 0.0011236435 0.0042318362 -0.005869848 9.903971e-03  
## [6,] 1.123217e-03 -0.0029548428 0.0040107638 0.001469314 -5.101214e-05  
## [,51] [,52] [,53] [,54] [,55]  
## [1,] 0.0000000000 0.0000000000 0.0000000000 0.000000000 0.000000000  
## [2,] 0.0047218405 0.0005183927 -0.0019873482 0.023313434 -0.005482234  
## [3,] -0.0072395879 0.0025063718 -0.0004360866 -0.003669058 -0.004988570  
## [4,] 0.0006822134 -0.0077170444 -0.0065175713 -0.024833017 -0.024697109  
## [5,] -0.0050087387 0.0022479949 -0.0101922542 0.010584889 -0.021991557  
## [6,] 0.0019372137 0.0001744969 -0.0050878345 0.007215838 -0.013816150  
## [,56] [,57] [,58] [,59] [,60]  
## [1,] 0.0000000000 0.000000000 0.000000000 0.0000000000 0.000000000  
## [2,] -0.0005951118 -0.003993977 -0.004077583 0.0241974984 0.024437931  
## [3,] 0.0203008763 0.012890729 -0.002548463 -0.0394799041 0.001841194  
## [4,] -0.0003656223 0.004814440 0.018623760 -0.0220252692 -0.001719721  
## [5,] 0.0061392368 0.001272718 0.036098078 -0.0291058914 -0.020806622  
## [6,] -0.0026074285 0.001459663 -0.004418045 0.0003882999 0.005000028  
## [,61] [,62] [,63] [,64] [,65]  
## [1,] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
## [2,] -0.010601098 -0.018555226 -0.017696268 0.001198559 -0.014089844  
## [3,] -0.003630036 -0.082908221 -0.023455856 -0.080750855 -0.021091011  
## [4,] -0.045180638 0.025006085 -0.067231692 -0.110363160 -0.056709143  
## [5,] 0.088645043 0.023872977 0.106661228 -0.100667086 0.015772504  
## [6,] -0.001457855 0.002073575 -0.009473303 -0.006694294 0.007727607  
## [,66] [,67]  
## [1,] 0.000000000 -0.05291270  
## [2,] 0.002200678 -0.02740230  
## [3,] 0.041644280 -0.05404264  
## [4,] 0.072696354 -0.14364448  
## [5,] -0.506531153 -0.04632233  
## [6,] -0.015578599 -0.08374587

plot(maum.scores[,1:2],col=colors)



#Vegan way to do PCA  
par(mfrow=c(1,1))  
maum.pca=rda(maumcounts[,4:70])  
class(maum.pca)

## [1] "rda" "cca"

str(maum.pca)

## List of 10  
## $ colsum : Named num [1:67] 33.973 13.099 9.203 0.39 0.421 ...  
## ..- attr(\*, "names")= chr [1:67] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...  
## $ tot.chi : num 3756  
## $ Ybar : num [1:32, 1:67] 3.497 9.603 2.599 3.317 -0.275 ...  
## ..- attr(\*, "scaled:center")= Named num [1:67] 155.5312 26.6562 17.5938 0.0938 0.125 ...  
## .. ..- attr(\*, "names")= chr [1:67] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. ..$ : chr [1:67] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...  
## ..- attr(\*, "METHOD")= chr "PCA"  
## $ method : chr "rda"  
## $ call : language rda(X = maumcounts[, 4:70])  
## $ pCCA : NULL  
## $ CCA : NULL  
## $ CA :List of 7  
## ..$ eig : Named num [1:30] 2056 808 297 164 124 ...  
## .. ..- attr(\*, "names")= chr [1:30] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ poseig : NULL  
## ..$ u : num [1:32, 1:30] -0.0568 -0.1668 -0.0784 -0.1414 -0.0425 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:30] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ v : num [1:67, 1:30] -0.704112 0.113539 -0.063457 -0.000862 0.000854 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:67] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...  
## .. .. ..$ : chr [1:30] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ rank : int 30  
## ..$ tot.chi: num 3756  
## ..$ Xbar : num [1:32, 1:67] 3.497 9.603 2.599 3.317 -0.275 ...  
## .. ..- attr(\*, "scaled:center")= Named num [1:67] 155.5312 26.6562 17.5938 0.0938 0.125 ...  
## .. .. ..- attr(\*, "names")= chr [1:67] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:67] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...  
## .. ..- attr(\*, "METHOD")= chr "PCA"  
## $ inertia : chr "variance"  
## $ regularization: chr "this is a vegan::rda result object"  
## - attr(\*, "class")= chr [1:2] "rda" "cca"

summary(maum.pca)

##   
## Call:  
## rda(X = maumcounts[, 4:70])   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 3756 1  
## Unconstrained 3756 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 2056.0821 807.7953 297.24426 163.58417 124.40873  
## Proportion Explained 0.5475 0.2151 0.07914 0.04356 0.03313  
## Cumulative Proportion 0.5475 0.7625 0.84168 0.88524 0.91836  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 93.41539 59.73667 37.72589 31.489204 19.30465  
## Proportion Explained 0.02487 0.01591 0.01004 0.008384 0.00514  
## Cumulative Proportion 0.94324 0.95914 0.96919 0.977571 0.98271  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 14.173327 11.243924 7.917751 6.299878 4.564863  
## Proportion Explained 0.003774 0.002994 0.002108 0.001677 0.001215  
## Cumulative Proportion 0.986485 0.989479 0.991587 0.993265 0.994480  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 4.31893 2.8459162 2.4818129 2.0760678 1.934286  
## Proportion Explained 0.00115 0.0007578 0.0006608 0.0005528 0.000515  
## Cumulative Proportion 0.99563 0.9963877 0.9970485 0.9976013 0.998116  
## PC21 PC22 PC23 PC24 PC25  
## Eigenvalue 1.7866083 1.442036 0.9531952 0.7489877 0.5223989  
## Proportion Explained 0.0004757 0.000384 0.0002538 0.0001994 0.0001391  
## Cumulative Proportion 0.9985920 0.998976 0.9992297 0.9994292 0.9995683  
## PC26 PC27 PC28 PC29 PC30  
## Eigenvalue 0.4516177 0.4033854 0.3669328 2.433e-01 1.562e-01  
## Proportion Explained 0.0001202 0.0001074 0.0000977 6.479e-05 4.159e-05  
## Cumulative Proportion 0.9996885 0.9997959 0.9998936 1.000e+00 1.000e+00  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 18.47199   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4  
## Microcystis.spp. -9.623e+00 -1.973e+00 2.642e+00 -3.728e-01  
## Nitzschia.spp. 1.552e+00 -1.687e+00 -1.547e+00 1.305e+00  
## Pseudoanabaena.spp. -8.673e-01 -8.172e-01 -5.662e-01 -1.089e+00  
## Glaucocystis.spp... -1.179e-02 -2.187e-02 -2.114e-02 -1.325e-02  
## morphospecies.10 1.167e-02 -2.183e-02 2.557e-02 2.005e-02  
## Aulacoseria.spp. 3.751e+00 2.553e+00 -1.246e-01 -2.723e+00  
## Filamentous.Chlorophyte -9.086e-01 7.196e+00 1.409e+00 1.346e+00  
## Diatoma.spp... 4.008e-02 8.307e-02 1.202e-01 -1.736e-01  
## morphospecies.1 -1.150e-02 -7.432e-03 9.078e-03 2.186e-02  
## pollen. 1.759e-03 -1.105e-02 -6.903e-02 4.312e-02  
## Selenastraceae 4.590e-01 -2.067e-02 -1.350e-02 -1.643e-01  
## morphospecies.2 2.229e-02 -6.682e-03 -1.538e-02 -9.643e-03  
## morphospecies.3 -4.280e-02 8.802e-02 1.125e-01 -1.130e-01  
## Cyclotella.spp. -4.568e-01 -5.810e-01 -2.017e-01 -1.608e-01  
## morphospecies.4 5.117e-03 5.035e-03 3.154e-01 -6.057e-02  
## Dolichospermum.spp. -1.026e-02 -7.903e-03 -2.068e-02 -6.166e-03  
## Aphanocapsa.spp.. 6.018e-02 1.486e-02 -2.288e-02 -7.247e-02  
## morphospecies.5 1.182e-01 -3.200e-02 -2.854e-02 1.204e-01  
## Merismopedia.spp. 2.382e-01 6.024e-03 -4.150e-01 -2.755e-01  
## Scenedesmus.spp. 3.979e-01 -7.760e-02 3.669e-02 5.034e-01  
## morphospecies.6 1.284e-01 4.515e-02 -2.158e-02 -3.026e-01  
## morphospecies.7 6.345e-02 -8.022e-03 2.754e-03 3.563e-02  
## morphospecies.8 1.770e-01 -1.785e-01 7.348e-02 1.144e-01  
## clamydomonadaceae.1 -1.643e-03 8.612e-02 2.014e-02 4.249e-02  
## morphospecies.12 -2.098e-18 -1.215e-16 -3.844e-17 9.773e-18  
## morphospecies.11 -6.859e-03 -1.196e+00 -5.229e-01 1.012e+00  
## morphospecies.13 1.652e-02 6.916e-02 -3.452e-02 -4.129e-03  
## Westella.spp.. 2.530e-02 1.599e-04 -1.256e-02 3.866e-02  
## Melosira.spp... 8.572e+00 -2.249e+00 3.037e+00 6.541e-01  
## morphospecies.14 8.213e-02 -2.427e-02 6.262e-02 -1.216e-01  
## morphospecies.15 1.311e-01 -1.972e-02 6.980e-02 -2.694e-01  
## morphospecies.16 -1.474e-02 1.779e-02 1.683e-01 -6.468e-02  
## Unidentified.13 -1.189e-01 -1.133e-01 3.725e-02 -1.227e-01  
## Spirulina.spp... 8.330e-02 -1.318e-01 -9.268e-03 -1.755e-01  
## Tetraedron.spp. -2.275e-03 -9.966e-03 3.263e-02 -1.576e-02  
## Cycyotella.spp..2.. -1.333e+00 7.429e-01 -2.288e+00 6.104e-01  
## Thalassiosira.spp. 7.430e-02 -1.516e-01 -9.746e-02 4.977e-02  
## Micractinium.spp... -4.275e-02 -2.884e-01 -1.651e-01 -9.544e-02  
## morphospecies.17 -4.246e-03 -3.857e-03 -8.747e-04 4.669e-03  
## morphospecies.18 -1.303e-01 -7.013e-02 -7.839e-02 5.022e-02  
## morphospecies.19 -3.358e-02 -4.736e-02 -2.491e-03 2.447e-02  
## morphospecies.20 2.058e-01 -1.548e-01 -2.883e-02 -2.527e-02  
## clamydomonadaceae.2 -9.275e-03 -2.663e-02 -4.052e-02 7.387e-02  
## morphospecies.21 3.782e-03 -1.372e-01 -2.446e-01 -6.998e-02  
## Dinobryon.spp. 1.550e-02 2.392e-02 -3.042e-02 -1.577e-02  
## morphospecies.22 8.705e-02 -6.457e-02 9.255e-02 1.083e-01  
## morphospecies.23 4.684e-02 1.377e-02 1.751e-02 6.575e-03  
## morphospecies.24 -2.302e-03 8.077e-03 -7.194e-04 1.131e-02  
## morphospecies.25 1.005e-01 -9.369e-02 -3.066e-02 -1.292e-01  
## morphospecies.26 1.312e-02 9.093e-03 -3.179e-02 4.125e-03  
## morphospecies.27 4.849e-02 3.411e-03 -1.517e-02 -2.138e-02  
## morphospecies.28 4.455e-03 -2.112e-02 -1.774e-02 7.413e-03  
## morphospecies.29 1.004e-01 -1.121e-01 -9.178e-02 3.187e-02  
## Tetraselmis.spp... 7.025e-02 -8.450e-02 4.958e-02 2.815e-02  
## morphospecies.30 6.460e-03 -1.234e-02 -9.607e-03 1.169e-02  
## morphospecies.31 8.967e-02 4.090e-02 -2.158e-01 1.449e-01  
## Kirchneriella.spp. 1.676e-02 -3.629e-03 1.615e-03 2.336e-02  
## morphospecies.32 2.578e-03 1.830e-03 -3.093e-02 9.392e-03  
## Tetraedron.spp..2 2.291e-03 5.305e-03 -1.140e-02 6.836e-03  
## Dinobryon.spp..1 -2.158e-03 7.730e-02 5.793e-03 -6.854e-03  
## Desmodesmus.spp... -2.801e-03 4.150e-02 2.040e-02 7.056e-03  
## Selenastrum.spp. 1.383e-02 -2.523e-02 -1.031e-02 4.555e-02  
## Unidentified.33 -1.379e-02 -3.065e-02 -2.927e-02 -1.753e-02  
## Euglena.spp. 1.303e-03 -5.137e-02 -1.167e-02 -1.743e-03  
## Phacus.spp. 1.447e-02 -8.934e-03 1.301e-02 1.653e-02  
## Unidentified.34 3.539e-02 -6.688e-02 2.976e-02 3.210e-02  
## Treubaria.spp. 9.211e-03 -7.878e-03 1.082e-02 9.075e-03  
## PC5 PC6  
## Microcystis.spp. -9.370e-01 2.697e-01  
## Nitzschia.spp. -2.011e+00 -1.062e+00  
## Pseudoanabaena.spp. 1.180e+00 -1.523e+00  
## Glaucocystis.spp... 7.129e-03 -3.470e-02  
## morphospecies.10 4.603e-02 2.894e-02  
## Aulacoseria.spp. -1.676e+00 3.484e-01  
## Filamentous.Chlorophyte -1.171e-01 -5.745e-01  
## Diatoma.spp... 3.039e-02 2.058e-02  
## morphospecies.1 7.920e-03 2.346e-02  
## pollen. 9.175e-02 1.362e-02  
## Selenastraceae 2.624e-01 -5.354e-01  
## morphospecies.2 2.558e-02 7.066e-04  
## morphospecies.3 7.472e-02 -2.702e-01  
## Cyclotella.spp. 1.183e-01 -6.680e-03  
## morphospecies.4 1.122e-01 -3.679e-01  
## Dolichospermum.spp. 1.059e-02 -3.832e-02  
## Aphanocapsa.spp.. 7.968e-02 -1.810e-01  
## morphospecies.5 -2.070e-02 -2.993e-02  
## Merismopedia.spp. 7.180e-01 -5.604e-01  
## Scenedesmus.spp. 3.244e-01 3.731e-01  
## morphospecies.6 -2.184e-01 3.119e-02  
## morphospecies.7 3.112e-02 3.471e-02  
## morphospecies.8 1.527e-01 -4.434e-02  
## clamydomonadaceae.1 8.295e-02 5.622e-02  
## morphospecies.12 -7.125e-18 -9.828e-17  
## morphospecies.11 -9.754e-01 -3.207e-01  
## morphospecies.13 1.825e-02 -3.317e-02  
## Westella.spp.. 3.700e-02 -2.581e-02  
## Melosira.spp... 1.540e-01 4.304e-01  
## morphospecies.14 -1.497e-01 -3.893e-02  
## morphospecies.15 2.742e-01 -6.880e-02  
## morphospecies.16 6.822e-02 -1.305e-01  
## Unidentified.13 3.120e-02 -9.409e-02  
## Spirulina.spp... 1.440e-01 -3.727e-02  
## Tetraedron.spp. 4.260e-03 -4.362e-02  
## Cycyotella.spp..2.. 3.259e-01 1.759e+00  
## Thalassiosira.spp. -1.911e-01 -5.369e-02  
## Micractinium.spp... 1.476e-01 -9.280e-02  
## morphospecies.17 -3.814e-03 6.589e-03  
## morphospecies.18 6.099e-02 3.523e-02  
## morphospecies.19 -2.509e-02 7.968e-02  
## morphospecies.20 1.075e-01 5.925e-02  
## clamydomonadaceae.2 9.749e-02 -4.684e-03  
## morphospecies.21 7.889e-02 -6.515e-02  
## Dinobryon.spp. -1.012e-02 4.934e-03  
## morphospecies.22 1.008e-01 2.975e-02  
## morphospecies.23 3.615e-02 3.789e-02  
## morphospecies.24 8.049e-03 -3.825e-03  
## morphospecies.25 1.218e-01 -5.172e-02  
## morphospecies.26 2.035e-02 -2.197e-02  
## morphospecies.27 -2.487e-02 2.351e-02  
## morphospecies.28 -4.199e-03 -1.557e-02  
## morphospecies.29 -1.492e-02 -7.801e-02  
## Tetraselmis.spp... 7.957e-02 5.651e-02  
## morphospecies.30 -5.709e-03 -2.510e-04  
## morphospecies.31 -7.577e-02 -2.290e-01  
## Kirchneriella.spp. 1.123e-02 -1.678e-02  
## morphospecies.32 4.643e-03 -4.391e-02  
## Tetraedron.spp..2 1.567e-03 -1.430e-02  
## Dinobryon.spp..1 -4.161e-02 2.967e-02  
## Desmodesmus.spp... -8.472e-03 3.668e-02  
## Selenastrum.spp. -7.409e-02 -6.674e-03  
## Unidentified.33 8.639e-03 -5.002e-02  
## Euglena.spp. 1.649e-02 -3.547e-02  
## Phacus.spp. 9.666e-03 -2.489e-03  
## Unidentified.34 3.488e-02 6.988e-03  
## Treubaria.spp. 1.615e-02 8.536e-03  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -1.04978 1.98878 5.7966 -3.1035 1.88419 -5.85286  
## 3 -3.08070 -2.90809 2.9935 0.4785 -4.13140 4.58866  
## 4 -1.44894 -1.31590 -0.2985 1.5931 -1.30148 2.24825  
## 5 -2.61237 0.91410 -0.9451 1.9973 -0.83830 1.89783  
## 6 -0.78548 2.75597 -0.2455 3.8586 2.74659 -1.30517  
## 7 0.01006 1.35245 -7.6656 -0.9986 -0.24877 -3.07735  
## 8 -2.91791 -4.46426 3.6687 -3.4340 -2.81567 -3.54238  
## 9 -2.30238 -2.26935 -5.2040 -3.7114 5.15769 4.28524  
## 10 -1.21396 -2.19716 -3.3119 -3.1388 5.53593 -1.40021  
## 11 1.83751 -0.06547 -2.0894 2.2835 0.78116 4.20334  
## 12 2.20417 -4.20986 -3.2780 3.9900 -1.94791 -0.08564  
## 13 0.78173 1.81017 -3.8890 2.3326 0.53454 -4.87774  
## 14 -3.53080 2.25009 0.9976 1.3016 -0.21371 1.31638  
## 15 -3.75103 4.41501 4.0950 2.6890 -0.01201 1.25028  
## 16 -0.82805 7.68241 0.4752 -1.0445 -4.72913 0.82223  
## 17 1.43401 7.42595 -3.7596 1.7372 1.55105 -0.75160  
## 18 -3.72455 -0.07227 -0.3811 -4.4804 -2.54650 2.58057  
## 19 -2.13414 3.29533 -1.5067 0.8171 2.58206 -2.61989  
## 20 -2.37881 1.64922 0.3098 0.9140 -0.34821 3.99628  
## 21 -2.65400 -1.47024 -1.6636 -1.6014 1.40229 -1.38519  
## 22 6.41303 0.84286 -0.4030 5.6580 -8.37261 -3.87336  
## 23 4.93606 -3.04834 4.4401 5.6392 3.29811 -0.84926  
## 24 -1.79418 -1.77398 4.8601 -0.7402 -0.43892 -0.97445  
## 25 -4.00451 -3.71198 -2.8989 -0.3634 -6.44458 1.85379  
## 26 3.14293 -2.68798 3.6913 3.0964 5.51000 2.91266  
## 27 -1.04978 1.98878 5.7966 -3.1035 1.88419 -5.85286  
## 28 1.32334 -7.37806 -0.4599 0.8311 -2.31468 -3.17676  
## 29 -0.68389 -2.99604 -2.7749 -1.4605 0.51515 -5.22725  
## 30 8.93400 2.30694 1.5219 -10.0684 -3.85776 3.53625  
## 31 6.45172 -1.18656 -1.1189 -4.0978 3.55743 0.26449  
## 32 4.12654 1.67951 0.2414 -0.1189 0.33751 3.66007  
## 33 0.35015 -0.60204 3.0060 2.2484 3.28375 5.43565

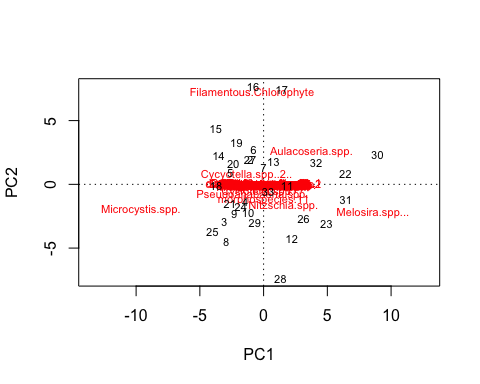
eigenvals(maum.pca)

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 2056.0821 807.7953 297.2443 163.5842 124.4087 93.4154 59.7367   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 37.7259 31.4892 19.3046 14.1733 11.2439 7.9178 6.2999   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 4.5649 4.3189 2.8459 2.4818 2.0761 1.9343 1.7866   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 1.4420 0.9532 0.7490 0.5224 0.4516 0.4034 0.3669   
## PC29 PC30   
## 0.2433 0.1562

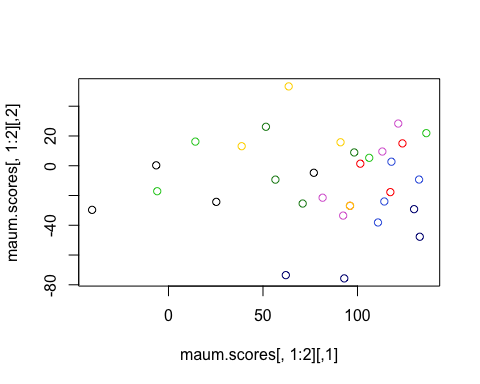
eigenvals(maum.pca)/sum(eigenvals(maum.pca))

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 0.5474538 0.2150841 0.0791445 0.0435560 0.0331252 0.0248728 0.0159055   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 0.0100449 0.0083843 0.0051401 0.0037738 0.0029938 0.0021082 0.0016774   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 0.0012154 0.0011500 0.0007578 0.0006608 0.0005528 0.0005150 0.0004757   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 0.0003840 0.0002538 0.0001994 0.0001391 0.0001202 0.0001074 0.0000977   
## PC29 PC30   
## 0.0000648 0.0000416

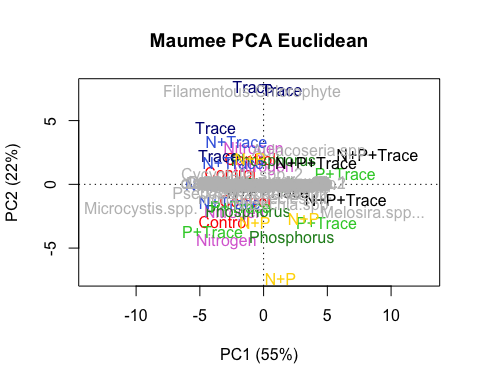
plot(maum.pca)



plot(maum.scores[,1:2],col=colors)



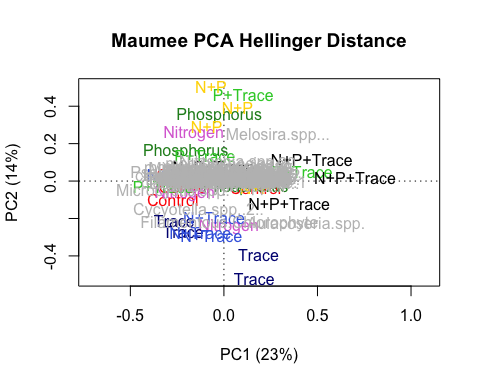
plot(maum.pca,type="none",xlab="PC1 (55%)",ylab="PC2 (22%)",main="Maumee PCA Euclidean")  
text(maum.pca,labels=maumcounts$Treatment,col=colors)  
text(maum.pca,display="species",col=8)



# Hellinger distance-based PCA  
maum.hel=decostand(maumcounts[,4:70],method="hellinger")  
maum.hel.pca=rda(maum.hel)  
summary(maum.hel.pca)

##   
## Call:  
## rda(X = maum.hel)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.104 1  
## Unconstrained 0.104 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5 PC6  
## Eigenvalue 0.02412 0.01487 0.01119 0.008418 0.006165 0.005545  
## Proportion Explained 0.23194 0.14295 0.10757 0.080939 0.059277 0.053313  
## Cumulative Proportion 0.23194 0.37489 0.48246 0.563397 0.622675 0.675988  
## PC7 PC8 PC9 PC10 PC11  
## Eigenvalue 0.004138 0.003836 0.003492 0.003058 0.002612  
## Proportion Explained 0.039788 0.036889 0.033572 0.029401 0.025115  
## Cumulative Proportion 0.715775 0.752665 0.786237 0.815638 0.840753  
## PC12 PC13 PC14 PC15 PC16  
## Eigenvalue 0.002169 0.001968 0.001601 0.001341 0.001259  
## Proportion Explained 0.020859 0.018921 0.015398 0.012890 0.012109  
## Cumulative Proportion 0.861612 0.880533 0.895931 0.908822 0.920931  
## PC17 PC18 PC19 PC20 PC21  
## Eigenvalue 0.001237 0.00118 0.000970 0.0008818 0.0007458  
## Proportion Explained 0.011899 0.01135 0.009327 0.0084788 0.0071709  
## Cumulative Proportion 0.932830 0.94418 0.953505 0.9619839 0.9691548  
## PC22 PC23 PC24 PC25 PC26  
## Eigenvalue 0.0006313 0.0005145 0.0004544 0.0004215 0.0003476  
## Proportion Explained 0.0060703 0.0049472 0.0043696 0.0040532 0.0033419  
## Cumulative Proportion 0.9752251 0.9801723 0.9845418 0.9885950 0.9919369  
## PC27 PC28 PC29 PC30  
## Eigenvalue 0.0003033 0.0002288 0.000192 0.0001144  
## Proportion Explained 0.0029168 0.0022003 0.001846 0.0010998  
## Cumulative Proportion 0.9948537 0.9970540 0.998900 1.0000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.339979   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4  
## Microcystis.spp. -2.725e-01 -5.375e-02 9.223e-02 -5.947e-02  
## Nitzschia.spp. 2.786e-02 9.800e-02 -1.124e-01 4.077e-02  
## Pseudoanabaena.spp. -7.086e-02 4.185e-02 1.154e-01 1.104e-01  
## Glaucocystis.spp... -9.927e-03 1.133e-02 6.902e-03 2.585e-02  
## morphospecies.10 -5.437e-03 1.719e-02 -4.386e-03 -1.009e-02  
## Aulacoseria.spp. 4.398e-01 -2.304e-01 9.307e-03 6.227e-02  
## Filamentous.Chlorophyte 2.924e-02 -2.269e-01 3.858e-02 -8.079e-02  
## Diatoma.spp... 1.789e-02 -1.967e-03 6.852e-02 4.175e-02  
## morphospecies.1 -1.482e-02 3.228e-03 -4.610e-03 -1.174e-02  
## pollen. -1.122e-02 1.124e-02 -7.931e-05 2.612e-02  
## Selenastraceae 6.889e-02 4.656e-02 4.000e-02 3.617e-02  
## morphospecies.2 2.306e-03 5.603e-03 -1.931e-03 1.458e-02  
## morphospecies.3 2.194e-02 -1.444e-02 9.619e-02 1.562e-02  
## Cyclotella.spp. -6.006e-02 1.615e-02 1.868e-03 1.121e-02  
## morphospecies.4 1.664e-02 5.250e-02 6.880e-02 -6.303e-02  
## Dolichospermum.spp. -4.743e-03 5.507e-03 5.320e-03 2.691e-02  
## Aphanocapsa.spp.. 2.864e-02 2.084e-02 6.925e-02 6.536e-02  
## morphospecies.5 1.023e-02 1.972e-02 -5.299e-02 1.926e-02  
## Merismopedia.spp. 5.633e-02 4.340e-02 3.788e-02 1.478e-01  
## Scenedesmus.spp. 2.668e-02 7.287e-03 -1.360e-01 -9.204e-02  
## morphospecies.6 2.998e-02 -1.399e-02 1.019e-02 9.442e-02  
## morphospecies.7 2.108e-02 1.756e-02 -2.702e-02 -1.280e-02  
## morphospecies.8 1.465e-03 7.376e-02 2.617e-02 -1.237e-03  
## clamydomonadaceae.1 5.021e-06 -1.233e-02 -9.168e-03 -2.174e-02  
## morphospecies.12 -1.364e-17 -6.295e-18 8.911e-19 -1.053e-17  
## morphospecies.11 -7.643e-02 6.916e-02 -7.516e-02 2.785e-02  
## morphospecies.13 8.271e-03 -1.147e-02 1.172e-02 5.825e-02  
## Westella.spp.. 7.269e-03 1.339e-02 -5.330e-03 6.084e-03  
## Melosira.spp... 2.890e-01 2.451e-01 -6.445e-02 -1.138e-01  
## morphospecies.14 2.147e-02 2.829e-03 5.287e-03 -7.008e-03  
## morphospecies.15 4.466e-02 2.667e-02 7.858e-02 5.207e-02  
## morphospecies.16 1.598e-02 1.729e-02 8.164e-02 -3.921e-02  
## Unidentified.13 -2.708e-02 1.865e-02 6.609e-02 2.473e-03  
## Spirulina.spp... 7.498e-03 3.670e-02 4.489e-02 3.774e-02  
## Tetraedron.spp. 7.153e-03 1.083e-02 3.480e-02 -6.341e-03  
## Cycyotella.spp..2.. -1.351e-01 -1.571e-01 -2.543e-01 9.204e-02  
## Thalassiosira.spp. 1.628e-02 1.988e-02 -6.341e-02 5.236e-02  
## Micractinium.spp... -4.722e-02 6.170e-02 -1.232e-02 6.760e-02  
## morphospecies.17 -6.160e-03 9.090e-04 -2.740e-03 -8.332e-03  
## morphospecies.18 -7.885e-02 2.765e-02 -1.525e-02 2.352e-03  
## morphospecies.19 -1.816e-02 4.085e-04 -2.211e-02 -1.742e-02  
## morphospecies.20 3.633e-02 8.741e-02 -4.463e-02 1.634e-02  
## clamydomonadaceae.2 -3.277e-02 2.380e-02 -1.762e-02 2.589e-02  
## morphospecies.21 -1.824e-02 2.242e-02 -3.372e-02 9.543e-02  
## Dinobryon.spp. 1.579e-02 -7.551e-03 -1.326e-02 5.553e-03  
## morphospecies.22 1.538e-03 4.143e-02 -1.187e-02 -3.084e-02  
## morphospecies.23 1.518e-02 1.865e-02 3.900e-03 2.668e-02  
## morphospecies.24 -3.228e-03 4.678e-04 1.214e-03 7.359e-03  
## morphospecies.25 2.151e-02 5.978e-02 7.905e-03 6.698e-02  
## morphospecies.26 7.640e-03 3.530e-04 -9.276e-03 1.285e-02  
## morphospecies.27 3.213e-02 2.582e-03 -1.482e-02 1.745e-02  
## morphospecies.28 -3.065e-03 1.703e-02 -6.317e-03 8.645e-03  
## morphospecies.29 1.679e-02 6.519e-02 -1.993e-02 4.173e-02  
## Tetraselmis.spp... 1.274e-02 4.032e-02 -1.881e-02 3.058e-03  
## morphospecies.30 -6.715e-04 9.591e-03 -9.706e-03 -5.087e-03  
## morphospecies.31 6.972e-03 1.171e-02 -4.386e-02 5.123e-02  
## Kirchneriella.spp. 5.383e-03 1.153e-02 -2.112e-03 2.571e-03  
## morphospecies.32 1.390e-03 6.728e-03 2.030e-03 2.551e-02  
## Tetraedron.spp..2 2.675e-03 -4.992e-04 -9.609e-04 8.325e-03  
## Dinobryon.spp..1 1.338e-02 -3.431e-02 -1.176e-02 -1.186e-02  
## Desmodesmus.spp... 3.799e-03 -1.622e-02 -5.985e-03 -1.526e-02  
## Selenastrum.spp. -4.669e-03 6.018e-03 -1.775e-02 -5.217e-03  
## Unidentified.33 -1.069e-02 1.370e-02 7.980e-03 3.021e-02  
## Euglena.spp. -9.810e-03 3.425e-02 1.936e-03 2.637e-02  
## Phacus.spp. 2.708e-03 1.203e-02 -1.151e-03 -5.753e-03  
## Unidentified.34 7.579e-04 3.561e-02 -7.847e-03 -1.136e-03  
## Treubaria.spp. 1.864e-03 1.008e-02 -2.592e-03 -5.893e-03  
## PC5 PC6  
## Microcystis.spp. 1.622e-02 1.118e-02  
## Nitzschia.spp. 1.049e-01 -3.462e-03  
## Pseudoanabaena.spp. 3.852e-02 -9.239e-02  
## Glaucocystis.spp... -7.220e-03 1.366e-02  
## morphospecies.10 -3.649e-02 -1.138e-04  
## Aulacoseria.spp. 7.385e-02 -6.477e-03  
## Filamentous.Chlorophyte -6.884e-02 1.241e-02  
## Diatoma.spp... -1.118e-01 1.077e-01  
## morphospecies.1 1.473e-02 3.546e-02  
## pollen. 1.718e-03 -6.662e-03  
## Selenastraceae 3.370e-02 -2.498e-02  
## morphospecies.2 -5.043e-03 2.073e-02  
## morphospecies.3 1.274e-02 -3.040e-02  
## Cyclotella.spp. 2.068e-02 5.207e-04  
## morphospecies.4 3.584e-02 -2.641e-02  
## Dolichospermum.spp. -1.633e-02 7.190e-03  
## Aphanocapsa.spp.. -4.484e-02 1.629e-02  
## morphospecies.5 -1.418e-04 2.511e-02  
## Merismopedia.spp. -6.441e-02 -9.757e-02  
## Scenedesmus.spp. -1.154e-01 -1.251e-01  
## morphospecies.6 -4.868e-02 1.170e-01  
## morphospecies.7 -2.077e-02 -2.185e-02  
## morphospecies.8 -5.495e-02 -1.797e-02  
## clamydomonadaceae.1 -7.311e-02 1.091e-02  
## morphospecies.12 3.733e-18 -3.304e-18  
## morphospecies.11 1.117e-01 8.766e-02  
## morphospecies.13 -2.918e-02 1.819e-02  
## Westella.spp.. -1.862e-02 -1.544e-02  
## Melosira.spp... -2.767e-02 1.967e-02  
## morphospecies.14 2.474e-02 -2.940e-02  
## morphospecies.15 -3.707e-02 -3.787e-02  
## morphospecies.16 -6.326e-03 -2.535e-02  
## Unidentified.13 8.613e-03 -4.289e-02  
## Spirulina.spp... -3.880e-02 9.849e-03  
## Tetraedron.spp. 1.575e-02 -1.050e-02  
## Cycyotella.spp..2.. -3.586e-02 -4.446e-02  
## Thalassiosira.spp. -1.188e-02 4.925e-02  
## Micractinium.spp... -1.038e-02 -4.023e-02  
## morphospecies.17 6.795e-03 5.877e-03  
## morphospecies.18 2.611e-02 1.276e-02  
## morphospecies.19 -1.946e-02 1.117e-02  
## morphospecies.20 -1.296e-02 -2.861e-02  
## clamydomonadaceae.2 -4.004e-02 3.043e-02  
## morphospecies.21 -1.299e-02 -2.534e-02  
## Dinobryon.spp. -7.617e-03 1.069e-02  
## morphospecies.22 -2.705e-02 4.060e-03  
## morphospecies.23 -5.433e-02 5.241e-02  
## morphospecies.24 -9.519e-03 6.707e-03  
## morphospecies.25 -2.010e-02 2.276e-02  
## morphospecies.26 1.960e-03 -2.263e-02  
## morphospecies.27 8.455e-04 1.962e-02  
## morphospecies.28 -5.788e-03 1.643e-03  
## morphospecies.29 -1.124e-02 2.064e-03  
## Tetraselmis.spp... -7.118e-02 4.139e-02  
## morphospecies.30 1.007e-03 -4.985e-03  
## morphospecies.31 2.705e-02 1.793e-03  
## Kirchneriella.spp. 5.484e-03 -2.771e-04  
## morphospecies.32 -2.512e-03 -1.648e-03  
## Tetraedron.spp..2 3.028e-03 -5.852e-03  
## Dinobryon.spp..1 -3.773e-04 1.918e-02  
## Desmodesmus.spp... -2.288e-02 8.246e-03  
## Selenastrum.spp. 3.164e-02 3.182e-02  
## Unidentified.33 -9.379e-03 1.576e-02  
## Euglena.spp. -1.358e-02 9.744e-03  
## Phacus.spp. 2.457e-03 5.575e-03  
## Unidentified.34 -1.436e-02 -6.724e-03  
## Treubaria.spp. -1.688e-02 -3.748e-03  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 0.17006 -0.03823 0.71039 -0.24374 0.100045 -0.197505  
## 3 -0.20963 -0.03238 -0.15053 -0.22860 0.121542 0.046119  
## 4 -0.22204 0.03276 -0.09876 -0.30034 0.244936 0.211835  
## 5 -0.27315 -0.09988 -0.15747 -0.27095 0.064139 0.014620  
## 6 -0.12443 0.01803 0.04680 0.28371 -0.366966 0.258572  
## 7 0.02556 -0.24090 0.04568 0.36411 0.218817 -0.077196  
## 8 -0.16164 0.25505 0.39728 -0.19453 0.256372 0.022500  
## 9 -0.20914 -0.06757 -0.09498 0.24705 -0.003766 -0.569535  
## 10 -0.20403 0.15931 -0.02136 0.20004 -0.064441 -0.400458  
## 11 0.11653 -0.03139 -0.23304 -0.01879 0.047836 0.023168  
## 12 -0.02444 0.34913 -0.35332 -0.18519 0.036641 -0.181448  
## 13 0.10155 -0.01895 -0.03648 0.31603 0.114940 -0.222142  
## 14 -0.26447 -0.21500 0.05475 -0.08281 -0.034476 -0.172019  
## 15 -0.21744 -0.27353 0.00869 -0.25659 -0.307014 -0.111643  
## 16 0.16151 -0.52023 -0.05371 -0.09996 -0.044659 0.188673  
## 17 0.18471 -0.39191 -0.19673 -0.05492 0.094174 -0.253092  
## 18 -0.06683 -0.29201 0.07277 0.29192 -0.054911 0.179917  
## 19 -0.05289 -0.19489 0.02049 0.29149 -0.261840 -0.085011  
## 20 -0.12570 -0.27425 -0.07366 -0.10637 0.080498 0.513871  
## 21 -0.24613 0.03082 0.07935 0.24169 0.089863 0.161120  
## 22 0.41911 0.05113 -0.33474 -0.14869 0.318437 0.085749  
## 23 0.10327 0.45864 -0.04390 -0.21938 0.093671 0.212567  
## 24 -0.10111 0.13237 0.23554 -0.05754 -0.063969 0.320047  
## 25 -0.32383 -0.03154 -0.12984 0.05959 0.354407 0.132116  
## 26 0.07271 0.39322 -0.10111 -0.22990 -0.658321 -0.146219  
## 27 0.17006 -0.03823 0.71039 -0.24374 0.100045 -0.197505  
## 28 -0.06887 0.50590 -0.09360 0.25287 0.414551 -0.006458  
## 29 -0.09266 0.28785 0.13123 0.53171 -0.263061 0.256628  
## 30 0.70100 0.01847 0.08126 0.19908 -0.119137 0.414187  
## 31 0.46919 0.11357 -0.04813 0.12612 0.061391 -0.333222  
## 32 0.34920 -0.12286 -0.26963 -0.16365 -0.019971 -0.121354  
## 33 -0.05604 0.07753 -0.10362 -0.29970 -0.549772 0.033122

maum.hel.pca.scores=scores(maum.hel.pca,choices=1:18,display="sites")  
plot(maum.hel.pca,type="none",xlab="PC1 (23%)",ylab="PC2 (14%)",main="Maumee PCA Hellinger Distance")  
text(maum.hel.pca,labels=maumcounts$Treatment,col=colors)  
text(maum.hel.pca,display="species",col=8)

 Interpretation: While Euclidean is typically not the best distance to use for ecological data, the Euclidean PCA presents facinating results. Mougeotia, Microcystis and Melosira spp. stand out from the species cluster, which are the same species that are important in the Hellinger transformed RDA later on. Mougeotia spp. is associated with the trace metal treatment, while Melosira spp. seems to fall around a variety of P containing treatments.

The Hellinger transformed PCA tells a similar story. Melosira falls out near the P containing treatments, while Aulacoseira and Mougeotia come out near the trace and nitrogen treatments. There is a fair amount of variation explained by these PCA axes.

NORTH ERIE PCA

ne.cov=cov(necounts[,5:147])  
ne.cov

## Cyclotella.spp. Peridinium.spp. Cocconeis.spp.  
## Cyclotella.spp. 1.178216e+02 1.27419355 1.176411290  
## Peridinium.spp. 1.274194e+00 0.51612903 -0.048387097  
## Cocconeis.spp. 1.176411e+00 -0.04838710 0.273185484  
## Selenastrum. 1.169355e+00 0.03225806 -0.056451613  
## Gomphenema. 1.383065e+00 0.09677419 0.028225806  
## pennate.1 1.461694e+00 0.06451613 0.042338710  
## pennate.2 2.217742e-01 0.16129032 -0.004032258  
## pennate.3 -4.715726e+00 -0.16129032 0.219758065  
## pennate.4 -4.415323e-01 -0.09677419 0.042338710  
## Unidentified.3.5 2.510081e+00 0.29032258 -0.102822581  
## Aphanizomenon -4.375000e-01 0.03225806 -0.018145161  
## Unidentified.4.5 -1.658266e+00 -0.24193548 -0.206653226  
## Synedra. 3.169355e+00 0.09677419 0.137096774  
## Unidentified.4 1.189516e+00 0.19354839 -0.036290323  
## Dinobryon. 0.000000e+00 0.00000000 0.000000000  
## Unidentified.5 -2.004335e+01 -1.30645161 -0.172379032  
## Unidentified.6 -6.118952e-01 -0.01612903 0.033266129  
## Unidentified.6.5 -4.221774e+00 -0.16129032 -0.060483871  
## Unidentified.7 5.378024e+00 -0.11290323 0.152217742  
## Synedra..1 -1.330645e+00 0.03225806 -0.040322581  
## Unidentified.8 -3.074597e-01 -0.04838710 0.015120968  
## Unidentified.9 6.955645e-02 -0.04838710 -0.027217742  
## Unidentified.10 -3.731855e+00 -0.09677419 0.010080645  
## Unidentified.14 -2.088710e+00 -0.16129032 -0.056451613  
## Unidentified.15 -6.078629e-01 -0.04838710 -0.027217742  
## Tabellaria. 1.572581e-01 0.06451613 0.028225806  
## Gomphonema. 0.000000e+00 0.00000000 0.000000000  
## centric.1 9.087702e+00 -0.01612903 -0.041330645  
## Unidentified.16 1.596774e+00 0.38709677 -0.145161290  
## pennate.4.5 5.302419e-01 0.03225806 -0.018145161  
## Glaucocystis.spp... 7.173387e+00 -0.29032258 0.366935484  
## Unidentified.18 0.000000e+00 0.00000000 0.000000000  
## Unidentified.19 -7.942540e+00 -0.62903226 0.444556452  
## Unidentified.20 -1.058468e-01 -0.01612903 -0.009072581  
## Unidentified.21 -3.800403e-01 -0.14516129 0.232862903  
## Unidentified.22 -1.673992e+01 0.35483871 0.195564516  
## Aulacoseria. 5.393145e-01 2.79032258 -0.621975806  
## centric.2 1.038306e+00 0.00000000 0.070564516  
## pennate.5 -1.094758e+00 0.06451613 0.002016129  
## Unidentified.23 -3.316532e-01 -0.01612903 -0.009072581  
## Unidentified.24 -5.745968e-01 -0.16129032 -0.090725806  
## Unidentified.25 -1.333065e+01 -0.58064516 0.830645161  
## Unidentified.28 1.530242e+00 -0.03225806 0.110887097  
## Stephanodiscus. 3.346774e-01 -0.09677419 0.044354839  
## Unidentified.29 1.258065e+00 -0.19354839 0.161290323  
## Unidentified.30 6.177419e+00 0.00000000 0.274193548  
## Unidentified.31 -8.417339e-01 -0.17741935 0.158266129  
## Unidentified.32 1.530242e+00 -0.03225806 0.110887097  
## Unidentified.33 1.729839e+00 0.19354839 0.084677419  
## pennate.6 -1.925403e-01 -0.04838710 0.097782258  
## Unidentified.35 6.833669e+00 -0.08064516 0.317540323  
## pennate.7 4.416331e+00 0.17741935 -0.035282258  
## Unidentified.36 7.651210e-01 -0.01612903 0.055443548  
## Unidentified.36.5 7.651210e-01 -0.01612903 0.055443548  
## Unidentified.37 4.590726e+00 -0.09677419 0.332661290  
## Unidentified.39 0.000000e+00 0.00000000 0.000000000  
## Unidentified.40 -7.872984e-01 -0.04838710 -0.013104839  
## Unidentified.41 -1.058468e-01 -0.01612903 -0.009072581  
## Unidentified.42 -5.987903e-01 -0.03225806 0.014112903  
## pennate.8 -3.407258e-01 -0.03225806 -0.018145161  
## Unidentified.44 1.598790e+00 0.48387097 0.437500000  
## Unidentified.45 1.300403e+00 0.06451613 0.106854839  
## Unidentified.46 3.105847e+00 0.24193548 0.009072581  
## Unidentified.47 1.199597e-01 0.01612903 0.023185484  
## pennate.9 1.754032e-01 0.06451613 0.014112903  
## Unidentified.48 -8.164315e+00 0.33870968 -0.035282258  
## Unidentified.50 3.044355e-01 -0.03225806 -0.018145161  
## Unidentified.51 6.552419e-01 -0.09677419 -0.054435484  
## Unidentified.52 6.088710e-01 -0.06451613 -0.036290323  
## Unidentified.53 2.080645e+00 -0.25806452 -0.145161290  
## Unidentified.54 -2.385081e+00 -0.22580645 0.034274194  
## Unidentified.55 -7.046371e-01 -0.01612903 -0.027217742  
## Unidentified.56 1.522177e-01 -0.01612903 -0.009072581  
## Unidentified.57 -5.947581e-02 -0.04838710 -0.027217742  
## Unidentified.58 7.752016e-01 0.04838710 -0.063508065  
## Unidentified.59 1.522177e-01 -0.01612903 -0.009072581  
## Unidentified.60 -2.116935e-01 -0.03225806 0.014112903  
## Unidentified.61 1.522177e-01 -0.01612903 -0.009072581  
## Unidentified.62 1.522177e-01 -0.01612903 -0.009072581  
## Unidentified.63 1.522177e-01 -0.01612903 -0.009072581  
## Unidentified.64 9.274194e-02 -0.03225806 -0.036290323  
## Unidentified.65 1.522177e-01 -0.01612903 -0.009072581  
## Unidentified.66 4.637097e-02 -0.03225806 -0.018145161  
## Unidentified.67 -4.959677e-01 -0.19354839 -0.076612903  
## Unidentified.68 -1.666331e+00 -0.08064516 -0.053427419  
## centric.3 1.945565e+00 0.03225806 -0.054435484  
## Unidentified.69 6.088710e-01 -0.06451613 -0.036290323  
## centric.4 -5.756048e-01 -0.04838710 0.005040323  
## Unidentified.70 -2.943548e-01 -0.06451613 -0.036290323  
## Unidentified.71 -2.479839e-01 -0.09677419 -0.054435484  
## Unidentified.72 -2.116935e-01 -0.03225806 -0.018145161  
## Unidentified.73 -1.058468e-01 0.01612903 -0.009072581  
## Unidentified.74 -2.044052e+01 0.17741935 0.075604839  
## Unidentified.75 -2.116935e-01 0.03225806 -0.018145161  
## Unidentified.76 2.318548e-02 -0.01612903 -0.009072581  
## Unidentified.77 2.318548e-02 -0.01612903 -0.009072581  
## Unidentified.78 5.544355e-02 0.04838710 -0.009072581  
## Unidentified.79 5.544355e-02 0.04838710 -0.009072581  
## Dolichospermum. 5.544355e-02 0.04838710 -0.009072581  
## Unidentified.80 -3.951613e-01 0.19354839 -0.008064516  
## Unidentified.81 -5.433468e-01 0.01612903 -0.027217742  
## Unidentified.82 -9.072581e-03 -0.01612903 -0.009072581  
## Unidentified.83 -1.814516e-02 -0.03225806 -0.018145161  
## pennate.11 -9.072581e-03 -0.01612903 -0.009072581  
## Unidentified.84 -9.072581e-03 -0.01612903 -0.009072581  
## Unidentified.86 -8.014113e-01 0.01612903 -0.027217742  
## pennate.12 -2.026210e-01 0.04838710 -0.009072581  
## Unidentified.88 -1.496976e+00 -0.08064516 -0.045362903  
## Actinastrum.spp. -2.075806e+01 0.87096774 -0.629032258  
## Unidentified.90 -8.981855e-01 -0.04838710 -0.027217742  
## Unidentified.91 -2.671371e-01 0.01612903 -0.009072581  
## Unidentified.92 2.721774e-01 0.03225806 -0.018145161  
## Unidentified.93 -2.671371e-01 0.01612903 -0.009072581  
## Unidentified.94 -1.036290e+00 0.03225806 -0.036290323  
## Unidentified.95 -2.671371e-01 0.01612903 -0.009072581  
## Unidentified.96 -2.031250e+00 0.24193548 -0.063508065  
## Unidentified.97 -3.892137e+00 0.62903226 -0.117943548  
## Unidentified.98 3.245968e+00 0.03225806 -0.108870968  
## Unidentified.99 -8.266129e-02 -0.03225806 -0.018145161  
## Unidentified.100 -1.068548e+00 -0.06451613 -0.036290323  
## Unidentified.101 -2.671371e-01 -0.01612903 -0.009072581  
## Unidentified.102 -3.316532e-01 -0.01612903 -0.009072581  
## pennate.13 -3.639113e-01 -0.01612903 0.023185484  
## Unidentified.103 -7.278226e-01 -0.03225806 0.046370968  
## Nitzschia.spp. 2.576915e+01 1.50000000 0.478830645  
## unidentified.1 7.749698e+01 -1.33870968 1.819556452  
## filament.1 8.145565e+01 -1.29032258 1.004032258  
## Unidentified.1.5 1.834677e-01 -0.12903226 -1.139112903  
## Unidentified.2 2.005847e+01 4.96774194 -0.006048387  
## Fragillaria.spp. -1.395867e+01 4.98387097 -1.442540323  
## Microcystis.spp. -1.465333e+02 1.04838710 -9.307459677  
## Merismopedia.spp. -2.810484e+00 0.29032258 -0.068548387  
## Pediastrum.spp. 1.255786e+02 0.80645161 -1.421370968  
## Scenedesmus.spp. -5.848790e+00 0.48387097 0.635080645  
## clamydomonadaceae.1 -1.160282e+00 -0.01612903 -0.063508065  
## Unidentified.13 5.312399e+01 -0.43548387 -0.940524194  
## Chlamydomonas.spp. 2.177419e-01 -0.06451613 -0.040322581  
## Unidentified.27 1.262026e+02 -0.43548387 3.138104839  
## Pseudoanabaena.spp. -2.279839e+01 -0.64516129 1.427419355  
## Unidentified.26 6.186492e+00 0.04838710 -0.071572581  
## Unidentified.87 -1.601815e+00 0.30645161 0.011088710  
## Unidentified.43 8.034274e-01 0.17741935 0.093750000  
## Micractinium.spp... 3.215726e+00 0.32258065 0.086693548  
## Selenastrum. Gomphenema. pennate.1 pennate.2  
## Cyclotella.spp. 1.169354839 1.383064516 1.461693548 0.221774194  
## Peridinium.spp. 0.032258065 0.096774194 0.064516129 0.161290323  
## Cocconeis.spp. -0.056451613 0.028225806 0.042338710 -0.004032258  
## Selenastrum. 6.580645161 0.032258065 -0.080645161 0.032258065  
## Gomphenema. 0.032258065 0.112903226 0.040322581 0.048387097  
## pennate.1 -0.080645161 0.040322581 0.157258065 0.008064516  
## pennate.2 0.032258065 0.048387097 0.008064516 0.112903226  
## pennate.3 0.338709677 -0.056451613 -0.068548387 -0.024193548  
## pennate.4 0.467741935 -0.024193548 0.028225806 -0.024193548  
## Unidentified.3.5 -0.467741935 -0.024193548 -0.004032258 0.104838710  
## Aphanizomenon 0.145161290 -0.008064516 -0.012096774 0.024193548  
## Unidentified.4.5 2.298387097 0.076612903 -0.223790323 -0.149193548  
## Synedra. 0.000000000 0.000000000 -0.016129032 -0.032258065  
## Unidentified.4 0.161290323 0.048387097 0.104838710 0.048387097  
## Dinobryon. 0.000000000 0.000000000 0.000000000 0.000000000  
## Unidentified.5 11.637096774 -0.463709677 -0.695564516 -0.463709677  
## Unidentified.6 0.379032258 -0.028225806 -0.042338710 -0.028225806  
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## Merismopedia.spp. 0.528225806 0.149193548 -0.072580645  
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# Eigen analysis with R base functions  
ne.eigen=eigen(ne.cov)  
ne.eigen

## eigen() decomposition  
## $values  
## [1] 3.239606e+03 9.534802e+02 8.955664e+02 5.011889e+02 3.561187e+02  
## [6] 2.425836e+02 1.911374e+02 1.280007e+02 1.171723e+02 9.043831e+01  
## [11] 7.883826e+01 5.214582e+01 4.377215e+01 3.362370e+01 2.806509e+01  
## [16] 2.638120e+01 2.089309e+01 1.580514e+01 1.215295e+01 9.759880e+00  
## [21] 8.558626e+00 5.916554e+00 4.541977e+00 3.986383e+00 3.283811e+00  
## [26] 3.065156e+00 2.354965e+00 2.130270e+00 1.574897e+00 1.297467e+00  
## [31] 1.163290e+00 8.858970e-13 7.412388e-14 4.019893e-14 2.266053e-14  
## [36] 1.696096e-14 1.572926e-14 1.116384e-14 8.319865e-15 7.158396e-15  
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## [46] 1.276408e-15 5.158782e-16 4.886623e-16 4.291538e-16 3.883809e-16  
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## [140,] -1.752793e-02 9.864652e-03 -0.0125537273 -1.001508e-02  
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## [142,] 1.288903e-02 6.318028e-02 -8.000378e-02 9.744830e-02  
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## [5,] 0.0019358501 0.0100712996 1.393233e-03 1.519148e-03  
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## [10,] 0.0024593419 0.0029682043 7.256609e-03 2.714890e-03  
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## [15,] -0.0018245051 -0.0041251298 -7.455684e-03 -1.519461e-03  
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## [19,] -0.0001705257 -0.0100071746 -4.532216e-03 -4.679397e-04  
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## [23,] -0.0055455172 -0.0064606370 -4.168818e-03 -1.628357e-04  
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## [28,] -0.0027967989 -0.0135518295 8.301852e-03 4.043732e-03  
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## [37,] 0.0066788657 -0.0025118724 5.756770e-03 1.829099e-03  
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## [39,] -0.0036131159 -0.0366899363 -2.600742e-02 2.086105e-02  
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## [47,] 0.0252662772 -0.0501354518 2.052538e-02 2.335163e-02  
## [48,] 0.0449284845 -0.0113876882 -7.686424e-02 5.686722e-02  
## [49,] 0.0340254103 0.0491038974 -2.592779e-02 2.671952e-02  
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## [92,] -0.1805909625 -0.0724711032 1.649519e-01 1.444695e-01  
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## [126,] -0.0030890882 0.0016453504 -2.500271e-03 -4.813711e-03  
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## [129,] -0.0001341676 -0.0017355020 -1.262814e-03 1.408446e-03  
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## [131,] -0.0014211716 -0.0014709180 -1.294174e-03 -1.519715e-03  
## [132,] -0.0260414572 -0.0060640504 2.494597e-03 -2.690321e-02  
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## [38,] -0.0886239130 -1.367188e-01 0.0632824864 1.314276e-01  
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## [40,] -0.0036223052 -1.694146e-02 0.0432057124 1.181077e-02  
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## [48,] -0.0102889853 -0.0233577443 0.006151640 0.0001971091  
## [49,] -0.0304934996 -0.0127950283 0.016644894 -0.0060294102  
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## [52,] -0.0314938960 0.0562949849 0.019060499 0.0805205419  
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## [14,] 0.1139186037 1.928325e-01 -1.972387e-01  
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## [16,] 0.0201975874 -3.097595e-02 2.919877e-02  
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## [27,] -0.1609789256 8.313354e-06 1.144318e-01  
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## [143,] 0.1427720269 1.453796e-01 5.389219e-02

ne.scores=as.matrix(necounts[,5:147])%\*%as.matrix(ne.eigen$vectors)  
  
par(mfrow=c(1,1))  
ne.pca=rda(necounts[,5:147])  
class(ne.pca)

## [1] "rda" "cca"

str(ne.pca)

## List of 10  
## $ colsum : Named num [1:143] 10.855 0.718 0.523 2.565 0.336 ...  
## ..- attr(\*, "names")= chr [1:143] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...  
## $ tot.chi : num 7075  
## $ Ybar : num [1:32, 1:143] 3.721 1.566 0.668 0.848 -0.589 ...  
## ..- attr(\*, "scaled:center")= Named num [1:143] 13.281 0.5 0.281 2.75 0.125 ...  
## .. ..- attr(\*, "names")= chr [1:143] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. ..$ : chr [1:143] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...  
## ..- attr(\*, "METHOD")= chr "PCA"  
## $ method : chr "rda"  
## $ call : language rda(X = necounts[, 5:147])  
## $ pCCA : NULL  
## $ CCA : NULL  
## $ CA :List of 7  
## ..$ eig : Named num [1:31] 3240 953 896 501 356 ...  
## .. ..- attr(\*, "names")= chr [1:31] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ poseig : NULL  
## ..$ u : num [1:32, 1:31] -0.098 -0.1331 0.0151 -0.0314 0.1262 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:31] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ v : num [1:143, 1:31] -0.069582 0.000422 -0.003002 -0.000627 -0.000456 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:143] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...  
## .. .. ..$ : chr [1:31] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ rank : int 31  
## ..$ tot.chi: num 7075  
## ..$ Xbar : num [1:32, 1:143] 3.721 1.566 0.668 0.848 -0.589 ...  
## .. ..- attr(\*, "scaled:center")= Named num [1:143] 13.281 0.5 0.281 2.75 0.125 ...  
## .. .. ..- attr(\*, "names")= chr [1:143] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:143] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...  
## .. ..- attr(\*, "METHOD")= chr "PCA"  
## $ inertia : chr "variance"  
## $ regularization: chr "this is a vegan::rda result object"  
## - attr(\*, "class")= chr [1:2] "rda" "cca"

summary(ne.pca)

##   
## Call:  
## rda(X = necounts[, 5:147])   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 7075 1  
## Unconstrained 7075 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 3239.6056 953.4802 895.5664 501.18892 356.11873  
## Proportion Explained 0.4579 0.1348 0.1266 0.07084 0.05034  
## Cumulative Proportion 0.4579 0.5927 0.7193 0.79013 0.84047  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 242.58362 191.13736 128.00072 117.17231 90.43831  
## Proportion Explained 0.03429 0.02702 0.01809 0.01656 0.01278  
## Cumulative Proportion 0.87475 0.90177 0.91987 0.93643 0.94921  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 78.83826 52.145822 43.772146 33.623705 28.065086  
## Proportion Explained 0.01114 0.007371 0.006187 0.004753 0.003967  
## Cumulative Proportion 0.96036 0.967726 0.973913 0.978666 0.982633  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 26.381201 20.893087 15.805145 12.152946 9.75988  
## Proportion Explained 0.003729 0.002953 0.002234 0.001718 0.00138  
## Cumulative Proportion 0.986362 0.989315 0.991549 0.993267 0.99465  
## PC21 PC22 PC23 PC24 PC25  
## Eigenvalue 8.55863 5.9165539 4.541977 3.9863829 3.2838110  
## Proportion Explained 0.00121 0.0008363 0.000642 0.0005635 0.0004642  
## Cumulative Proportion 0.99586 0.9966926 0.997335 0.9978981 0.9983623  
## PC26 PC27 PC28 PC29 PC30  
## Eigenvalue 3.0651562 2.3549652 2.1302701 1.5748968 1.2974675  
## Proportion Explained 0.0004333 0.0003329 0.0003011 0.0002226 0.0001834  
## Cumulative Proportion 0.9987956 0.9991284 0.9994296 0.9996522 0.9998356  
## PC31  
## Eigenvalue 1.1632904  
## Proportion Explained 0.0001644  
## Cumulative Proportion 1.0000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 21.64043   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4 PC5  
## Cyclotella.spp. -1.019e+00 -2.428e-01 -1.317e+00 2.647e-01 9.317e-01  
## Peridinium.spp. 6.185e-03 3.289e-02 -1.643e-02 4.809e-02 -2.662e-02  
## Cocconeis.spp. -4.396e-02 -7.740e-05 2.448e-02 2.890e-03 -8.025e-04  
## Selenastrum. -9.185e-03 4.026e-02 5.765e-02 -7.224e-04 9.628e-02  
## Gomphenema. -6.684e-03 5.837e-03 -2.712e-02 2.364e-02 1.610e-02  
## pennate.1 -9.618e-03 -1.349e-02 4.554e-03 1.550e-02 3.133e-02  
## pennate.2 9.913e-03 2.064e-02 -1.305e-02 1.630e-02 -4.102e-03  
## pennate.3 1.191e-02 5.893e-03 8.400e-02 -8.015e-03 -5.328e-02  
## pennate.4 -3.409e-02 3.595e-02 4.282e-02 -1.974e-02 2.704e-02  
## Unidentified.3.5 6.227e-02 1.460e-01 -9.659e-04 1.426e-01 6.132e-02  
## Aphanizomenon -7.759e-04 1.521e-02 1.425e-02 -1.958e-04 -1.850e-03  
## Unidentified.4.5 -7.313e-02 -1.513e-02 2.625e-02 1.735e-02 -6.854e-02  
## Synedra. -9.073e-02 5.426e-03 3.165e-03 4.007e-02 -1.041e-01  
## Unidentified.4 -7.443e-04 -1.153e-02 1.193e-03 1.907e-02 2.286e-02  
## Dinobryon. -3.682e-16 -1.288e-16 -3.235e-16 3.152e-16 -3.899e-16  
## Unidentified.5 -4.585e-01 7.373e-01 9.108e-01 -4.876e-01 5.264e-01  
## Unidentified.6 -9.475e-03 8.308e-03 4.399e-02 -1.257e-02 1.003e-02  
## Unidentified.6.5 -2.737e-02 1.722e-02 1.273e-01 -4.990e-02 2.713e-02  
## Unidentified.7 7.597e-02 1.848e-01 3.487e-01 -1.547e-01 2.631e-01  
## Synedra..1 1.505e-02 4.141e-02 3.186e-02 1.287e-02 2.015e-02  
## Unidentified.8 3.934e-02 2.276e-02 -6.314e-03 -6.970e-02 -3.394e-02  
## Unidentified.9 3.702e-02 8.361e-03 -2.382e-02 8.098e-03 2.262e-02  
## Unidentified.10 3.011e-02 4.119e-03 7.986e-02 -1.256e-01 -2.020e-02  
## Unidentified.14 1.575e-01 3.048e-02 8.470e-02 -3.518e-02 -2.599e-02  
## Unidentified.15 1.026e-02 3.795e-02 -1.162e-02 7.477e-03 -2.464e-03  
## Tabellaria. 1.882e-02 1.409e-02 9.130e-03 2.270e-02 2.508e-02  
## Gomphonema. 6.189e-18 -8.395e-17 1.112e-17 1.577e-16 -2.150e-17  
## centric.1 5.461e-03 -1.288e-01 -2.162e-01 3.448e-02 1.261e-01  
## Unidentified.16 -3.941e-02 7.074e-02 -7.653e-03 1.523e-01 -1.890e-01  
## pennate.4.5 -1.310e-02 -2.721e-02 2.295e-03 2.768e-03 -1.290e-03  
## Glaucocystis.spp... -2.190e-01 -9.609e-02 5.567e-02 1.223e-02 9.904e-03  
## Unidentified.18 0.000e+00 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## Unidentified.19 -2.686e-01 1.048e-01 3.753e-01 -1.889e-01 -2.374e-02  
## Unidentified.20 5.831e-03 6.482e-04 -1.168e-03 -1.700e-02 -9.193e-03  
## Unidentified.21 -9.375e-02 4.731e-02 1.076e-01 -4.417e-02 4.650e-02  
## Unidentified.22 -1.541e-01 -3.694e-02 1.697e-01 4.964e-01 -4.240e-01  
## Aulacoseria. 1.035e-01 1.734e-01 -6.065e-02 3.992e-01 -6.386e-01  
## centric.2 -7.624e-02 -2.404e-02 5.283e-02 2.774e-02 7.284e-03  
## pennate.5 -3.598e-02 8.608e-02 7.444e-02 -8.158e-03 3.809e-02  
## Unidentified.23 -8.918e-03 -1.051e-02 4.622e-03 -3.304e-03 8.943e-03  
## Unidentified.24 -1.010e-02 -3.585e-02 4.667e-02 -1.710e-02 3.510e-02  
## Unidentified.25 2.494e-01 -1.249e-01 1.768e-01 -2.660e-01 -5.085e-01  
## Unidentified.28 -3.042e-02 -3.277e-03 1.517e-02 -7.124e-03 1.421e-02  
## Stephanodiscus. 2.601e-03 6.038e-03 1.545e-02 4.102e-02 1.407e-02  
## Unidentified.29 1.022e-02 -4.512e-02 -5.404e-02 -7.924e-02 -9.862e-02  
## Unidentified.30 -1.418e-01 -2.833e-03 -1.515e-02 7.048e-02 2.601e-02  
## Unidentified.31 -6.160e-02 -2.641e-02 3.273e-02 9.024e-03 -3.942e-02  
## Unidentified.32 -3.042e-02 -3.277e-03 1.517e-02 -7.124e-03 1.421e-02  
## Unidentified.33 -3.005e-02 9.899e-03 1.718e-02 2.184e-02 2.291e-02  
## pennate.6 -4.299e-02 -2.799e-02 3.935e-02 -1.728e-02 3.030e-02  
## Unidentified.35 -1.212e-01 -5.753e-02 -7.642e-02 -3.527e-02 2.779e-02  
## pennate.7 -5.010e-01 -7.838e-02 -3.927e-01 1.379e-01 -4.183e-01  
## Unidentified.36 -1.521e-02 -1.638e-03 7.586e-03 -3.562e-03 7.106e-03  
## Unidentified.36.5 -1.521e-02 -1.638e-03 7.586e-03 -3.562e-03 7.106e-03  
## Unidentified.37 -9.125e-02 -9.830e-03 4.552e-02 -2.137e-02 4.264e-02  
## Unidentified.39 0.000e+00 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## Unidentified.40 3.381e-02 4.153e-04 9.543e-03 -6.755e-02 -4.432e-02  
## Unidentified.41 5.831e-03 6.482e-04 -1.168e-03 -1.700e-02 -9.193e-03  
## Unidentified.42 4.305e-04 6.445e-03 1.879e-02 -1.808e-02 -7.197e-03  
## pennate.8 1.834e-03 1.007e-02 9.308e-03 -2.351e-02 6.434e-05  
## Unidentified.44 7.023e-02 4.832e-02 9.262e-02 1.136e-01 1.028e-01  
## Unidentified.45 -2.493e-02 4.410e-02 3.022e-02 1.176e-02 2.918e-02  
## Unidentified.46 -8.491e-02 -1.049e-01 3.952e-02 -8.741e-02 1.515e-01  
## Unidentified.47 6.974e-04 -5.467e-04 3.306e-03 2.013e-03 5.145e-03  
## pennate.9 4.200e-03 9.960e-03 6.112e-03 1.154e-02 1.270e-02  
## Unidentified.48 3.978e-01 5.454e-03 6.457e-02 5.183e-02 -7.648e-02  
## Unidentified.50 -2.906e-03 5.071e-03 1.903e-02 -2.807e-02 9.471e-03  
## Unidentified.51 -1.434e-03 1.333e-02 4.640e-02 -8.716e-02 1.448e-02  
## Unidentified.52 -5.812e-03 1.014e-02 3.806e-02 -5.613e-02 1.894e-02  
## Unidentified.53 5.625e-02 -5.091e-02 6.563e-02 -1.128e-01 7.705e-02  
## Unidentified.54 1.081e-01 -8.097e-03 7.292e-03 -1.128e-01 -8.801e-02  
## Unidentified.55 5.344e-02 -7.673e-03 -1.788e-03 5.818e-03 9.128e-03  
## Unidentified.56 -1.453e-03 2.536e-03 9.514e-03 -1.403e-02 4.735e-03  
## Unidentified.57 1.021e-02 3.832e-03 7.178e-03 -4.802e-02 -1.365e-02  
## Unidentified.58 6.056e-03 -5.697e-03 2.335e-02 -2.063e-02 -9.443e-03  
## Unidentified.59 -1.453e-03 2.536e-03 9.514e-03 -1.403e-02 4.735e-03  
## Unidentified.60 1.046e-02 -1.766e-03 1.074e-02 -1.301e-02 -1.882e-03  
## Unidentified.61 -1.453e-03 2.536e-03 9.514e-03 -1.403e-02 4.735e-03  
## Unidentified.62 -1.453e-03 2.536e-03 9.514e-03 -1.403e-02 4.735e-03  
## Unidentified.63 -1.453e-03 2.536e-03 9.514e-03 -1.403e-02 4.735e-03  
## Unidentified.64 1.482e-02 7.164e-03 2.259e-02 -5.006e-02 -7.452e-06  
## Unidentified.65 -1.453e-03 2.536e-03 9.514e-03 -1.403e-02 4.735e-03  
## Unidentified.66 4.378e-03 3.184e-03 8.346e-03 -3.103e-02 -4.458e-03  
## Unidentified.67 4.692e-02 1.038e-02 3.111e-02 -1.741e-01 -5.203e-02  
## Unidentified.68 1.014e-01 4.985e-05 -2.554e-02 -1.299e-02 -3.409e-02  
## centric.3 -1.332e-02 -4.240e-02 -2.161e-02 -4.983e-02 5.783e-03  
## Unidentified.69 -5.812e-03 1.014e-02 3.806e-02 -5.613e-02 1.894e-02  
## centric.4 1.609e-02 -1.677e-03 5.981e-03 -4.556e-02 -3.484e-02  
## Unidentified.70 2.666e-02 8.284e-03 -3.701e-03 -3.592e-02 -2.288e-02  
## Unidentified.71 4.501e-02 2.096e-02 -4.092e-03 -5.783e-03 -1.349e-02  
## Unidentified.72 1.166e-02 1.296e-03 -2.337e-03 -3.399e-02 -1.839e-02  
## Unidentified.73 1.189e-02 1.444e-03 4.730e-03 -4.998e-03 -2.848e-04  
## Unidentified.74 5.560e-01 1.837e-01 6.845e-01 -6.173e-01 -2.232e-01  
## Unidentified.75 2.378e-02 2.889e-03 9.459e-03 -9.997e-03 -5.695e-04  
## Unidentified.76 9.171e-03 6.339e-03 -1.956e-04 1.507e-02 4.697e-03  
## Unidentified.77 9.171e-03 6.339e-03 -1.956e-04 1.507e-02 4.697e-03  
## Unidentified.78 3.502e-03 1.051e-02 2.806e-03 9.526e-03 7.551e-03  
## Unidentified.79 3.502e-03 1.051e-02 2.806e-03 9.526e-03 7.551e-03  
## Dolichospermum. 3.502e-03 1.051e-02 2.806e-03 9.526e-03 7.551e-03  
## Unidentified.80 -8.185e-03 5.408e-02 3.993e-02 4.407e-02 3.512e-02  
## Unidentified.81 4.505e-02 1.390e-03 -3.711e-03 2.034e-02 1.696e-02  
## Unidentified.82 -9.221e-03 -1.094e-02 4.504e-03 2.758e-03 -5.170e-03  
## Unidentified.83 -1.844e-02 -2.188e-02 9.009e-03 5.515e-03 -1.034e-02  
## pennate.11 -9.221e-03 -1.094e-02 4.504e-03 2.758e-03 -5.170e-03  
## Unidentified.84 -9.221e-03 -1.094e-02 4.504e-03 2.758e-03 -5.170e-03  
## Unidentified.86 4.477e-02 -3.329e-03 -2.742e-03 1.714e-02 -1.695e-03  
## pennate.12 3.221e-03 5.788e-03 3.775e-03 6.320e-03 -1.111e-02  
## Unidentified.88 1.039e-01 -2.279e-02 -1.629e-02 2.704e-02 2.353e-02  
## Actinastrum.spp. 7.345e-01 1.849e-01 3.867e-02 1.342e-01 9.364e-03  
## Unidentified.90 1.806e-02 -1.909e-02 3.682e-03 2.943e-04 2.368e-02  
## Unidentified.91 7.075e-03 5.012e-03 -1.468e-03 -2.143e-04 -3.473e-05  
## Unidentified.92 8.916e-04 2.161e-03 -1.064e-02 1.400e-02 -1.851e-03  
## Unidentified.93 7.075e-03 5.012e-03 -1.468e-03 -2.143e-04 -3.473e-05  
## Unidentified.94 2.898e-02 2.241e-02 1.341e-03 5.353e-03 -7.991e-03  
## Unidentified.95 7.075e-03 5.012e-03 -1.468e-03 -2.143e-04 -3.473e-05  
## Unidentified.96 5.712e-02 3.221e-02 2.293e-02 1.313e-02 -3.025e-02  
## Unidentified.97 1.026e-01 7.297e-02 5.756e-02 3.338e-02 -7.500e-02  
## Unidentified.98 -1.467e-03 -1.664e-01 -4.110e-02 5.190e-02 6.831e-02  
## Unidentified.99 1.244e-02 -1.906e-02 -8.038e-04 5.530e-03 7.106e-03  
## Unidentified.100 4.239e-02 -3.481e-03 9.026e-03 2.028e-03 -5.463e-03  
## Unidentified.101 1.060e-02 -8.703e-04 2.256e-03 5.070e-04 -1.366e-03  
## Unidentified.102 -8.918e-03 -1.051e-02 4.622e-03 -3.304e-03 8.943e-03  
## pennate.13 -1.149e-02 -2.636e-03 3.531e-03 1.806e-02 -1.126e-02  
## Unidentified.103 -2.298e-02 -5.272e-03 7.063e-03 3.612e-02 -2.251e-02  
## Nitzschia.spp. -6.691e-01 -6.493e-01 -6.834e-01 1.072e+00 -8.171e-01  
## unidentified.1 -2.052e+00 9.810e-01 1.409e-01 -5.400e-01 3.227e+00  
## filament.1 -2.794e+00 -4.040e+00 -1.206e+00 -1.385e-01 1.948e+00  
## Unidentified.1.5 -6.558e-01 -1.083e+00 2.081e-03 4.136e-01 2.527e-01  
## Unidentified.2 -9.345e-02 4.585e+00 -9.007e-01 3.925e+00 1.004e+00  
## Fragillaria.spp. 1.977e-02 9.626e-01 -1.247e-01 1.764e-01 -1.045e+00  
## Microcystis.spp. 1.319e+01 -1.827e+00 -1.865e+00 8.531e-01 5.667e-01  
## Merismopedia.spp. 1.557e-01 4.746e-02 3.206e-03 -6.827e-02 -1.781e-01  
## Pediastrum.spp. -1.682e+00 1.947e+00 -6.644e+00 -2.008e+00 -6.421e-01  
## Scenedesmus.spp. 8.277e-02 -6.192e-01 1.832e-01 -2.174e-01 -4.118e-01  
## clamydomonadaceae.1 4.238e-02 -1.128e-02 -4.731e-04 1.854e-02 1.692e-05  
## Unidentified.13 -1.828e-01 -7.466e-01 -1.110e+00 1.516e-01 1.300e+00  
## Chlamydomonas.spp. 3.018e-02 -1.384e-02 2.882e-02 -1.689e-02 1.458e-02  
## Unidentified.27 -4.669e+00 -3.641e+00 -1.684e+00 3.024e+00 -1.055e+00  
## Pseudoanabaena.spp. 2.216e-01 1.925e-01 1.043e+00 -7.878e-01 -5.544e-01  
## Unidentified.26 3.728e-02 3.356e-02 -9.574e-02 1.578e-01 3.400e-02  
## Unidentified.87 4.043e-03 4.515e-02 2.030e-02 1.938e-02 -4.273e-02  
## Unidentified.43 1.747e-02 5.579e-02 3.144e-02 3.428e-02 5.157e-02  
## Micractinium.spp... -5.975e-03 -9.382e-02 -2.290e-02 -3.500e-02 6.411e-02  
## PC6  
## Cyclotella.spp. 6.056e-02  
## Peridinium.spp. 7.106e-02  
## Cocconeis.spp. -2.612e-02  
## Selenastrum. -9.159e-02  
## Gomphenema. 1.124e-02  
## pennate.1 1.835e-02  
## pennate.2 3.738e-02  
## pennate.3 -3.974e-02  
## pennate.4 -1.775e-02  
## Unidentified.3.5 1.625e-01  
## Aphanizomenon 3.473e-02  
## Unidentified.4.5 -8.321e-02  
## Synedra. -5.682e-02  
## Unidentified.4 2.415e-02  
## Dinobryon. 5.794e-17  
## Unidentified.5 -3.194e-01  
## Unidentified.6 -3.508e-02  
## Unidentified.6.5 -6.540e-02  
## Unidentified.7 4.006e-02  
## Synedra..1 2.588e-02  
## Unidentified.8 9.950e-03  
## Unidentified.9 -5.444e-04  
## Unidentified.10 -3.165e-02  
## Unidentified.14 -1.555e-01  
## Unidentified.15 -1.219e-02  
## Tabellaria. 1.218e-02  
## Gomphonema. -5.885e-18  
## centric.1 1.563e-01  
## Unidentified.16 1.032e-01  
## pennate.4.5 -4.754e-03  
## Glaucocystis.spp... -1.811e-02  
## Unidentified.18 0.000e+00  
## Unidentified.19 -2.115e-01  
## Unidentified.20 2.524e-03  
## Unidentified.21 -6.471e-02  
## Unidentified.22 4.481e-01  
## Aulacoseria. 1.903e+00  
## centric.2 1.126e-02  
## pennate.5 7.980e-02  
## Unidentified.23 4.269e-03  
## Unidentified.24 -1.286e-03  
## Unidentified.25 -2.129e-01  
## Unidentified.28 7.089e-03  
## Stephanodiscus. -1.238e-02  
## Unidentified.29 -6.272e-02  
## Unidentified.30 -1.356e-02  
## Unidentified.31 4.965e-04  
## Unidentified.32 7.089e-03  
## Unidentified.33 -8.782e-03  
## pennate.6 1.020e-02  
## Unidentified.35 8.045e-03  
## pennate.7 -8.822e-02  
## Unidentified.36 3.544e-03  
## Unidentified.36.5 3.544e-03  
## Unidentified.37 2.127e-02  
## Unidentified.39 0.000e+00  
## Unidentified.40 -1.006e-02  
## Unidentified.41 2.524e-03  
## Unidentified.42 -5.817e-03  
## pennate.8 2.404e-03  
## Unidentified.44 1.704e-01  
## Unidentified.45 -1.435e-02  
## Unidentified.46 4.781e-02  
## Unidentified.47 2.921e-03  
## pennate.9 1.443e-02  
## Unidentified.48 -5.410e-02  
## Unidentified.50 1.024e-02  
## Unidentified.51 2.813e-02  
## Unidentified.52 2.048e-02  
## Unidentified.53 6.777e-02  
## Unidentified.54 -1.523e-02  
## Unidentified.55 -9.678e-03  
## Unidentified.56 5.121e-03  
## Unidentified.57 1.017e-02  
## Unidentified.58 4.640e-02  
## Unidentified.59 5.121e-03  
## Unidentified.60 -9.622e-04  
## Unidentified.61 5.121e-03  
## Unidentified.62 5.121e-03  
## Unidentified.63 5.121e-03  
## Unidentified.64 8.339e-04  
## Unidentified.65 5.121e-03  
## Unidentified.66 7.645e-03  
## Unidentified.67 3.207e-02  
## Unidentified.68 1.710e-02  
## centric.3 1.423e-02  
## Unidentified.69 2.048e-02  
## centric.4 -6.480e-04  
## Unidentified.70 -3.035e-05  
## Unidentified.71 -1.524e-02  
## Unidentified.72 5.049e-03  
## Unidentified.73 -1.193e-02  
## Unidentified.74 -1.059e+00  
## Unidentified.75 -2.386e-02  
## Unidentified.76 -7.604e-03  
## Unidentified.77 -7.604e-03  
## Unidentified.78 1.151e-02  
## Unidentified.79 1.151e-02  
## Dolichospermum. 1.151e-02  
## Unidentified.80 3.214e-02  
## Unidentified.81 1.376e-02  
## Unidentified.82 -5.320e-03  
## Unidentified.83 -1.064e-02  
## pennate.11 -5.320e-03  
## Unidentified.84 -5.320e-03  
## Unidentified.86 3.710e-02  
## pennate.12 3.485e-02  
## Unidentified.88 5.634e-03  
## Actinastrum.spp. -2.381e-01  
## Unidentified.90 7.517e-03  
## Unidentified.91 -2.701e-03  
## Unidentified.92 -9.630e-05  
## Unidentified.93 -2.701e-03  
## Unidentified.94 -1.343e-02  
## Unidentified.95 -2.701e-03  
## Unidentified.96 -2.207e-02  
## Unidentified.97 -4.130e-02  
## Unidentified.98 2.733e-02  
## Unidentified.99 3.818e-04  
## Unidentified.100 -1.396e-02  
## Unidentified.101 -3.489e-03  
## Unidentified.102 4.269e-03  
## pennate.13 -5.139e-03  
## Unidentified.103 -1.028e-02  
## Nitzschia.spp. 9.974e-01  
## unidentified.1 6.793e-01  
## filament.1 3.211e-01  
## Unidentified.1.5 3.318e-01  
## Unidentified.2 -4.677e-01  
## Fragillaria.spp. 2.591e+00  
## Microcystis.spp. -3.878e-02  
## Merismopedia.spp. 1.299e-01  
## Pediastrum.spp. -3.195e-01  
## Scenedesmus.spp. 4.812e-01  
## clamydomonadaceae.1 -1.375e-02  
## Unidentified.13 7.410e-01  
## Chlamydomonas.spp. 4.531e-02  
## Unidentified.27 -8.128e-01  
## Pseudoanabaena.spp. -6.796e-01  
## Unidentified.26 -1.151e-01  
## Unidentified.87 1.308e-01  
## Unidentified.43 1.631e-02  
## Micractinium.spp... -5.568e-02  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -2.1208 8.18485 -8.10221 -1.273219 6.18712 -1.31030  
## 3 -2.8809 4.07003 2.93956 2.692933 3.59383 -1.58071  
## 4 0.3266 -0.25604 1.54807 0.942680 2.40928 1.36808  
## 5 -0.6805 1.18743 4.45565 -6.572048 2.21758 2.39802  
## 6 2.7308 0.30358 -0.54713 -7.959157 -4.30529 1.18222  
## 7 5.5686 0.67638 2.21489 -2.340831 -0.13336 -5.58774  
## 8 4.2948 2.96872 -0.09161 7.056347 2.19967 -3.56088  
## 9 1.6401 4.92058 1.31428 4.461003 3.53603 5.38959  
## 10 -4.3182 -5.12225 2.10947 1.291395 -2.42121 -2.49128  
## 11 -7.1224 -0.76723 3.55276 -1.668078 3.32792 1.65986  
## 12 3.9274 -5.18704 -0.68804 -1.042737 2.30633 2.30206  
## 13 -0.6249 -3.49683 -8.48076 -5.100763 -2.68052 0.66853  
## 14 5.5789 -2.01460 0.57611 0.479474 -3.09897 -2.84862  
## 15 2.0735 -1.39263 3.89535 -5.416042 -7.70595 -2.66791  
## 16 1.5085 2.71071 1.76795 2.959663 -5.20169 16.32084  
## 17 9.7285 -2.13477 -1.52612 2.532675 2.20404 0.52768  
## 18 3.3132 2.34733 -0.68765 -0.100363 -0.01626 -1.26470  
## 19 3.6948 2.62853 2.07350 1.202307 -2.70194 -1.48764  
## 20 1.6017 5.92437 -1.81435 1.167235 -0.38464 -1.90367  
## 21 4.9629 -0.40758 1.05673 0.237445 -0.63963 -1.63389  
## 22 0.8643 -8.51927 -1.43316 2.352517 3.96757 1.81269  
## 23 -2.8956 -1.33553 -4.29734 6.655520 -0.85077 1.21960  
## 24 -2.2012 -0.59570 -11.26629 -0.988101 2.44642 -2.71527  
## 25 -1.8144 -7.61977 -1.03493 0.005076 1.81715 0.26478  
## 26 -4.5449 0.81360 -1.63763 4.556559 -9.89428 -2.57701  
## 27 -4.1762 -4.92110 2.16474 -1.547286 4.18809 1.99923  
## 28 -0.6361 -3.40306 1.62518 -1.197420 4.44303 1.49623  
## 29 -5.3807 -1.23451 1.65378 8.458593 -5.27113 -2.40658  
## 30 -1.8719 4.41087 4.90615 -3.051349 4.33542 -0.05621  
## 31 -2.8408 -0.06498 3.49394 -1.159685 0.45314 -3.25405  
## 32 -3.8578 2.92166 5.01033 -1.479891 0.59487 -4.70297  
## 33 -3.8474 4.40425 -4.75125 -6.154450 -4.92184 3.44002

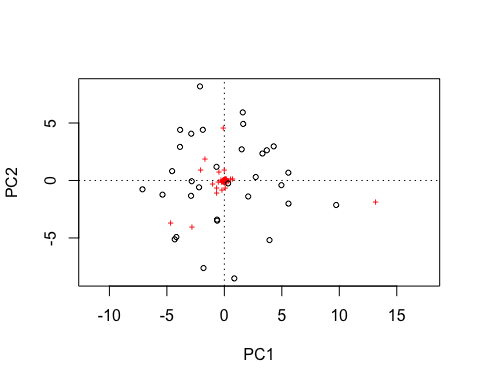
eigenvals(ne.pca)

## PC1 PC2 PC3 PC4 PC5 PC6 PC7 PC8   
## 3239.606 953.480 895.566 501.189 356.119 242.584 191.137 128.001   
## PC9 PC10 PC11 PC12 PC13 PC14 PC15 PC16   
## 117.172 90.438 78.838 52.146 43.772 33.624 28.065 26.381   
## PC17 PC18 PC19 PC20 PC21 PC22 PC23 PC24   
## 20.893 15.805 12.153 9.760 8.559 5.917 4.542 3.986   
## PC25 PC26 PC27 PC28 PC29 PC30 PC31   
## 3.284 3.065 2.355 2.130 1.575 1.297 1.163

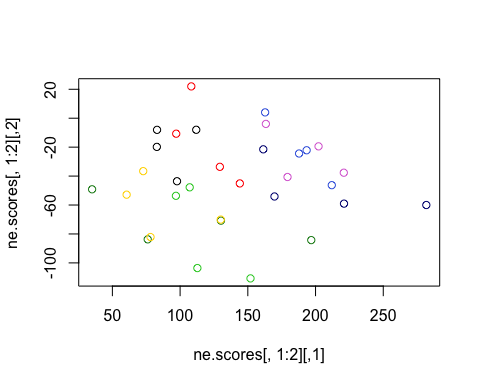
eigenvals(ne.pca)/sum(eigenvals(ne.pca))

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 0.4579205 0.1347751 0.1265889 0.0708434 0.0503376 0.0342894 0.0270174   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 0.0180930 0.0165624 0.0127835 0.0111438 0.0073708 0.0061872 0.0047527   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 0.0039670 0.0037290 0.0029533 0.0022341 0.0017178 0.0013796 0.0012098   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 0.0008363 0.0006420 0.0005635 0.0004642 0.0004333 0.0003329 0.0003011   
## PC29 PC30 PC31   
## 0.0002226 0.0001834 0.0001644

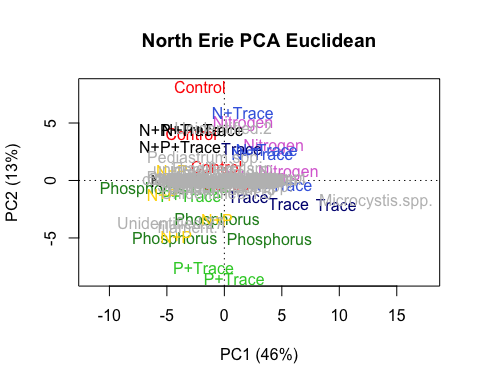
plot(ne.pca)



plot(ne.scores[,1:2],col=colors)



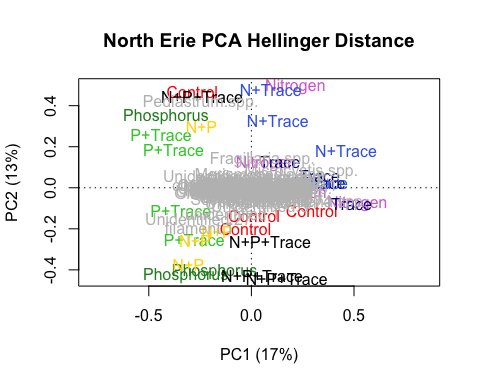
plot(ne.pca,type="none",xlab="PC1 (46%)",ylab="PC2 (13%)",main="North Erie PCA Euclidean")  
text(ne.pca,labels=necounts$Treatment,col=colors)  
text(ne.pca,display="species",col=8)



# Hellinger distance-based PCA  
ne.hel=decostand(necounts[,5:147],method="hellinger")  
ne.hel.pca=rda(ne.hel)  
summary(ne.hel.pca)

##   
## Call:  
## rda(X = ne.hel)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.2138 1  
## Unconstrained 0.2138 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5 PC6  
## Eigenvalue 0.03725 0.02848 0.01940 0.01689 0.01379 0.01229  
## Proportion Explained 0.17423 0.13322 0.09076 0.07901 0.06448 0.05749  
## Cumulative Proportion 0.17423 0.30745 0.39821 0.47721 0.54169 0.59918  
## PC7 PC8 PC9 PC10 PC11 PC12  
## Eigenvalue 0.01030 0.009867 0.00794 0.006468 0.006225 0.005124  
## Proportion Explained 0.04818 0.046147 0.03713 0.030251 0.029113 0.023963  
## Cumulative Proportion 0.64736 0.693509 0.73064 0.760894 0.790007 0.813970  
## PC13 PC14 PC15 PC16 PC17  
## Eigenvalue 0.004661 0.004355 0.003733 0.003429 0.003077  
## Proportion Explained 0.021798 0.020370 0.017461 0.016039 0.014391  
## Cumulative Proportion 0.835767 0.856138 0.873599 0.889638 0.904029  
## PC18 PC19 PC20 PC21 PC22 PC23  
## Eigenvalue 0.002716 0.00242 0.002242 0.001923 0.001789 0.001534  
## Proportion Explained 0.012702 0.01132 0.010487 0.008992 0.008367 0.007173  
## Cumulative Proportion 0.916731 0.92805 0.938536 0.947527 0.955895 0.963068  
## PC24 PC25 PC26 PC27 PC28  
## Eigenvalue 0.001408 0.001347 0.001259 0.001004 0.0008696  
## Proportion Explained 0.006584 0.006298 0.005888 0.004695 0.0040671  
## Cumulative Proportion 0.969652 0.975950 0.981838 0.986533 0.9906000  
## PC29 PC30 PC31  
## Eigenvalue 0.0007791 0.0007075 0.0005233  
## Proportion Explained 0.0036440 0.0033088 0.0024472  
## Cumulative Proportion 0.9942440 0.9975528 1.0000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.604534   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4 PC5  
## Cyclotella.spp. -1.064e-01 4.659e-03 1.271e-02 2.611e-02 4.670e-02  
## Peridinium.spp. -1.707e-03 2.764e-02 4.118e-03 2.351e-02 2.713e-02  
## Cocconeis.spp. -7.684e-04 -2.776e-02 -1.077e-02 -1.082e-02 1.553e-02  
## Selenastrum. 6.208e-03 -4.023e-02 -8.545e-02 9.899e-04 2.598e-02  
## Gomphenema. -1.163e-02 6.725e-03 1.062e-03 1.051e-02 1.290e-02  
## pennate.1 -1.323e-02 -5.318e-03 1.408e-02 1.329e-02 7.538e-03  
## pennate.2 5.372e-03 1.166e-02 7.133e-03 1.486e-02 1.558e-02  
## pennate.3 2.139e-02 -3.238e-02 -3.888e-02 -2.409e-02 1.899e-02  
## pennate.4 2.750e-03 -2.290e-02 -4.151e-02 1.550e-02 -1.305e-02  
## Unidentified.3.5 1.731e-02 1.473e-02 4.016e-02 5.572e-02 2.416e-02  
## Aphanizomenon 4.107e-03 -3.027e-03 -6.007e-03 1.353e-02 7.423e-03  
## Unidentified.4.5 3.411e-03 -1.101e-02 -4.501e-02 -4.973e-02 2.120e-03  
## Synedra. -1.740e-02 -1.148e-03 -1.567e-02 -1.503e-02 9.433e-03  
## Unidentified.4 -6.668e-03 2.218e-04 9.279e-03 6.778e-03 4.598e-03  
## Dinobryon. 1.282e-17 -3.024e-19 -2.259e-18 1.753e-18 3.255e-17  
## Unidentified.5 4.216e-02 -8.721e-02 -1.979e-01 5.684e-02 -4.877e-02  
## Unidentified.6 1.652e-02 -2.402e-02 -1.820e-02 -9.264e-03 7.017e-04  
## Unidentified.6.5 2.923e-02 -4.322e-02 -1.248e-02 3.207e-03 -4.238e-02  
## Unidentified.7 7.342e-02 -1.904e-02 2.589e-02 6.906e-02 4.563e-02  
## Synedra..1 1.643e-02 3.528e-04 2.888e-03 3.741e-02 -4.299e-03  
## Unidentified.8 2.161e-02 2.574e-02 2.326e-04 -2.142e-02 1.554e-02  
## Unidentified.9 3.019e-03 9.258e-03 7.300e-04 1.026e-02 -8.946e-03  
## Unidentified.10 3.636e-02 -5.246e-03 7.633e-04 -1.601e-02 -1.066e-02  
## Unidentified.14 6.500e-02 -1.644e-02 -1.904e-02 -5.247e-02 1.840e-02  
## Unidentified.15 3.118e-03 1.573e-02 -1.950e-03 1.018e-02 -7.144e-03  
## Tabellaria. 6.522e-03 -3.162e-03 8.630e-03 2.558e-02 9.754e-03  
## Gomphonema. -9.324e-18 -4.069e-18 4.544e-17 -1.530e-17 1.788e-17  
## centric.1 -5.716e-02 1.379e-02 3.899e-02 2.670e-03 1.237e-02  
## Unidentified.16 -7.441e-04 2.202e-02 7.234e-03 1.412e-02 6.135e-02  
## pennate.4.5 -9.376e-03 -9.676e-03 6.788e-03 -6.972e-03 -4.306e-03  
## Glaucocystis.spp... -4.961e-02 -3.224e-02 7.619e-03 -1.286e-02 1.543e-02  
## Unidentified.18 0.000e+00 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## Unidentified.19 3.494e-02 -7.338e-02 -1.194e-01 -3.922e-02 1.465e-02  
## Unidentified.20 4.192e-03 9.666e-03 -3.101e-03 -7.310e-03 2.862e-04  
## Unidentified.21 3.544e-03 -4.221e-02 -6.080e-02 6.503e-03 -2.326e-02  
## Unidentified.22 2.535e-03 -1.416e-02 7.281e-02 3.193e-02 3.381e-02  
## Aulacoseria. -4.784e-02 3.764e-02 6.718e-02 1.709e-02 1.373e-01  
## centric.2 -1.716e-02 -3.484e-02 1.044e-02 1.211e-02 2.101e-02  
## pennate.5 7.270e-03 -2.623e-02 -4.522e-02 4.273e-02 1.479e-02  
## Unidentified.23 -5.765e-03 -7.041e-03 3.541e-03 -1.043e-03 -3.224e-03  
## Unidentified.24 2.612e-03 -2.798e-02 8.242e-03 6.749e-03 -1.273e-02  
## Unidentified.25 5.642e-02 1.397e-02 4.903e-03 -1.215e-01 2.544e-02  
## Unidentified.28 -8.384e-03 -1.116e-02 -5.337e-04 2.425e-04 6.117e-03  
## Stephanodiscus. 2.630e-03 -1.025e-02 2.742e-02 1.257e-02 -1.889e-03  
## Unidentified.29 1.029e-02 1.608e-02 -7.252e-03 -6.408e-02 1.095e-02  
## Unidentified.30 -2.845e-02 -2.081e-02 -3.837e-02 -1.970e-03 9.573e-03  
## Unidentified.31 -1.576e-02 -9.793e-03 8.302e-03 -8.850e-03 3.919e-03  
## Unidentified.32 -8.384e-03 -1.116e-02 -5.337e-04 2.425e-04 6.117e-03  
## Unidentified.33 -9.509e-03 -1.737e-02 -1.085e-02 2.647e-02 6.003e-03  
## pennate.6 -6.499e-03 -2.783e-02 7.010e-03 -4.040e-03 1.146e-02  
## Unidentified.35 -4.522e-02 -1.034e-02 7.955e-03 -1.439e-02 1.581e-02  
## pennate.7 -1.149e-01 -3.843e-04 -6.902e-02 -4.468e-02 1.108e-02  
## Unidentified.36 -5.929e-03 -7.891e-03 -3.774e-04 1.714e-04 4.325e-03  
## Unidentified.36.5 -5.929e-03 -7.891e-03 -3.774e-04 1.714e-04 4.325e-03  
## Unidentified.37 -1.452e-02 -1.933e-02 -9.245e-04 4.200e-04 1.059e-02  
## Unidentified.39 0.000e+00 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## Unidentified.40 2.626e-02 1.382e-02 -9.591e-03 -3.299e-02 5.413e-03  
## Unidentified.41 4.192e-03 9.666e-03 -3.101e-03 -7.310e-03 2.862e-04  
## Unidentified.42 1.151e-02 -6.650e-03 -1.019e-02 -7.800e-03 -1.358e-03  
## pennate.8 5.982e-03 4.560e-03 -1.281e-02 1.604e-03 -6.234e-03  
## Unidentified.44 1.542e-02 -1.292e-02 2.464e-02 5.886e-02 4.199e-02  
## Unidentified.45 2.973e-03 1.311e-03 -7.582e-03 1.414e-02 7.090e-03  
## Unidentified.46 -3.402e-02 -2.734e-02 1.326e-03 1.649e-02 -2.720e-02  
## Unidentified.47 2.376e-04 -2.461e-03 3.743e-03 4.719e-03 4.518e-03  
## pennate.9 1.480e-03 -3.833e-04 7.044e-03 1.236e-02 1.242e-02  
## Unidentified.48 1.030e-01 3.415e-02 4.826e-02 1.092e-02 -2.432e-02  
## Unidentified.50 7.991e-03 -3.027e-03 2.369e-04 -2.998e-04 1.392e-02  
## Unidentified.51 1.683e-02 4.879e-03 -2.727e-03 -7.784e-03 2.230e-02  
## Unidentified.52 1.130e-02 -4.281e-03 3.351e-04 -4.239e-04 1.969e-02  
## Unidentified.53 1.680e-02 -7.377e-03 2.695e-02 -4.289e-03 1.291e-02  
## Unidentified.54 3.612e-02 2.392e-02 1.673e-03 -3.305e-02 6.953e-03  
## Unidentified.55 1.718e-02 -1.859e-05 1.344e-03 1.520e-03 -8.321e-03  
## Unidentified.56 5.651e-03 -2.140e-03 1.675e-04 -2.120e-04 9.845e-03  
## Unidentified.57 1.158e-02 1.153e-02 -4.219e-03 -1.055e-02 1.025e-02  
## Unidentified.58 7.239e-03 2.926e-03 9.000e-03 1.215e-03 2.838e-02  
## Unidentified.59 5.651e-03 -2.140e-03 1.675e-04 -2.120e-04 9.845e-03  
## Unidentified.60 1.255e-02 -1.706e-03 4.392e-03 -7.788e-03 8.096e-03  
## Unidentified.61 5.651e-03 -2.140e-03 1.675e-04 -2.120e-04 9.845e-03  
## Unidentified.62 5.651e-03 -2.140e-03 1.675e-04 -2.120e-04 9.845e-03  
## Unidentified.63 5.651e-03 -2.140e-03 1.675e-04 -2.120e-04 9.845e-03  
## Unidentified.64 2.146e-02 5.265e-03 -6.599e-03 -1.122e-02 1.396e-02  
## Unidentified.65 5.651e-03 -2.140e-03 1.675e-04 -2.120e-04 9.845e-03  
## Unidentified.66 9.843e-03 7.525e-03 -2.934e-03 -7.522e-03 1.013e-02  
## Unidentified.67 2.929e-02 2.173e-02 -3.646e-03 -2.734e-02 1.870e-02  
## Unidentified.68 4.057e-02 3.236e-02 2.238e-02 -1.778e-03 -3.283e-03  
## centric.3 -1.037e-02 2.569e-03 6.816e-03 -1.390e-02 4.221e-03  
## Unidentified.69 1.130e-02 -4.281e-03 3.351e-04 -4.239e-04 1.969e-02  
## centric.4 1.565e-02 1.213e-02 -4.871e-03 -2.705e-02 5.567e-03  
## Unidentified.70 1.120e-02 1.626e-02 -5.108e-03 -9.214e-03 7.569e-04  
## Unidentified.71 1.409e-02 1.591e-02 -4.914e-03 -6.690e-03 9.481e-04  
## Unidentified.72 5.928e-03 1.367e-02 -4.386e-03 -1.034e-02 4.048e-04  
## Unidentified.73 9.275e-03 -1.373e-03 -3.734e-03 -3.613e-03 -2.456e-04  
## Unidentified.74 1.335e-01 -6.117e-02 -1.431e-01 -1.126e-01 7.393e-04  
## Unidentified.75 1.312e-02 -1.942e-03 -5.281e-03 -5.110e-03 -3.473e-04  
## Unidentified.76 3.943e-03 -4.808e-04 2.643e-04 3.447e-03 2.612e-04  
## Unidentified.77 3.943e-03 -4.808e-04 2.643e-04 3.447e-03 2.612e-04  
## Unidentified.78 1.243e-03 2.077e-03 3.300e-03 7.640e-03 7.904e-03  
## Unidentified.79 1.243e-03 2.077e-03 3.300e-03 7.640e-03 7.904e-03  
## Dolichospermum. 1.243e-03 2.077e-03 3.300e-03 7.640e-03 7.904e-03  
## Unidentified.80 4.075e-03 -1.523e-02 -9.640e-03 1.305e-02 1.522e-02  
## Unidentified.81 9.143e-03 3.432e-03 8.378e-03 1.277e-02 -1.718e-04  
## Unidentified.82 -3.418e-03 -7.755e-03 3.527e-03 -4.125e-03 3.467e-04  
## Unidentified.83 -4.834e-03 -1.097e-02 4.988e-03 -5.833e-03 4.903e-04  
## pennate.11 -3.418e-03 -7.755e-03 3.527e-03 -4.125e-03 3.467e-04  
## Unidentified.84 -3.418e-03 -7.755e-03 3.527e-03 -4.125e-03 3.467e-04  
## Unidentified.86 1.022e-02 3.433e-03 8.775e-03 9.750e-03 5.868e-03  
## pennate.12 2.317e-03 2.078e-03 3.697e-03 4.617e-03 1.394e-02  
## Unidentified.88 1.249e-02 2.142e-03 8.029e-03 8.116e-03 -1.277e-02  
## Actinastrum.spp. 7.106e-02 4.490e-02 -1.440e-02 8.206e-02 -1.412e-01  
## Unidentified.90 1.141e-03 -4.809e-03 1.134e-02 6.537e-03 -1.365e-02  
## Unidentified.91 2.458e-03 6.211e-03 1.114e-03 1.777e-03 -8.659e-03  
## Unidentified.92 -3.713e-03 9.248e-03 -4.484e-04 1.413e-03 -5.983e-03  
## Unidentified.93 2.458e-03 6.211e-03 1.114e-03 1.777e-03 -8.659e-03  
## Unidentified.94 1.920e-02 1.917e-02 9.446e-03 1.461e-02 -2.261e-02  
## Unidentified.95 2.458e-03 6.211e-03 1.114e-03 1.777e-03 -8.659e-03  
## Unidentified.96 2.821e-02 1.433e-02 1.620e-02 1.379e-02 -2.351e-02  
## Unidentified.97 3.154e-02 1.237e-02 1.642e-02 1.474e-02 -1.466e-02  
## Unidentified.98 -2.692e-02 -2.335e-03 1.692e-02 -5.418e-03 -1.065e-02  
## Unidentified.99 1.568e-03 -3.762e-03 1.018e-02 6.046e-04 -6.190e-03  
## Unidentified.100 1.238e-02 8.882e-04 9.804e-03 5.743e-03 -1.152e-02  
## Unidentified.101 6.191e-03 4.441e-04 4.902e-03 2.872e-03 -5.759e-03  
## Unidentified.102 -5.765e-03 -7.041e-03 3.541e-03 -1.043e-03 -3.224e-03  
## pennate.13 -5.098e-03 -4.804e-03 3.230e-03 3.307e-04 2.621e-03  
## Unidentified.103 -7.209e-03 -6.794e-03 4.568e-03 4.676e-04 3.707e-03  
## Nitzschia.spp. -8.810e-02 5.533e-03 4.829e-02 -1.555e-03 4.920e-02  
## unidentified.1 -9.145e-02 -1.284e-01 -1.224e-01 1.672e-01 5.403e-02  
## filament.1 -2.527e-01 -1.961e-01 2.044e-02 -4.233e-02 -1.314e-01  
## Unidentified.1.5 -9.834e-02 -1.244e-02 1.305e-01 -1.582e-02 -6.441e-03  
## Unidentified.2 2.311e-02 4.405e-02 -8.963e-02 2.336e-01 2.259e-03  
## Fragillaria.spp. 5.355e-02 1.374e-01 -7.098e-03 3.679e-02 2.012e-01  
## Microcystis.spp. 2.435e-01 8.022e-02 1.229e-01 -3.443e-02 -1.155e-01  
## Merismopedia.spp. 5.319e-02 6.248e-02 1.350e-02 -2.453e-02 3.247e-02  
## Pediastrum.spp. -2.472e-01 4.184e-01 -1.726e-01 -7.792e-02 -5.002e-02  
## Scenedesmus.spp. 3.410e-02 -5.969e-02 2.214e-02 -6.683e-02 4.180e-02  
## clamydomonadaceae.1 1.674e-02 8.166e-03 2.184e-02 1.185e-02 -2.840e-02  
## Unidentified.13 -1.702e-01 5.855e-02 1.382e-01 7.507e-02 -4.589e-02  
## Chlamydomonas.spp. 1.714e-02 -6.199e-03 2.366e-02 -4.844e-03 2.333e-02  
## Unidentified.27 -2.576e-01 -1.496e-01 1.820e-02 -1.050e-01 7.467e-02  
## Pseudoanabaena.spp. 1.761e-01 -7.084e-02 -4.236e-02 -8.398e-02 5.842e-02  
## Unidentified.26 -1.156e-02 -2.694e-03 2.330e-03 -1.194e-02 1.238e-02  
## Unidentified.87 2.319e-03 2.718e-03 -1.613e-02 9.188e-03 5.900e-03  
## Unidentified.43 1.324e-02 8.820e-03 7.556e-03 3.476e-02 9.568e-03  
## Micractinium.spp... -1.642e-03 -1.808e-02 1.656e-02 -2.788e-03 -3.274e-02  
## PC6  
## Cyclotella.spp. 1.158e-01  
## Peridinium.spp. -2.401e-02  
## Cocconeis.spp. -6.466e-03  
## Selenastrum. 1.402e-02  
## Gomphenema. 1.541e-03  
## pennate.1 7.007e-03  
## pennate.2 -1.417e-02  
## pennate.3 -3.443e-02  
## pennate.4 -6.765e-03  
## Unidentified.3.5 2.340e-02  
## Aphanizomenon -7.852e-03  
## Unidentified.4.5 -2.639e-02  
## Synedra. -1.043e-02  
## Unidentified.4 3.130e-03  
## Dinobryon. -1.194e-17  
## Unidentified.5 1.261e-02  
## Unidentified.6 9.664e-03  
## Unidentified.6.5 -1.371e-02  
## Unidentified.7 6.985e-02  
## Synedra..1 -1.342e-02  
## Unidentified.8 3.271e-02  
## Unidentified.9 4.298e-03  
## Unidentified.10 4.183e-02  
## Unidentified.14 2.631e-02  
## Unidentified.15 -4.207e-03  
## Tabellaria. 8.796e-03  
## Gomphonema. -3.209e-18  
## centric.1 4.087e-02  
## Unidentified.16 -3.253e-02  
## pennate.4.5 -1.127e-04  
## Glaucocystis.spp... 3.331e-03  
## Unidentified.18 0.000e+00  
## Unidentified.19 -8.024e-03  
## Unidentified.20 1.425e-02  
## Unidentified.21 -8.291e-03  
## Unidentified.22 -7.304e-02  
## Aulacoseria. -4.294e-02  
## centric.2 7.811e-03  
## pennate.5 -3.208e-03  
## Unidentified.23 2.399e-03  
## Unidentified.24 1.113e-02  
## Unidentified.25 -4.053e-02  
## Unidentified.28 4.292e-03  
## Stephanodiscus. 1.354e-03  
## Unidentified.29 1.982e-02  
## Unidentified.30 -8.432e-03  
## Unidentified.31 1.416e-02  
## Unidentified.32 4.292e-03  
## Unidentified.33 -1.038e-02  
## pennate.6 1.275e-02  
## Unidentified.35 1.508e-02  
## pennate.7 -6.882e-02  
## Unidentified.36 3.035e-03  
## Unidentified.36.5 3.035e-03  
## Unidentified.37 7.433e-03  
## Unidentified.39 0.000e+00  
## Unidentified.40 2.514e-02  
## Unidentified.41 1.425e-02  
## Unidentified.42 -4.869e-03  
## pennate.8 1.289e-02  
## Unidentified.44 1.036e-02  
## Unidentified.45 2.826e-02  
## Unidentified.46 1.594e-02  
## Unidentified.47 2.804e-03  
## pennate.9 4.138e-03  
## Unidentified.48 -8.421e-03  
## Unidentified.50 1.898e-02  
## Unidentified.51 4.425e-02  
## Unidentified.52 2.684e-02  
## Unidentified.53 4.428e-02  
## Unidentified.54 4.544e-02  
## Unidentified.55 1.695e-03  
## Unidentified.56 1.342e-02  
## Unidentified.57 3.357e-02  
## Unidentified.58 7.933e-03  
## Unidentified.59 1.342e-02  
## Unidentified.60 1.042e-02  
## Unidentified.61 1.342e-02  
## Unidentified.62 1.342e-02  
## Unidentified.63 1.342e-02  
## Unidentified.64 3.720e-02  
## Unidentified.65 1.342e-02  
## Unidentified.66 2.767e-02  
## Unidentified.67 6.154e-02  
## Unidentified.68 5.115e-03  
## centric.3 2.368e-02  
## Unidentified.69 2.684e-02  
## centric.4 1.664e-02  
## Unidentified.70 2.569e-02  
## Unidentified.71 2.643e-02  
## Unidentified.72 2.015e-02  
## Unidentified.73 3.971e-03  
## Unidentified.74 2.732e-02  
## Unidentified.75 5.616e-03  
## Unidentified.76 1.011e-03  
## Unidentified.77 1.011e-03  
## Unidentified.78 1.334e-03  
## Unidentified.79 1.334e-03  
## Dolichospermum. 1.334e-03  
## Unidentified.80 -3.668e-03  
## Unidentified.81 -9.418e-04  
## Unidentified.82 -9.918e-04  
## Unidentified.83 -1.403e-03  
## pennate.11 -9.918e-04  
## Unidentified.84 -9.918e-04  
## Unidentified.86 -8.770e-03  
## pennate.12 -6.494e-03  
## Unidentified.88 -3.599e-03  
## Actinastrum.spp. -9.965e-02  
## Unidentified.90 1.769e-03  
## Unidentified.91 -1.051e-03  
## Unidentified.92 -3.421e-03  
## Unidentified.93 -1.051e-03  
## Unidentified.94 -1.507e-02  
## Unidentified.95 -1.051e-03  
## Unidentified.96 -2.349e-02  
## Unidentified.97 -3.165e-02  
## Unidentified.98 3.870e-04  
## Unidentified.99 -1.426e-03  
## Unidentified.100 -5.622e-03  
## Unidentified.101 -2.811e-03  
## Unidentified.102 2.399e-03  
## pennate.13 -9.097e-03  
## Unidentified.103 -1.286e-02  
## Nitzschia.spp. -7.088e-02  
## unidentified.1 1.299e-01  
## filament.1 1.555e-02  
## Unidentified.1.5 2.027e-02  
## Unidentified.2 -1.300e-01  
## Fragillaria.spp. -2.507e-02  
## Microcystis.spp. 2.653e-02  
## Merismopedia.spp. -9.592e-03  
## Pediastrum.spp. 2.504e-02  
## Scenedesmus.spp. -9.944e-02  
## clamydomonadaceae.1 -1.629e-02  
## Unidentified.13 8.050e-02  
## Chlamydomonas.spp. 1.816e-02  
## Unidentified.27 -9.340e-02  
## Pseudoanabaena.spp. 3.063e-02  
## Unidentified.26 9.065e-03  
## Unidentified.87 -2.262e-02  
## Unidentified.43 2.998e-02  
## Micractinium.spp... -4.942e-03  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -0.28764 0.46577 -0.256225 0.302382 -0.05132 0.38742  
## 3 -0.02886 -0.19784 -0.106109 0.507831 0.16110 0.33185  
## 4 0.01325 -0.13719 0.208701 0.263086 0.25189 0.15631  
## 5 0.29421 -0.11145 0.008723 -0.011036 0.51259 0.69861  
## 6 0.21422 0.49394 -0.158495 -0.373557 0.01463 0.72820  
## 7 0.51602 -0.07641 -0.207747 -0.201024 -0.01366 0.22094  
## 8 0.22010 -0.02684 0.014752 0.192414 0.01458 0.05643  
## 9 0.07090 0.11851 0.188280 0.435833 0.45088 0.07612  
## 10 -0.17884 -0.40577 0.184540 -0.215816 0.01814 -0.05189  
## 11 -0.31980 -0.42565 -0.020358 0.009248 0.23332 0.16370  
## 12 -0.06416 -0.01728 0.537953 -0.146509 -0.31196 0.10912  
## 13 -0.41623 0.34836 0.082438 -0.401263 -0.13084 0.14499  
## 14 0.35974 0.02267 0.220244 -0.394947 -0.09118 -0.15604  
## 15 0.48793 -0.07750 -0.024352 -0.838819 0.25909 -0.17618  
## 16 0.13861 0.12434 0.221173 0.276192 0.83421 -0.38851  
## 17 0.33297 0.05710 0.214008 0.216351 -0.34035 -0.09593  
## 18 0.12815 0.32380 0.058086 0.092649 -0.45141 -0.05478  
## 19 0.46157 0.18106 0.240320 0.215667 -0.21448 -0.46322  
## 20 0.09430 0.47579 -0.058963 0.307812 -0.21605 -0.12724  
## 21 0.32078 0.02301 0.253990 0.148786 -0.29838 -0.14563  
## 22 -0.27837 -0.25327 0.317774 -0.136509 -0.02599 0.08338  
## 23 -0.37965 0.18683 -0.096132 -0.022436 0.16466 -0.14583  
## 24 -0.43992 0.25825 -0.280302 -0.094047 -0.13969 -0.01435  
## 25 -0.34365 -0.11078 0.188114 -0.164216 -0.26836 0.05071  
## 26 -0.24299 0.29831 -0.099421 -0.206381 0.41886 -0.43696  
## 27 -0.30707 -0.37503 0.188594 -0.055563 -0.17169 0.12778  
## 28 -0.16663 -0.21619 0.290407 0.108965 -0.29748 0.12664  
## 29 -0.27499 -0.25913 0.174235 0.017837 0.14140 -0.49070  
## 30 0.09169 -0.26157 -0.497150 0.456702 -0.33405 -0.06958  
## 31 0.05227 -0.42811 -0.606025 -0.166082 -0.10596 -0.07467  
## 32 0.17186 -0.44166 -0.749046 0.003462 -0.10199 -0.20632  
## 33 -0.23977 0.44393 -0.432007 -0.127012 0.08951 -0.36437

ne.hel.pca.scores=scores(ne.hel.pca,choices=1:18,display="sites")  
plot(ne.hel.pca,type="none",xlab="PC1 (17%)",ylab="PC2 (13%)",main="North Erie PCA Hellinger Distance")  
text(ne.hel.pca,labels=necounts$Treatment,col=colors)  
text(ne.hel.pca,display="species",col=8)

 Interpretation: Again, while Euclidean isn’t the best distance to use, the Euclidean PCA shows Microcystis spp. being associated with trace metal only treatment. P and P+trace treatments cluster together, as do nitrogen containing treatments. The axes explain a substantial amount of variation. The hellinger transformed PCA does not show the same patterns. N+trace and N treatments cluster, and diagonally P contaning treatments cluster. Pediastrum spp. falls out inbetween these treatment semi-clusters, near a control and N+P+trace treatment. Though there are some patterns, I don’t think this ordination does a good job demonstrating any strong patterns. There is a lot of overlap between treatments, with only low to moderate variation explained on the axes.

GREEN BAY PCA

gb.cov=cov(gbcounts[,5:52])  
gb.cov

## Chlamydonaceae Aulacoseira.spp. morphospecies.1  
## Chlamydonaceae 1.458669355 3.55947581 -0.39012097  
## Aulacoseira.spp. 3.559475806 1868.74092742 -14.73286290  
## morphospecies.1 -0.390120968 -14.73286290 8.53125000  
## Meloseira.spp... -6.089717742 -114.98891129 -9.90625000  
## centric.1 0.996975806 -4.86189516 -0.53326613  
## pennate.3 1.166330645 -39.04737903 -3.70262097  
## Actinastrum.spp. 0.055443548 -2.81149194 -0.11592742  
## morphospecies.2 0.736895161 -11.17842742 -0.39415323  
## morphospecies.3 -0.052419355 1.89919355 -0.09274194  
## morphospecies.4 -0.017137097 6.21270161 -0.30141129  
## morphospecies.5 -0.006048387 -15.40120968 -0.19556452  
## morphospecies.7 -0.166330645 4.24092742 -0.39415323  
## Selenastrum.spp. -0.006048387 -2.59475806 -0.32459677  
## morphospecies.8 0.312500000 43.96572581 -0.78830645  
## Closterium.spp. 0.044354839 -0.19758065 -0.09274194  
## pennate.4 -0.020161290 -0.10080645 0.03629032  
## Pediastrum.spp..1 -1.761088710 0.73487903 -3.45262097  
## Staurastrum.spp. 0.011088710 1.48286290 -0.02318548  
## Pediastrum.spp..2 0.177419355 23.72580645 -0.37096774  
## Cosmarium.spp. 0.012096774 0.83467742 -0.09274194  
## Merismopedia.spp. -1.216733871 -10.86592742 1.08366935  
## Gomphoneis.spp... 0.075604839 -0.71068548 -0.02318548  
## Atractomorpha.spp... 0.033266129 -0.09979839 -0.06955645  
## morphospecies.9 -0.031250000 -1.71270161 -0.06955645  
## morphospecies.10 -0.021169355 1.41834677 -0.02318548  
## morphospecies.11 0.107862903 -1.48487903 -0.02318548  
## Pediastrum.spp..3 0.171370968 -40.19153226 -1.43750000  
## Treubaria.spp. -0.021169355 -1.67842742 -0.02318548  
## morphospecies.12 0.107862903 -0.77520161 -0.02318548  
## mophospecies.13 -0.052419355 2.25403226 -0.09274194  
## Staurastrum.spp..3 -0.021169355 -1.64616935 -0.02318548  
## Dinobryon.spp.. 0.000000000 0.00000000 0.00000000  
## Cyclotella.spp. 3.979838710 0.80241935 -2.70564516  
## Scenedesmum.spp. 2.623991935 -24.22681452 4.94455645  
## Microcystis.spp. -6.502016129 -272.71975806 -50.10282258  
## Navicula.spp... 0.091733871 8.85383065 0.12197581  
## Stephanodiscus.spp. 0.169354839 6.81451613 -1.10483871  
## Pseudoanabaena.spp. 1.113911290 -78.43850806 -2.95665323  
## Fragillaria.spp... 11.567540323 -79.25100806 -4.28931452  
## Micractinium.spp. 0.677419355 -19.74193548 -0.74193548  
## Staurastrum.spp..2 -0.010080645 0.64314516 -0.04637097  
## Pediastrum.spp. -1.545362903 110.11995968 -1.24092742  
## filamentous.cyanobacteria 5.678427419 -147.13205645 -1.97278226  
## Coconeis.spp. -0.114919355 -0.23588710 -0.23185484  
## Dolichospermum.spp. -0.289314516 20.09375000 0.41431452  
## Planktothrix.spp.. 0.086693548 -1.61491935 0.08266129  
## Diatoma.spp. 0.040322581 13.68548387 -0.55645161  
## Selenastrum.spp... -0.104838710 -5.65322581 0.45967742  
## Meloseira.spp... centric.1 pennate.3  
## Chlamydonaceae -6.08971774 0.99697581 1.16633065  
## Aulacoseira.spp. -114.98891129 -4.86189516 -39.04737903  
## morphospecies.1 -9.90625000 -0.53326613 -3.70262097  
## Meloseira.spp... 724.49092742 -12.35786290 -27.12399194  
## centric.1 -12.35786290 6.72479839 5.81350806  
## pennate.3 -27.12399194 5.81350806 24.45060484  
## Actinastrum.spp. -2.62197581 0.56149194 0.53729839  
## morphospecies.2 3.38205645 1.63810484 2.74294355  
## morphospecies.3 -2.66532258 0.55241935 0.06854839  
## morphospecies.4 6.11189516 -0.23689516 -1.19657258  
## morphospecies.5 1.41330645 0.03024194 0.14314516  
## morphospecies.7 4.60786290 -0.39415323 -0.74092742  
## Selenastrum.spp. 0.34879032 0.67540323 2.04637097  
## morphospecies.8 -11.30040323 2.05040323 4.13104839  
## Closterium.spp. 3.04435484 -0.09274194 -0.09274194  
## pennate.4 1.27016129 -0.02822581 0.32661290  
## Pediastrum.spp..1 20.10987903 -1.38810484 1.24899194  
## Staurastrum.spp. -0.66633065 -0.02318548 0.17842742  
## Pediastrum.spp..2 -10.66129032 -0.37096774 2.85483871  
## Cosmarium.spp. -1.95564516 -0.09274194 0.16532258  
## Merismopedia.spp. 3.39616935 -0.98084677 -10.50504032  
## Gomphoneis.spp... -0.66633065 -0.02318548 -0.07963710  
## Atractomorpha.spp... -1.99899194 -0.06955645 -0.20665323  
## morphospecies.9 -0.28931452 -0.06955645 -0.20665323  
## morphospecies.10 -0.66633065 0.29939516 0.08165323  
## morphospecies.11 -0.66633065 0.33165323 0.40423387  
## Pediastrum.spp..3 48.10685484 0.49798387 4.67540323  
## Treubaria.spp. -0.66633065 -0.02318548 -0.07963710  
## morphospecies.12 -0.66633065 -0.02318548 -0.07963710  
## mophospecies.13 0.62500000 -0.09274194 -0.54435484  
## Staurastrum.spp..3 0.36592742 -0.02318548 0.33971774  
## Dinobryon.spp.. 0.00000000 0.00000000 0.00000000  
## Cyclotella.spp. -37.18145161 9.52016129 10.13306452  
## Scenedesmum.spp. -28.53729839 10.94455645 13.95262097  
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## Fragillaria.spp... -29.52923387 8.09778226 3.68649194  
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## Dolichospermum.spp. -16.16028226 0.80141129 -0.85181452  
## Planktothrix.spp.. 0.02217742 -0.04637097 -0.03024194  
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## morphospecies.4 -0.065524194 -0.09375000 -0.052419355  
## morphospecies.5 0.090725806 0.17943548 -0.024193548  
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## pennate.3 4.669354839 5.45463710  
## Actinastrum.spp. 0.104838710 0.54939516  
## morphospecies.2 0.717741935 2.86794355  
## morphospecies.3 0.032258065 0.53629032  
## morphospecies.4 -0.282258065 0.39616935  
## morphospecies.5 0.145161290 -0.10685484  
## morphospecies.7 -0.572580645 -1.71270161  
## Selenastrum.spp. 0.112903226 0.40927419  
## morphospecies.8 1.306451613 0.44556452  
## Closterium.spp. 0.129032258 0.14919355  
## pennate.4 0.032258065 0.14919355  
## Pediastrum.spp..1 2.637096774 -5.58568548  
## Staurastrum.spp. 0.040322581 -0.14818548  
## Pediastrum.spp..2 0.645161290 -2.37096774  
## Cosmarium.spp. 0.129032258 -0.01209677  
## Merismopedia.spp. -2.943548387 11.77318548  
## Gomphoneis.spp... -0.056451613 -0.05141129  
## Atractomorpha.spp... -0.137096774 0.13608871  
## morphospecies.9 -0.072580645 0.29737903  
## morphospecies.10 0.008064516 0.10987903  
## morphospecies.11 0.072580645 0.27116935  
## Pediastrum.spp..3 1.854838710 14.55443548  
## Treubaria.spp. -0.056451613 -0.11592742  
## morphospecies.12 -0.056451613 -0.01915323  
## mophospecies.13 -0.129032258 0.43951613  
## Staurastrum.spp..3 0.008064516 0.04536290  
## Dinobryon.spp.. 0.000000000 0.00000000  
## Cyclotella.spp. 3.096774194 11.53629032  
## Scenedesmum.spp. 4.427419355 5.85181452  
## Microcystis.spp. 10.887096774 -4.90120968  
## Navicula.spp... 0.395161290 -0.22883065  
## Stephanodiscus.spp. 2.709677419 1.70161290  
## Pseudoanabaena.spp. 1.701612903 31.66834677  
## Fragillaria.spp... -0.120967742 6.87600806  
## Micractinium.spp. 0.677419355 2.80645161  
## Staurastrum.spp..2 0.016129032 -0.07056452  
## Pediastrum.spp. 2.233870968 -1.10786290  
## filamentous.cyanobacteria 15.895161290 22.42641129  
## Coconeis.spp. -0.048387097 0.06653226  
## Dolichospermum.spp. 0.056451613 2.00705645  
## Planktothrix.spp.. -0.112903226 -0.23185484  
## Diatoma.spp. -0.516129032 -0.36290323  
## Selenastrum.spp... -0.032258065 0.45967742  
## Fragillaria.spp... Micractinium.spp.  
## Chlamydonaceae 11.5675403 0.67741935  
## Aulacoseira.spp. -79.2510081 -19.74193548  
## morphospecies.1 -4.2893145 -0.74193548  
## Meloseira.spp... -29.5292339 10.38709677  
## centric.1 8.0977823 0.93548387  
## pennate.3 3.6864919 1.58064516  
## Actinastrum.spp. 0.2288306 0.09677419  
## morphospecies.2 2.3135081 1.83870968  
## morphospecies.3 -0.6814516 0.00000000  
## morphospecies.4 -0.4566532 -0.09677419  
## morphospecies.5 -1.4818548 0.64516129  
## morphospecies.7 -2.9768145 -0.41935484  
## Selenastrum.spp. -1.4173387 -0.12903226  
## morphospecies.8 -6.0826613 -0.58064516  
## Closterium.spp. -0.7137097 0.29032258  
## pennate.4 -0.7459677 0.03225806  
## Pediastrum.spp..1 -29.8538306 3.09677419  
## Staurastrum.spp. -0.1864919 -0.03225806  
## Pediastrum.spp..2 -2.9838710 -0.51612903  
## Cosmarium.spp. -0.7137097 0.12903226  
## Merismopedia.spp. -10.9707661 -1.77419355  
## Gomphoneis.spp... -0.1864919 0.06451613  
## Atractomorpha.spp... -0.5594758 0.00000000  
## morphospecies.9 -0.5594758 0.19354839  
## morphospecies.10 -0.1542339 -0.03225806  
## morphospecies.11 0.9102823 0.09677419  
## Pediastrum.spp..3 -11.5625000 7.03225806  
## Treubaria.spp. -0.1864919 0.00000000  
## morphospecies.12 2.5877016 -0.03225806  
## mophospecies.13 -0.7459677 0.09677419  
## Staurastrum.spp..3 -0.1864919 -0.03225806  
## Dinobryon.spp.. 0.0000000 0.00000000  
## Cyclotella.spp. -7.3588710 1.09677419  
## Scenedesmum.spp. 0.2006048 3.93548387  
## Microcystis.spp. -113.5745968 -4.09677419  
## Navicula.spp... 2.9586694 0.00000000  
## Stephanodiscus.spp. -0.1209677 0.67741935  
## Pseudoanabaena.spp. 6.8760081 2.80645161  
## Fragillaria.spp... 299.9183468 -1.58064516  
## Micractinium.spp. -1.5806452 4.12903226  
## Staurastrum.spp..2 -0.3729839 0.06451613  
## Pediastrum.spp. -16.7752016 0.61290323  
## filamentous.cyanobacteria 64.4727823 7.48387097  
## Coconeis.spp. 0.2318548 -0.19354839  
## Dolichospermum.spp. 2.8598790 -0.70967742  
## Planktothrix.spp.. 2.4012097 -0.06451613  
## Diatoma.spp. 0.6532258 0.00000000  
## Selenastrum.spp... -1.4919355 0.00000000  
## Staurastrum.spp..2 Pediastrum.spp.  
## Chlamydonaceae -0.010080645 -1.54536290  
## Aulacoseira.spp. 0.643145161 110.11995968  
## morphospecies.1 -0.046370968 -1.24092742  
## Meloseira.spp... -1.332661290 -51.54536290  
## centric.1 -0.046370968 -3.17641129  
## pennate.3 -0.094758065 6.08971774  
## Actinastrum.spp. 0.022177419 -0.20665323  
## morphospecies.2 -0.034274194 -2.34778226  
## morphospecies.3 0.024193548 -0.55241935  
## morphospecies.4 -0.026209677 0.10786290  
## morphospecies.5 0.004032258 0.48588710  
## morphospecies.7 -0.034274194 -2.34778226  
## Selenastrum.spp. 0.004032258 -1.22379032  
## morphospecies.8 -0.068548387 6.72379032  
## Closterium.spp. -0.008064516 -0.06854839  
## pennate.4 -0.008064516 0.15725806  
## Pediastrum.spp..1 1.663306452 -20.38608871  
## Staurastrum.spp. -0.002016129 0.57157258  
## Pediastrum.spp..2 -0.032258065 9.14516129  
## Cosmarium.spp. 0.056451613 0.15725806  
## Merismopedia.spp. -0.118951613 -6.59979839  
## Gomphoneis.spp... -0.002016129 -0.13810484  
## Atractomorpha.spp... -0.006048387 -0.41431452  
## morphospecies.9 0.026209677 -0.41431452  
## morphospecies.10 -0.002016129 -0.13810484  
## morphospecies.11 -0.002016129 -0.13810484  
## Pediastrum.spp..3 -0.125000000 -8.56250000  
## Treubaria.spp. -0.002016129 -0.13810484  
## morphospecies.12 -0.002016129 -0.13810484  
## mophospecies.13 0.024193548 -0.55241935  
## Staurastrum.spp..3 -0.002016129 -0.13810484  
## Dinobryon.spp.. 0.000000000 0.00000000  
## Cyclotella.spp. 0.088709677 -29.81048387  
## Scenedesmum.spp. -0.324596774 -0.75100806  
## Microcystis.spp. 0.012096774 102.29637097  
## Navicula.spp... -0.002016129 1.91028226  
## Stephanodiscus.spp. 0.016129032 2.23387097  
## Pseudoanabaena.spp. -0.070564516 -1.10786290  
## Fragillaria.spp... -0.372983871 -16.77520161  
## Micractinium.spp. 0.064516129 0.61290323  
## Staurastrum.spp..2 0.060483871 -0.27620968  
## Pediastrum.spp. -0.276209677 102.59576613  
## filamentous.cyanobacteria -0.715725806 26.74697581  
## Coconeis.spp. 0.076612903 -0.86491935  
## Dolichospermum.spp. -0.070564516 4.71471774  
## Planktothrix.spp.. -0.004032258 -0.27620968  
## Diatoma.spp. -0.016129032 0.55645161  
## Selenastrum.spp... 0.016129032 -0.58870968  
## filamentous.cyanobacteria Coconeis.spp.  
## Chlamydonaceae 5.678427e+00 -0.114919355  
## Aulacoseira.spp. -1.471321e+02 -0.235887097  
## morphospecies.1 -1.972782e+00 -0.231854839  
## Meloseira.spp... 1.271946e+02 -1.050403226  
## centric.1 1.731754e+01 -0.231854839  
## pennate.3 2.921270e+01 0.106854839  
## Actinastrum.spp. 1.713710e-02 0.014112903  
## morphospecies.2 1.191633e+01 -0.171370968  
## morphospecies.3 1.665323e+00 -0.008064516  
## morphospecies.4 -1.523185e+00 -0.002016129  
## morphospecies.5 6.995968e-01 -0.076612903  
## morphospecies.7 9.271169e+00 -0.074596774  
## Selenastrum.spp. 1.044153e+01 0.213709677  
## morphospecies.8 -2.618952e+00 -0.342741935  
## Closterium.spp. -7.661290e-02 -0.008064516  
## pennate.4 -2.399194e+00 -0.040322581  
## Pediastrum.spp..1 -5.418246e+01 1.122983871  
## Staurastrum.spp. -1.320565e-01 -0.010080645  
## Pediastrum.spp..2 -2.112903e+00 -0.161290323  
## Cosmarium.spp. -1.088710e-01 0.056451613  
## Merismopedia.spp. -5.959778e+01 -0.594758065  
## Gomphoneis.spp... 4.163306e-01 -0.010080645  
## Atractomorpha.spp... 1.248992e+00 -0.030241935  
## morphospecies.9 8.770161e-02 0.034274194  
## morphospecies.10 -3.578629e-01 -0.010080645  
## morphospecies.11 1.900202e+00 -0.010080645  
## Pediastrum.spp..3 -3.012298e+01 -0.625000000  
## Treubaria.spp. 1.545363e+00 -0.010080645  
## morphospecies.12 -9.385081e-01 -0.010080645  
## mophospecies.13 -2.979839e+00 -0.008064516  
## Staurastrum.spp..3 1.287298e+00 0.054435484  
## Dinobryon.spp.. 0.000000e+00 0.000000000  
## Cyclotella.spp. 5.666532e+01 0.088709677  
## Scenedesmum.spp. 9.860988e+01 -0.913306452  
## Microcystis.spp. -1.290302e+02 4.286290323  
## Navicula.spp... 7.432460e+00 0.151209677  
## Stephanodiscus.spp. 1.589516e+01 -0.048387097  
## Pseudoanabaena.spp. 2.242641e+01 0.066532258  
## Fragillaria.spp... 6.447278e+01 0.231854839  
## Micractinium.spp. 7.483871e+00 -0.193548387  
## Staurastrum.spp..2 -7.157258e-01 0.076612903  
## Pediastrum.spp. 2.674698e+01 -0.864919355  
## filamentous.cyanobacteria 1.053184e+03 0.002016129  
## Coconeis.spp. 2.016129e-03 0.415322581  
## Dolichospermum.spp. 1.892641e+01 0.292338710  
## Planktothrix.spp.. -2.070565e+00 -0.020161290  
## Diatoma.spp. 8.282258e+00 0.080645161  
## Selenastrum.spp... -4.282258e+00 -0.016129032  
## Dolichospermum.spp. Planktothrix.spp..  
## Chlamydonaceae -0.289314516 0.086693548  
## Aulacoseira.spp. 20.093750000 -1.614919355  
## morphospecies.1 0.414314516 0.082661290  
## Meloseira.spp... -16.160282258 0.022177419  
## centric.1 0.801411290 -0.046370968  
## pennate.3 -0.851814516 -0.030241935  
## Actinastrum.spp. 0.017137097 -0.010080645  
## morphospecies.2 -0.341733871 -0.034274194  
## morphospecies.3 0.245967742 -0.008064516  
## morphospecies.4 0.057459677 -0.026209677  
## morphospecies.5 -0.332661290 0.004032258  
## morphospecies.7 -0.341733871 -0.034274194  
## Selenastrum.spp. -0.010080645 -0.028225806  
## morphospecies.8 0.348790323 -0.068548387  
## Closterium.spp. -0.108870968 -0.008064516  
## pennate.4 -0.108870968 0.024193548  
## Pediastrum.spp..1 -8.472782258 0.372983871  
## Staurastrum.spp. -0.035282258 -0.002016129  
## Pediastrum.spp..2 -0.564516129 -0.032258065  
## Cosmarium.spp. -0.141129032 -0.008064516  
## Merismopedia.spp. -1.694556452 -0.022177419  
## Gomphoneis.spp... 0.029233871 -0.002016129  
## Atractomorpha.spp... -0.009072581 -0.006048387  
## morphospecies.9 -0.041330645 -0.006048387  
## morphospecies.10 0.126008065 -0.002016129  
## morphospecies.11 -0.035282258 -0.002016129  
## Pediastrum.spp..3 -1.671370968 -0.125000000  
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## morphospecies.12 -0.035282258 0.030241935  
## mophospecies.13 -0.044354839 -0.008064516  
## Staurastrum.spp..3 -0.035282258 -0.002016129  
## Dinobryon.spp.. 0.000000000 0.000000000  
## Cyclotella.spp. -0.560483871 0.120967742  
## Scenedesmum.spp. -1.196572581 -0.550403226  
## Microcystis.spp. -20.062500000 -1.955645161  
## Navicula.spp... 1.013104839 -0.034274194  
## Stephanodiscus.spp. 0.056451613 -0.112903226  
## Pseudoanabaena.spp. 2.007056452 -0.231854839  
## Fragillaria.spp... 2.859879032 2.401209677  
## Micractinium.spp. -0.709677419 -0.064516129  
## Staurastrum.spp..2 -0.070564516 -0.004032258  
## Pediastrum.spp. 4.714717742 -0.276209677  
## filamentous.cyanobacteria 18.926411290 -2.070564516  
## Coconeis.spp. 0.292338710 -0.020161290  
## Dolichospermum.spp. 4.281250000 -0.070564516  
## Planktothrix.spp.. -0.070564516 0.060483871  
## Diatoma.spp. 0.508064516 -0.048387097  
## Selenastrum.spp... -0.185483871 0.016129032  
## Diatoma.spp. Selenastrum.spp...  
## Chlamydonaceae 0.040322581 -0.104838710  
## Aulacoseira.spp. 13.685483871 -5.653225806  
## morphospecies.1 -0.556451613 0.459677419  
## Meloseira.spp... -7.411290323 2.217741935  
## centric.1 -0.201612903 -0.056451613  
## pennate.3 -0.588709677 -0.024193548  
## Actinastrum.spp. -0.056451613 -0.008064516  
## morphospecies.2 -0.250000000 0.120967742  
## morphospecies.3 0.000000000 -0.032258065  
## morphospecies.4 0.040322581 0.088709677  
## morphospecies.5 -0.145161290 -0.016129032  
## morphospecies.7 0.685483871 -0.137096774  
## Selenastrum.spp. -0.080645161 -0.112903226  
## morphospecies.8 -0.822580645 0.048387097  
## Closterium.spp. -0.096774194 -0.032258065  
## pennate.4 -0.096774194 0.064516129  
## Pediastrum.spp..1 -4.072580645 0.201612903  
## Staurastrum.spp. -0.024193548 -0.008064516  
## Pediastrum.spp..2 -0.387096774 -0.129032258  
## Cosmarium.spp. -0.032258065 -0.032258065  
## Merismopedia.spp. -1.201612903 1.362903226  
## Gomphoneis.spp... 0.104838710 -0.008064516  
## Atractomorpha.spp... 0.346774194 -0.024193548  
## morphospecies.9 -0.008064516 0.008064516  
## morphospecies.10 -0.024193548 -0.008064516  
## morphospecies.11 0.008064516 -0.008064516  
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## Treubaria.spp. -0.024193548 -0.008064516  
## morphospecies.12 -0.024193548 -0.008064516  
## mophospecies.13 -0.064516129 -0.032258065  
## Staurastrum.spp..3 0.008064516 -0.008064516  
## Dinobryon.spp.. 0.000000000 0.000000000  
## Cyclotella.spp. -1.580645161 0.193548387  
## Scenedesmum.spp. -3.024193548 0.540322581  
## Microcystis.spp. 12.145161290 -1.500000000  
## Navicula.spp... 0.266129032 -0.072580645  
## Stephanodiscus.spp. -0.516129032 -0.032258065  
## Pseudoanabaena.spp. -0.362903226 0.459677419  
## Fragillaria.spp... 0.653225806 -1.491935484  
## Micractinium.spp. 0.000000000 0.000000000  
## Staurastrum.spp..2 -0.016129032 0.016129032  
## Pediastrum.spp. 0.556451613 -0.588709677  
## filamentous.cyanobacteria 8.282258065 -4.282258065  
## Coconeis.spp. 0.080645161 -0.016129032  
## Dolichospermum.spp. 0.508064516 -0.185483871  
## Planktothrix.spp.. -0.048387097 0.016129032  
## Diatoma.spp. 2.258064516 -0.193548387  
## Selenastrum.spp... -0.193548387 0.258064516

# Eigen analysis with R base functions  
gb.eigen=eigen(gb.cov)  
gb.eigen

## eigen() decomposition  
## $values  
## [1] 3.037268e+03 1.898237e+03 1.049843e+03 6.682090e+02 2.904417e+02  
## [6] 2.339952e+02 1.260830e+02 8.085294e+01 6.270694e+01 4.721325e+01  
## [11] 3.850684e+01 1.219204e+01 1.183053e+01 7.819720e+00 5.217348e+00  
## [16] 3.575684e+00 2.859962e+00 2.359771e+00 1.822934e+00 1.199351e+00  
## [21] 8.624091e-01 6.274031e-01 4.302514e-01 3.169836e-01 2.325705e-01  
## [26] 1.427562e-01 9.785524e-02 5.173698e-02 4.587303e-02 4.081544e-02  
## [31] 1.727636e-02 1.243987e-13 1.153208e-13 7.589959e-14 6.766799e-14  
## [36] 3.430696e-14 3.636772e-15 1.318377e-16 4.003121e-18 -9.691808e-18  
## [41] -1.546263e-15 -4.072704e-15 -5.408262e-15 -2.568115e-14 -3.368364e-14  
## [46] -5.170516e-14 -5.179727e-14 -7.061825e-14  
##   
## $vectors  
## [,1] [,2] [,3] [,4]  
## [1,] -2.248065e-03 5.652656e-04 5.360794e-03 -1.459689e-02  
## [2,] -2.019409e-01 9.422454e-01 2.225390e-01 9.376929e-02  
## [3,] -1.453783e-02 -1.033174e-02 -1.156456e-02 -2.531005e-02  
## [4,] -1.300225e-01 -1.613148e-01 1.374141e-01 9.442710e-01  
## [5,] 1.091610e-02 -1.295077e-03 1.846425e-02 -2.026096e-02  
## [6,] 4.842990e-02 -8.978595e-03 3.322829e-02 -2.630942e-02  
## [7,] 3.138222e-03 -4.642699e-04 1.509796e-04 -2.550593e-03  
## [8,] 9.457802e-04 -7.463195e-03 9.848690e-03 -6.174091e-04  
## [9,] 6.330826e-04 1.150227e-03 1.794718e-03 -3.375183e-03  
## [10,] -3.619583e-03 1.974218e-03 -6.008049e-04 8.217886e-03  
## [11,] 3.016895e-03 -7.252483e-03 -1.746062e-03 1.412999e-03  
## [12,] -3.096753e-03 6.834139e-05 8.985516e-03 3.978144e-03  
## [13,] 3.729384e-03 -1.557894e-03 1.030889e-02 4.402220e-04  
## [14,] 1.477602e-02 2.797973e-02 1.304640e-02 1.016473e-03  
## [15,] -4.745198e-04 -4.367572e-04 2.174959e-04 4.099064e-03  
## [16,] 8.893670e-04 3.740219e-04 -1.849397e-03 3.471527e-03  
## [17,] 1.277395e-02 9.078237e-03 -5.447936e-02 8.822434e-02  
## [18,] 9.904417e-04 1.117657e-03 5.493121e-04 -3.461214e-05  
## [19,] 1.584707e-02 1.788251e-02 8.788994e-03 -5.537942e-04  
## [20,] 1.495382e-03 1.019478e-03 2.441580e-04 -1.293178e-03  
## [21,] -1.839615e-02 -4.268871e-03 -6.590532e-02 2.840531e-03  
## [22,] 1.866025e-04 -3.095514e-04 1.708358e-04 -1.023224e-03  
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## [43,] 8.943191e-04 0.0007262561 0.0040005287 -0.0031919138  
## [44,] 1.701647e-01 -0.1027511280 -0.0900820649 -0.0540721877  
## [45,] 1.218991e-02 -0.0898717222 0.0567941281 0.0206141648  
## [46,] 2.613052e-01 0.1442189327 -0.1845049333 0.3757931524  
## [47,] 1.797455e-03 0.0366294345 -0.0344030895 0.0595011546  
## [48,] -9.602467e-02 -0.0752753764 0.0506529390 -0.2970685466  
## [,39] [,40] [,41] [,42]  
## [1,] 0.000000e+00 0.0000000000 0.0000000000 0.000000e+00  
## [2,] 1.103386e-07 0.0007204912 -0.0003899454 -3.377649e-04  
## [3,] -1.147918e-04 0.0169841369 0.0433231301 -3.856453e-02  
## [4,] -1.222717e-05 0.0005357098 0.0038924614 -6.216391e-03  
## [5,] 2.193412e-04 -0.0296551042 -0.0458879123 7.049867e-02  
## [6,] -9.743783e-05 0.0149712510 0.0055096705 -1.667377e-02  
## [7,] -1.099703e-04 0.0245884207 0.0547096100 -1.260277e-01  
## [8,] -6.950709e-04 0.0524080577 0.0228982234 -1.368010e-01  
## [9,] 4.168136e-04 -0.0159183959 0.0664740605 -2.730383e-01  
## [10,] -6.792179e-05 0.0101842697 0.2228504990 -5.373418e-02  
## [11,] -7.722198e-04 0.0817890118 0.0013629120 -6.544696e-02  
## [12,] 2.082213e-04 -0.0168485552 0.0357444468 -8.468317e-03  
## [13,] -8.212920e-04 0.0751937906 0.0369685897 5.453246e-02  
## [14,] -2.686736e-04 0.0303925510 -0.0109853313 1.526815e-02  
## [15,] 1.352702e-03 -0.1371999986 -0.1861556670 1.728324e-01  
## [16,] 3.119381e-04 -0.0284669887 -0.0025195755 -5.265623e-02  
## [17,] -8.968423e-06 0.0043466117 -0.0064700733 2.862863e-03  
## [18,] 8.679726e-05 0.0497068167 0.2001368209 -1.593378e-01  
## [19,] 2.926204e-04 -0.0267218696 0.0227168610 -1.791405e-02  
## [20,] -8.619706e-04 0.0747974466 -0.1003381845 7.695211e-02  
## [21,] -2.171894e-05 0.0014613607 -0.0136350586 -2.863594e-03  
## [22,] -7.695218e-04 0.0029211806 -0.3265168952 -2.815504e-01  
## [23,] -3.405959e-04 0.0721966149 0.5897805287 -1.443695e-01  
## [24,] -1.635125e-03 0.1305462999 -0.0339431765 -1.028886e-01  
## [25,] -1.912330e-04 0.0026889009 0.0260300393 -2.635713e-01  
## [26,] 5.508625e-04 -0.0414202978 -0.1223673439 -3.803691e-01  
## [27,] 7.519591e-05 -0.0142802780 -0.0337991494 1.386313e-02  
## [28,] 1.059340e-03 -0.1163103636 0.2788423094 -2.173206e-01  
## [29,] -7.330431e-04 0.1105971964 -0.3749348088 -5.613358e-01  
## [30,] -4.222789e-04 0.0069733115 0.2669202405 -1.706113e-01  
## [31,] 5.852369e-03 -0.6974629575 -0.0020089877 -1.593777e-01  
## [32,] 9.999733e-01 0.0068207990 -0.0004184202 1.342322e-04  
## [33,] 2.100694e-05 -0.0010629306 0.0125372478 -3.139350e-03  
## [34,] 1.265816e-05 -0.0069512649 -0.0003686170 2.896614e-04  
## [35,] 5.980404e-06 -0.0005941705 0.0009928445 7.036754e-05  
## [36,] 6.283125e-04 -0.1140468778 -0.1739009833 7.873998e-02  
## [37,] -1.018612e-04 0.0019314359 0.1097370484 -5.648009e-02  
## [38,] 3.625269e-05 -0.0032160046 0.0010340167 1.985607e-03  
## [39,] -1.042374e-05 0.0035507602 0.0100315757 5.615928e-04  
## [40,] 2.413779e-04 0.0118219887 0.0824283815 4.015172e-02  
## [41,] 2.516965e-03 -0.5192477188 0.1276676955 -8.605061e-02  
## [42,] -2.577883e-05 0.0005763979 0.0031913765 -6.203091e-03  
## [43,] 5.231855e-06 0.0002438696 -0.0056888284 3.685747e-03  
## [44,] -9.652727e-04 0.1528486262 0.0451609721 -9.552771e-02  
## [45,] -3.693127e-05 0.0090754972 0.0665833195 -3.314479e-02  
## [46,] 9.168534e-04 -0.3184893177 -0.0685462741 1.804241e-01  
## [47,] -2.276718e-04 0.0086632826 -0.0465594818 -1.780423e-02  
## [48,] 7.193653e-05 0.0928242323 0.0952923527 7.676900e-02  
## [,43] [,44] [,45] [,46]  
## [1,] 0.0000000000 0.000000e+00 0.000000e+00 0.000000e+00  
## [2,] -0.0049885372 -1.071327e-06 3.614476e-03 2.613734e-03  
## [3,] 0.0023702984 -5.309759e-03 1.568653e-02 1.520719e-02  
## [4,] 0.0027135619 -2.668595e-03 2.718285e-03 -1.061648e-04  
## [5,] -0.0500637547 -1.539752e-02 8.687956e-02 3.129723e-02  
## [6,] 0.0014851541 -1.226775e-02 1.380823e-02 7.587654e-04  
## [7,] 0.0139676270 -5.161473e-02 -7.733891e-03 -8.166235e-02  
## [8,] 0.2126459570 -5.866042e-02 -7.871955e-02 -2.857793e-01  
## [9,] -0.0566629595 1.312893e-01 2.113016e-02 -3.898150e-01  
## [10,] 0.0693238175 5.151143e-02 -6.013349e-02 7.634087e-02  
## [11,] -0.0279996144 -1.120718e-01 9.491395e-02 2.851208e-03  
## [12,] -0.1009352145 1.254635e-02 -7.209807e-02 6.241733e-02  
## [13,] 0.0416826896 8.064037e-02 3.683671e-02 -2.979847e-02  
## [14,] 0.1161215534 -9.116058e-02 -1.510423e-01 4.138107e-02  
## [15,] -0.0086011256 2.270118e-01 6.877818e-02 -1.978508e-01  
## [16,] -0.1331409470 -1.066615e-01 -3.674264e-02 -4.513258e-02  
## [17,] 0.0109357486 -1.820262e-03 -6.360442e-03 -4.367503e-03  
## [18,] -0.4301154906 -4.517858e-01 -2.310319e-01 -2.139575e-01  
## [19,] -0.0909178846 1.361544e-01 1.911110e-01 -3.358817e-02  
## [20,] 0.2352876389 -1.541037e-01 -8.266114e-03 4.156364e-02  
## [21,] -0.0051910684 -4.252706e-03 5.414851e-03 -1.022213e-02  
## [22,] -0.3855774935 -4.740864e-02 1.516072e-02 -3.188847e-01  
## [23,] 0.2167292023 -3.389950e-02 -6.208191e-02 1.828035e-02  
## [24,] 0.0376023085 -1.956280e-01 -3.766283e-02 1.506074e-01  
## [25,] 0.0672869126 5.225001e-01 -3.679806e-03 -3.324103e-01  
## [26,] 0.1787605553 2.858910e-01 -6.569170e-01 2.512879e-01  
## [27,] 0.0021249852 4.386653e-03 2.567493e-02 -8.512755e-03  
## [28,] -0.1878433599 2.173593e-01 4.040160e-01 2.806795e-01  
## [29,] 0.0572361045 -1.137323e-01 3.272943e-01 3.834780e-01  
## [30,] -0.1968619784 1.416607e-02 -1.516360e-02 6.728577e-02  
## [31,] 0.0908362074 -2.978025e-01 -5.593450e-02 -7.043041e-04  
## [32,] -0.0001925196 2.122356e-04 -3.549681e-05 4.027355e-05  
## [33,] 0.0039422985 3.820187e-03 1.253940e-02 2.928235e-03  
## [34,] -0.0057640370 -4.164037e-03 -1.135343e-02 5.477671e-03  
## [35,] -0.0014034207 8.493241e-04 1.579110e-04 2.475301e-03  
## [36,] 0.0708910508 3.299531e-02 -7.535099e-03 -5.475617e-02  
## [37,] -0.0745047334 4.113041e-02 -3.082549e-02 4.242815e-02  
## [38,] -0.0198016828 4.675825e-03 5.763261e-03 2.104283e-02  
## [39,] 0.0012305447 -6.785710e-04 3.386870e-04 -4.277657e-03  
## [40,] -0.1102484109 4.255529e-02 -2.434615e-02 1.461131e-01  
## [41,] 0.1600910274 -2.967931e-03 2.050352e-01 -9.188013e-02  
## [42,] 0.0123933912 -2.898402e-03 -5.137921e-03 -1.275014e-02  
## [43,] -0.0034723664 6.293200e-04 1.865638e-03 1.113500e-03  
## [44,] -0.1566878013 -1.319379e-02 -7.401239e-02 -1.670031e-02  
## [45,] 0.0116538360 -1.793396e-02 4.214701e-05 3.733194e-02  
## [46,] -0.4373144819 2.148004e-01 -2.809751e-01 2.832294e-01  
## [47,] 0.0603555343 -8.395507e-03 1.442990e-02 -4.779690e-02  
## [48,] -0.2521974891 1.996481e-01 8.446597e-02 8.943210e-02  
## [,47] [,48]  
## [1,] 0.000000e+00 2.779241e-01  
## [2,] -8.540919e-03 -3.738462e-03  
## [3,] 1.860540e-02 -2.589066e-02  
## [4,] -1.812281e-03 6.027465e-03  
## [5,] -9.401530e-02 -5.216097e-02  
## [6,] -1.929968e-02 8.248596e-03  
## [7,] -2.947050e-02 4.520973e-01  
## [8,] 2.220776e-01 -1.195451e-01  
## [9,] 3.059438e-01 1.783000e-01  
## [10,] 4.555849e-01 -3.426282e-01  
## [11,] -2.017399e-01 -2.282703e-01  
## [12,] -2.266812e-02 7.830270e-02  
## [13,] 8.635666e-02 -9.237664e-02  
## [14,] 1.004134e-01 2.345212e-02  
## [15,] 1.423746e-01 -7.974280e-02  
## [16,] 1.483686e-02 2.813175e-01  
## [17,] 3.054297e-03 1.003846e-02  
## [18,] 1.247535e-01 -4.107609e-02  
## [19,] -9.118058e-02 -1.075744e-01  
## [20,] -9.876764e-02 -2.497233e-01  
## [21,] -3.241138e-02 3.205995e-02  
## [22,] -3.295778e-01 -2.023010e-01  
## [23,] -4.821224e-01 -4.901320e-02  
## [24,] 2.039823e-01 1.195254e-01  
## [25,] -1.044490e-01 -7.383584e-02  
## [26,] -6.597313e-02 7.886884e-03  
## [27,] -5.966510e-02 2.158084e-02  
## [28,] 4.899557e-02 2.272862e-01  
## [29,] 7.360564e-02 -7.978143e-02  
## [30,] 1.972228e-01 -2.142428e-01  
## [31,] -5.422961e-02 -1.617227e-01  
## [32,] -1.240276e-05 3.605325e-08  
## [33,] 8.945067e-03 -1.532784e-02  
## [34,] 3.615389e-04 2.784046e-02  
## [35,] 3.880055e-04 -5.086548e-04  
## [36,] -1.199732e-02 1.350866e-01  
## [37,] 1.132721e-01 -4.284805e-03  
## [38,] -8.875281e-03 -1.647854e-02  
## [39,] -7.167487e-04 -1.053828e-02  
## [40,] 3.939481e-03 -3.500016e-02  
## [41,] -7.316877e-04 1.850180e-02  
## [42,] 7.458001e-03 1.381390e-02  
## [43,] -7.132034e-03 -2.134236e-03  
## [44,] -1.638657e-01 9.825959e-02  
## [45,] 4.234538e-03 1.606057e-02  
## [46,] 1.096816e-02 2.066623e-02  
## [47,] 1.832823e-01 3.203198e-02  
## [48,] 9.721370e-03 -3.087877e-01

gb.scores=as.matrix(gbcounts[,5:52])%\*%as.matrix(gb.eigen$vectors)  
  
par(mfrow=c(1,1))  
gb.pca=rda(gbcounts[,5:52])  
class(gb.pca)

## [1] "rda" "cca"

str(gb.pca)

## List of 10  
## $ colsum : Named num [1:48] 1.21 43.23 2.92 26.92 2.59 ...  
## ..- attr(\*, "names")= chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...  
## $ tot.chi : num 7585  
## $ Ybar : num [1:32, 1:48] 0.241 -0.118 -0.118 -0.118 0.421 ...  
## ..- attr(\*, "scaled:center")= Named num [1:48] 0.656 56.031 0.719 20.656 0.719 ...  
## .. ..- attr(\*, "names")= chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. ..$ : chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...  
## ..- attr(\*, "METHOD")= chr "PCA"  
## $ method : chr "rda"  
## $ call : language rda(X = gbcounts[, 5:52])  
## $ pCCA : NULL  
## $ CCA : NULL  
## $ CA :List of 7  
## ..$ eig : Named num [1:31] 3037 1898 1050 668 290 ...  
## .. ..- attr(\*, "names")= chr [1:31] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ poseig : NULL  
## ..$ u : num [1:32, 1:31] -0.1177 -0.1154 -0.0446 0.4587 -0.2409 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:31] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ v : num [1:48, 1:31] -0.00225 -0.20194 -0.01454 -0.13002 0.01092 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...  
## .. .. ..$ : chr [1:31] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ rank : int 31  
## ..$ tot.chi: num 7585  
## ..$ Xbar : num [1:32, 1:48] 0.241 -0.118 -0.118 -0.118 0.421 ...  
## .. ..- attr(\*, "scaled:center")= Named num [1:48] 0.656 56.031 0.719 20.656 0.719 ...  
## .. .. ..- attr(\*, "names")= chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...  
## .. ..- attr(\*, "METHOD")= chr "PCA"  
## $ inertia : chr "variance"  
## $ regularization: chr "this is a vegan::rda result object"  
## - attr(\*, "class")= chr [1:2] "rda" "cca"

summary(gb.pca)

##   
## Call:  
## rda(X = gbcounts[, 5:52])   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 7585 1  
## Unconstrained 7585 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 3037.2684 1898.2371 1049.8432 668.20900 290.44167  
## Proportion Explained 0.4004 0.2503 0.1384 0.08809 0.03829  
## Cumulative Proportion 0.4004 0.6507 0.7891 0.87719 0.91548  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 233.99525 126.08300 80.85294 62.706942 47.213252  
## Proportion Explained 0.03085 0.01662 0.01066 0.008267 0.006224  
## Cumulative Proportion 0.94633 0.96295 0.97361 0.981877 0.988102  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 38.506844 12.192037 11.83053 7.819720 5.2173485  
## Proportion Explained 0.005077 0.001607 0.00156 0.001031 0.0006878  
## Cumulative Proportion 0.993178 0.994786 0.99635 0.997376 0.9980641  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 3.5756836 2.859962 2.3597710 1.8229337 1.1993507  
## Proportion Explained 0.0004714 0.000377 0.0003111 0.0002403 0.0001581  
## Cumulative Proportion 0.9985356 0.998913 0.9992237 0.9994640 0.9996222  
## PC21 PC22 PC23 PC24 PC25  
## Eigenvalue 0.8624091 6.274e-01 4.303e-01 3.170e-01 2.326e-01  
## Proportion Explained 0.0001137 8.272e-05 5.672e-05 4.179e-05 3.066e-05  
## Cumulative Proportion 0.9997359 9.998e-01 9.999e-01 9.999e-01 9.999e-01  
## PC26 PC27 PC28 PC29 PC30  
## Eigenvalue 1.428e-01 0.0978552 5.174e-02 4.587e-02 4.082e-02  
## Proportion Explained 1.882e-05 0.0000129 6.821e-06 6.048e-06 5.381e-06  
## Cumulative Proportion 1.000e+00 0.9999795 1.000e+00 1.000e+00 1.000e+00  
## PC31  
## Eigenvalue 1.728e-02  
## Proportion Explained 2.278e-06  
## Cumulative Proportion 1.000e+00  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 22.02068   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4  
## Chlamydonaceae -0.0313257 0.0062270 -0.043918 -0.0954040  
## Aulacoseira.spp. -2.8139474 10.3798081 -1.823133 0.6128679  
## morphospecies.1 -0.2025776 -0.1138148 0.094742 -0.1654243  
## Meloseira.spp... -1.8118001 -1.7770492 -1.125754 6.1716730  
## centric.1 0.1521105 -0.0142666 -0.151267 -0.1324239  
## pennate.3 0.6748468 -0.0989085 -0.272220 -0.1719561  
## Actinastrum.spp. 0.0437296 -0.0051144 -0.001237 -0.0166705  
## morphospecies.2 0.0131790 -0.0822148 -0.080685 -0.0040353  
## morphospecies.3 0.0088217 0.0126709 -0.014703 -0.0220599  
## morphospecies.4 -0.0504371 0.0217481 0.004922 0.0537114  
## morphospecies.5 0.0420390 -0.0798936 0.014304 0.0092352  
## morphospecies.7 -0.0431517 0.0007529 -0.073613 0.0260008  
## Selenastrum.spp. 0.0519671 -0.0171618 -0.084455 0.0028773  
## morphospecies.8 0.2058966 0.3082257 -0.106882 0.0066436  
## Closterium.spp. -0.0066122 -0.0048113 -0.001782 0.0267911  
## pennate.4 0.0123929 0.0041202 0.015151 0.0226896  
## Pediastrum.spp..1 0.1779988 0.1000062 0.446318 0.5766266  
## Staurastrum.spp. 0.0138013 0.0123121 -0.004500 -0.0002262  
## Pediastrum.spp..2 0.2208211 0.1969944 -0.072003 -0.0036196  
## Cosmarium.spp. 0.0208374 0.0112306 -0.002000 -0.0084521  
## Merismopedia.spp. -0.2563413 -0.0470260 0.539924 0.0185655  
## Gomphoneis.spp... 0.0026002 -0.0034100 -0.001400 -0.0066877  
## Atractomorpha.spp... 0.0090427 0.0014801 -0.008238 -0.0173270  
## morphospecies.9 0.0005971 -0.0095403 0.003259 -0.0034254  
## morphospecies.10 0.0046183 0.0099333 -0.000555 -0.0031361  
## morphospecies.11 0.0095858 -0.0087739 -0.013538 -0.0103968  
## Pediastrum.spp..3 -0.0943573 -0.2586881 0.282286 0.4789010  
## Treubaria.spp. -0.0012998 -0.0111029 -0.007393 -0.0106488  
## morphospecies.12 -0.0090381 -0.0054879 0.010330 -0.0128049  
## mophospecies.13 -0.0122866 0.0134826 0.023855 0.0176149  
## Staurastrum.spp..3 0.0096313 -0.0092161 -0.008755 0.0028516  
## Dinobryon.spp.. 0.0000000 0.0000000 0.000000 0.0000000  
## Cyclotella.spp. -0.0909631 -0.0709214 -0.389115 -0.5062546  
## Scenedesmum.spp. 0.3750633 -0.1674732 -0.796139 -0.3885337  
## Microcystis.spp. 13.4577073 1.7457063 -0.922278 0.8849682  
## Navicula.spp... -0.0183012 0.0391708 -0.068912 -0.0352701  
## Stephanodiscus.spp. 0.0383794 0.0239326 -0.149613 0.0255466  
## Pseudoanabaena.spp. 0.0558545 -0.4592148 -0.010706 -0.3162583  
## Fragillaria.spp... -0.4770745 -0.7134361 -0.307852 -1.1205223  
## Micractinium.spp. -0.0065787 -0.1325158 -0.030069 0.0674131  
## Staurastrum.spp..2 0.0004994 0.0058489 0.006682 -0.0083620  
## Pediastrum.spp. 0.3939083 0.7619472 -0.469788 -0.2976950  
## filamentous.cyanobacteria -0.7613891 -2.4058773 -7.732919 -0.9566597  
## Coconeis.spp. 0.0196993 0.0033981 -0.001274 -0.0033518  
## Dolichospermum.spp. -0.1031820 0.0831733 -0.146630 -0.2012601  
## Planktothrix.spp.. -0.0071464 -0.0089210 0.019729 -0.0042383  
## Diatoma.spp. 0.0428295 0.0828884 -0.087806 -0.0545581  
## Selenastrum.spp... -0.0016204 -0.0290584 0.041824 0.0227747  
## PC5 PC6  
## Chlamydonaceae -0.1276091 -7.460e-02  
## Aulacoseira.spp. -0.2403158 -1.329e-01  
## morphospecies.1 0.1216646 9.275e-02  
## Meloseira.spp... -0.6671127 3.634e-02  
## centric.1 -0.0582815 -9.662e-02  
## pennate.3 -0.0060490 -1.205e-01  
## Actinastrum.spp. -0.0006046 -7.576e-03  
## morphospecies.2 0.0021140 -3.660e-02  
## morphospecies.3 0.0141407 7.483e-05  
## morphospecies.4 -0.0120781 2.583e-02  
## morphospecies.5 0.0379795 -1.624e-02  
## morphospecies.7 0.0294087 5.169e-02  
## Selenastrum.spp. 0.0461555 -5.234e-02  
## morphospecies.8 0.0597619 -5.189e-02  
## Closterium.spp. 0.0009753 1.403e-02  
## pennate.4 0.0183664 -3.767e-02  
## Pediastrum.spp..1 1.5922925 -3.386e+00  
## Staurastrum.spp. 0.0027920 -6.703e-03  
## Pediastrum.spp..2 0.0446724 -1.073e-01  
## Cosmarium.spp. 0.0201375 -2.715e-02  
## Merismopedia.spp. 0.1060202 3.933e-01  
## Gomphoneis.spp... 0.0044448 1.876e-03  
## Atractomorpha.spp... 0.0070846 1.337e-02  
## morphospecies.9 0.0105033 2.051e-03  
## morphospecies.10 -0.0005504 3.602e-03  
## morphospecies.11 -0.0052889 -1.221e-02  
## Pediastrum.spp..3 0.2054713 -2.585e-01  
## Treubaria.spp. 0.0100560 -2.550e-03  
## morphospecies.12 -0.0336813 -1.085e-02  
## mophospecies.13 0.0366656 -8.329e-02  
## Staurastrum.spp..3 0.0040920 -1.965e-03  
## Dinobryon.spp.. 0.0000000 0.000e+00  
## Cyclotella.spp. 0.5591395 -4.702e-01  
## Scenedesmum.spp. 0.3851463 -4.480e-01  
## Microcystis.spp. -0.2795062 -2.684e-02  
## Navicula.spp... -0.0344479 -1.009e-02  
## Stephanodiscus.spp. 0.0253535 -6.567e-02  
## Pseudoanabaena.spp. 0.0697824 3.861e-02  
## Fragillaria.spp... -3.8380553 -1.517e+00  
## Micractinium.spp. 0.0564146 -4.423e-02  
## Staurastrum.spp..2 0.0152169 -2.248e-02  
## Pediastrum.spp. 0.0142608 6.583e-01  
## filamentous.cyanobacteria 0.3801014 -4.962e-02  
## Coconeis.spp. -0.0003176 -1.918e-02  
## Dolichospermum.spp. -0.0240549 1.072e-01  
## Planktothrix.spp.. -0.0299269 -1.922e-02  
## Diatoma.spp. -0.0355233 5.441e-02  
## Selenastrum.spp... 0.0191884 9.274e-03  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -2.5926 5.9207 2.54873 2.5129 -1.5631 2.6800  
## 3 -2.5412 1.0708 -3.70739 -2.4297 -5.6653 -0.1217  
## 4 -0.9815 7.4850 -5.88169 -2.5497 0.1881 4.2758  
## 5 10.1000 -1.4850 4.00830 -0.1903 -1.3595 4.1241  
## 6 -5.3056 8.1875 -6.92754 0.8710 0.7294 0.8175  
## 7 6.6924 5.9703 -2.18219 -0.1097 1.3539 -3.2504  
## 8 -5.6984 -2.7119 1.32617 -5.2343 2.9218 3.0032  
## 9 -2.1997 -0.3882 4.92042 0.3792 0.6483 3.9867  
## 10 1.5747 0.4737 2.00508 2.0810 -0.8580 3.0110  
## 11 5.0225 -2.5899 3.23971 1.3266 -0.6152 2.6694  
## 12 1.2609 -1.6536 -0.67866 -3.2429 2.1553 0.9099  
## 13 0.6041 -4.5220 -5.57773 -4.9980 2.8777 2.8353  
## 14 1.8888 -0.3688 -8.72629 8.3727 -6.5375 -3.2781  
## 15 7.1057 2.1954 3.13382 -0.1645 -1.8834 3.0839  
## 16 2.5199 6.8933 2.26159 -0.1612 -1.5976 2.7403  
## 17 -2.8032 -1.4915 1.69950 -3.9091 1.4140 3.3469  
## 18 2.2395 4.8167 -0.26911 -1.5207 -0.2669 1.7467  
## 19 4.6483 -4.2546 -6.56495 -5.0415 -2.5647 -5.9213  
## 20 0.1173 -4.1426 0.77731 3.2250 1.3095 0.4064  
## 21 -5.5130 -2.9977 -3.10823 5.8912 -0.3364 3.1392  
## 22 -0.6303 -5.3839 -3.58506 -5.1637 4.8762 -1.2363  
## 23 -3.5755 -1.7136 2.16350 -4.3611 1.6551 4.3852  
## 24 -4.3827 -2.6611 5.00896 -6.2092 -16.3324 -5.2622  
## 25 -0.8053 1.0327 -1.01373 -2.6577 4.5131 -6.2925  
## 26 4.6703 -4.4690 -4.24537 1.3828 1.9843 -0.9529  
## 27 -5.1870 -1.3592 -0.34082 6.8823 -0.2112 1.2371  
## 28 -1.7175 1.8350 4.19378 3.7331 4.4221 -11.3648  
## 29 -1.5612 -6.0229 -0.08016 6.0596 1.0090 0.5478  
## 30 -1.3620 -1.9077 2.90397 4.7341 -0.6502 2.7678  
## 31 0.9173 -1.6648 4.55800 4.1540 1.8206 -4.0581  
## 32 -3.5524 4.1032 3.88607 -2.2650 3.6974 -5.3673  
## 33 1.0474 1.8035 4.25401 -1.3971 2.8657 -4.6085

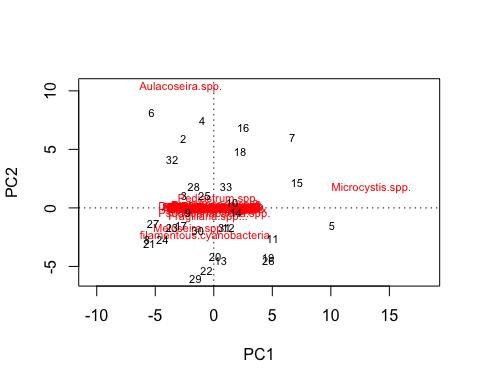
eigenvals(gb.pca)

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 3037.2684 1898.2371 1049.8432 668.2090 290.4417 233.9952 126.0830   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 80.8529 62.7069 47.2133 38.5068 12.1920 11.8305 7.8197   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 5.2173 3.5757 2.8600 2.3598 1.8229 1.1994 0.8624   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 0.6274 0.4303 0.3170 0.2326 0.1428 0.0979 0.0517   
## PC29 PC30 PC31   
## 0.0459 0.0408 0.0173

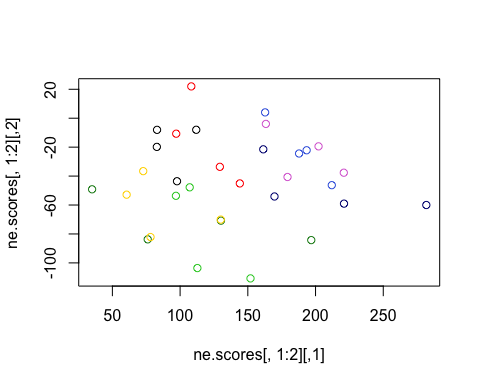
eigenvals(gb.pca)/sum(eigenvals(gb.pca))

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 0.4004256 0.2502586 0.1384086 0.0880949 0.0382911 0.0308493 0.0166225   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 0.0106594 0.0082671 0.0062245 0.0050766 0.0016074 0.0015597 0.0010309   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 0.0006878 0.0004714 0.0003770 0.0003111 0.0002403 0.0001581 0.0001137   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 0.0000827 0.0000567 0.0000418 0.0000307 0.0000188 0.0000129 0.0000068   
## PC29 PC30 PC31   
## 0.0000060 0.0000054 0.0000023

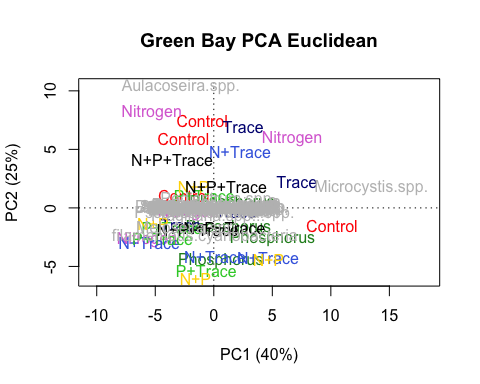
plot(gb.pca)



plot(ne.scores[,1:2],col=colors)



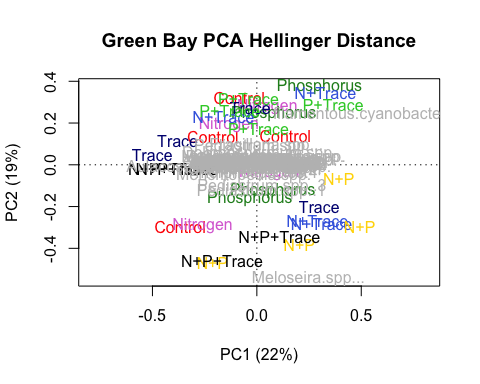
plot(gb.pca,type="none",xlab="PC1 (40%)",ylab="PC2 (25%)",main="Green Bay PCA Euclidean")  
text(gb.pca,labels=gbcounts$Treatment,col=colors)  
text(gb.pca,display="species",col=8)



# Hellinger distance-based PCA  
gb.hel=decostand(gbcounts[,5:52],method="hellinger")  
gb.hel.pca=rda(gb.hel)  
summary(gb.hel.pca)

##   
## Call:  
## rda(X = gb.hel)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.1553 1  
## Unconstrained 0.1553 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5 PC6  
## Eigenvalue 0.03432 0.02958 0.02115 0.01463 0.01215 0.008637  
## Proportion Explained 0.22102 0.19048 0.13622 0.09421 0.07821 0.055614  
## Cumulative Proportion 0.22102 0.41150 0.54772 0.64193 0.72014 0.775755  
## PC7 PC8 PC9 PC10 PC11  
## Eigenvalue 0.007045 0.005662 0.004006 0.003174 0.002201  
## Proportion Explained 0.045363 0.036462 0.025798 0.020437 0.014170  
## Cumulative Proportion 0.821118 0.857580 0.883378 0.903815 0.917985  
## PC12 PC13 PC14 PC15 PC16  
## Eigenvalue 0.002182 0.001958 0.001515 0.001062 0.001005  
## Proportion Explained 0.014050 0.012605 0.009757 0.006836 0.006468  
## Cumulative Proportion 0.932034 0.944639 0.954396 0.961232 0.967701  
## PC17 PC18 PC19 PC20 PC21  
## Eigenvalue 0.0008811 0.0007152 0.0006615 0.0006002 0.0004885  
## Proportion Explained 0.0056734 0.0046055 0.0042598 0.0038649 0.0031454  
## Cumulative Proportion 0.9733740 0.9779794 0.9822392 0.9861041 0.9892495  
## PC22 PC23 PC24 PC25 PC26  
## Eigenvalue 0.000377 0.0002946 0.000226 0.0001973 0.0001689  
## Proportion Explained 0.002428 0.0018969 0.001455 0.0012704 0.0010877  
## Cumulative Proportion 0.991677 0.9935742 0.995030 0.9963000 0.9973878  
## PC27 PC28 PC29 PC30 PC31  
## Eigenvalue 0.0001298 9.492e-05 7.705e-05 5.901e-05 4.489e-05  
## Proportion Explained 0.0008358 6.112e-04 4.962e-04 3.800e-04 2.891e-04  
## Cumulative Proportion 0.9982236 9.988e-01 9.993e-01 9.997e-01 1.000e+00  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.48126   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4  
## Chlamydonaceae 0.0044367 2.602e-02 0.0138823 -0.0039917  
## Aulacoseira.spp. -0.3413843 -1.292e-02 0.3829014 0.1534526  
## morphospecies.1 -0.0038969 2.264e-02 0.0073561 0.0094314  
## Meloseira.spp... 0.2471215 -5.440e-01 0.1260020 -0.0789328  
## centric.1 0.0184685 2.787e-02 -0.0121514 0.0058444  
## pennate.3 0.0074445 3.832e-02 -0.0509593 -0.0153707  
## Actinastrum.spp. 0.0001412 1.492e-02 -0.0215113 -0.0052198  
## morphospecies.2 0.0440443 -4.461e-03 -0.0127605 0.0098334  
## morphospecies.3 0.0022703 1.871e-02 0.0018018 0.0121102  
## morphospecies.4 -0.0002671 -4.103e-02 0.0375432 -0.0029325  
## morphospecies.5 0.0232727 -3.987e-03 -0.0641028 0.0053658  
## morphospecies.7 0.0220244 -4.502e-03 0.0160911 -0.0004317  
## Selenastrum.spp. 0.0289750 6.416e-03 -0.0041839 0.0377176  
## morphospecies.8 -0.0127836 5.085e-03 0.0195284 0.0287276  
## Closterium.spp. 0.0163231 -1.795e-02 -0.0026949 -0.0098468  
## pennate.4 -0.0046640 -2.257e-02 -0.0149010 0.0166475  
## Pediastrum.spp..1 0.0209113 -1.255e-01 -0.2174152 0.3165475  
## Staurastrum.spp. -0.0024187 3.459e-03 -0.0005782 0.0061645  
## Pediastrum.spp..2 -0.0096746 1.383e-02 -0.0023127 0.0246580  
## Cosmarium.spp. -0.0004475 5.970e-03 -0.0090653 0.0155724  
## Merismopedia.spp. -0.0624285 -4.932e-02 -0.0049037 -0.0207379  
## Gomphoneis.spp... 0.0018316 5.499e-03 -0.0021598 0.0043950  
## Atractomorpha.spp... -0.0023206 1.491e-02 -0.0006631 0.0008313  
## morphospecies.9 0.0004879 9.753e-05 -0.0069769 0.0024704  
## morphospecies.10 -0.0032558 4.666e-03 0.0030088 0.0009707  
## morphospecies.11 0.0060843 6.347e-03 -0.0048339 0.0006133  
## Pediastrum.spp..3 0.0248187 -1.023e-01 -0.0345772 0.0225519  
## Treubaria.spp. 0.0083127 6.483e-03 -0.0073544 0.0063140  
## morphospecies.12 -0.0031965 6.436e-03 0.0010752 -0.0137955  
## mophospecies.13 -0.0077029 -1.367e-02 -0.0081049 0.0267221  
## Staurastrum.spp..3 0.0079350 -1.344e-03 -0.0048807 0.0009184  
## Dinobryon.spp.. 0.0000000 0.000e+00 0.0000000 0.0000000  
## Cyclotella.spp. 0.0087503 7.874e-03 -0.0479825 0.0429527  
## Scenedesmum.spp. 0.0797394 3.632e-02 -0.0410284 0.0913660  
## Microcystis.spp. -0.0883397 3.741e-02 -0.1618791 -0.1030823  
## Navicula.spp... 0.0054679 3.007e-02 0.0235085 0.0154345  
## Stephanodiscus.spp. 0.0318131 2.256e-02 -0.0067945 0.0180545  
## Pseudoanabaena.spp. 0.0433908 3.728e-02 -0.0581148 -0.0438121  
## Fragillaria.spp... 0.0451393 9.207e-02 0.0602240 -0.1728894  
## Micractinium.spp. 0.0586606 -1.301e-02 -0.0381806 0.0324447  
## Staurastrum.spp..2 -0.0084579 3.304e-03 -0.0081444 0.0188637  
## Pediastrum.spp. -0.0233462 8.924e-02 -0.0034333 -0.0786967  
## filamentous.cyanobacteria 0.5230604 2.426e-01 0.1864317 0.0981090  
## Coconeis.spp. -0.0042172 -7.978e-03 -0.0020855 0.0034736  
## Dolichospermum.spp. 0.0128866 5.320e-02 0.0436440 0.0058191  
## Planktothrix.spp.. -0.0069562 -3.917e-03 -0.0054495 -0.0125180  
## Diatoma.spp. 0.0131032 3.431e-02 0.0334706 -0.0002974  
## Selenastrum.spp... -0.0083359 -2.370e-02 -0.0203630 -0.0009720  
## PC5 PC6  
## Chlamydonaceae -5.201e-02 -0.0160696  
## Aulacoseira.spp. -1.839e-02 0.0115189  
## morphospecies.1 3.299e-02 -0.0294060  
## Meloseira.spp... 1.201e-02 0.0251719  
## centric.1 -2.966e-02 -0.0486406  
## pennate.3 -2.577e-03 0.0283954  
## Actinastrum.spp. -3.805e-03 -0.0049449  
## morphospecies.2 -1.196e-02 -0.0485100  
## morphospecies.3 2.600e-03 -0.0109325  
## morphospecies.4 -7.948e-05 -0.0080259  
## morphospecies.5 4.981e-03 0.0091898  
## morphospecies.7 1.372e-02 -0.0102127  
## Selenastrum.spp. -8.156e-03 -0.0059766  
## morphospecies.8 1.721e-02 -0.0505538  
## Closterium.spp. 9.140e-03 -0.0037756  
## pennate.4 -4.156e-03 0.0047214  
## Pediastrum.spp..1 -1.301e-01 0.1110241  
## Staurastrum.spp. 1.640e-03 0.0042667  
## Pediastrum.spp..2 6.562e-03 0.0170667  
## Cosmarium.spp. -7.054e-04 0.0088936  
## Merismopedia.spp. 3.542e-02 -0.1421294  
## Gomphoneis.spp... 8.613e-04 -0.0012986  
## Atractomorpha.spp... 7.687e-03 -0.0058098  
## morphospecies.9 3.928e-03 -0.0096678  
## morphospecies.10 2.129e-04 -0.0078368  
## morphospecies.11 -9.479e-03 -0.0040987  
## Pediastrum.spp..3 -6.427e-03 -0.0473990  
## Treubaria.spp. 8.300e-04 -0.0041888  
## morphospecies.12 -2.443e-02 -0.0007281  
## mophospecies.13 -1.115e-02 0.0122700  
## Staurastrum.spp..3 1.409e-03 0.0009441  
## Dinobryon.spp.. 0.000e+00 0.0000000  
## Cyclotella.spp. -9.306e-03 -0.1166601  
## Scenedesmum.spp. -2.029e-02 -0.1472022  
## Microcystis.spp. 6.850e-02 0.0162102  
## Navicula.spp... -3.711e-03 0.0249257  
## Stephanodiscus.spp. 1.247e-02 0.0335298  
## Pseudoanabaena.spp. 9.690e-03 -0.0503184  
## Fragillaria.spp... -3.491e-01 0.0282800  
## Micractinium.spp. -1.655e-04 -0.0022444  
## Staurastrum.spp..2 -5.623e-03 0.0061933  
## Pediastrum.spp. 1.270e-01 0.1830070  
## filamentous.cyanobacteria 4.295e-02 0.0162702  
## Coconeis.spp. -8.221e-03 0.0106015  
## Dolichospermum.spp. 1.443e-02 -0.0156352  
## Planktothrix.spp.. -2.598e-02 0.0027482  
## Diatoma.spp. -1.002e-04 0.0213636  
## Selenastrum.spp... 1.304e-02 -0.0284261  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -0.36730 -0.29918 0.314939 -0.08055 0.02517 -0.01512  
## 3 0.13650 0.13851 0.401511 -0.23128 -0.29113 0.21863  
## 4 -0.08388 0.32072 0.392825 0.06917 0.32734 0.45185  
## 5 -0.20960 0.13473 -0.540885 -0.52039 0.31077 0.20165  
## 6 0.06037 -0.03521 0.556332 0.22034 0.06657 -0.24244  
## 7 -0.13362 0.19108 -0.031942 0.34057 0.09063 0.23572  
## 8 0.05068 0.28045 0.162931 0.14106 0.19507 -0.48651  
## 9 -0.25967 -0.29046 -0.004661 -0.25501 0.18366 -0.66998  
## 10 -0.03336 -0.16118 0.136171 -0.17150 0.15751 -0.05219  
## 11 0.07591 -0.12427 -0.283641 -0.31697 0.05009 -0.10456  
## 12 0.08127 0.24400 -0.095838 0.19502 0.03822 -0.05762  
## 13 0.30029 0.37544 -0.042905 -0.04255 0.21346 -0.21475  
## 14 0.29929 -0.20203 0.303919 -0.01588 -0.39000 0.35391  
## 15 -0.37882 0.11363 -0.165603 -0.33262 0.07554 0.20114  
## 16 -0.50053 0.04877 0.113235 -0.12082 0.09572 0.01248  
## 17 -0.03138 0.27131 0.109856 -0.05438 0.18441 0.10131  
## 18 -0.16022 0.22962 0.148059 0.04777 0.01048 -0.38564  
## 19 0.32809 0.34226 -0.260664 0.03307 -0.51117 -0.22102  
## 20 0.29060 -0.26876 -0.190694 0.02507 0.03742 -0.34745  
## 21 0.31028 -0.28464 0.431875 -0.15004 0.07004 0.11077  
## 22 0.36569 0.28521 -0.323535 0.27777 0.03651 -0.18427  
## 23 -0.03942 0.31559 0.073939 -0.18316 0.35593 0.34209  
## 24 -0.12875 0.25925 0.043307 -0.55567 -0.98396 -0.02933  
## 25 0.00875 0.17392 -0.069485 0.54205 -0.11384 0.22878  
## 26 0.39280 -0.06653 -0.241602 0.04546 0.06974 0.04673  
## 27 0.20393 -0.38079 0.266503 0.14464 0.02388 0.03444  
## 28 -0.21253 -0.46922 -0.177942 0.40498 -0.23425 0.19763  
## 29 0.49256 -0.29807 -0.343483 -0.14394 0.19635 0.42037  
## 30 0.10864 -0.34686 0.027733 -0.16688 0.10404 -0.27280  
## 31 -0.16683 -0.45940 -0.289522 0.05669 -0.06905 0.15425  
## 32 -0.41984 -0.01832 -0.128698 0.48255 -0.18591 -0.08351  
## 33 -0.37991 -0.01954 -0.292032 0.31542 -0.13923 0.05542

gb.hel.pca.scores=scores(gb.hel.pca,choices=1:18,display="sites")  
plot(gb.hel.pca,type="none",xlab="PC1 (22%)",ylab="PC2 (19%)",main="Green Bay PCA Hellinger Distance")  
text(gb.hel.pca,labels=gbcounts$Treatment,col=colors)  
text(gb.hel.pca,display="species",col=8)

 Interpretation: In the euclidean PCA, Aulacoseira and Microcystis spp. separate from the rest of the species, mainly near N and trace containing treatments. There is again a large proportion of variation explained, but no strong patterns displayed by this ordination. In the hellinger transformed PCA, Melosira spp. falls out from the rest near N+P, N+P+trace and N+trace treatments, which makes me think that N is driving this pattern. There is still a lot of overlap of treatments in this PCA, and only moderate variation explained.

FORD PCA

ford.cov=cov(fordcounts[,4:80])  
ford.cov

## pennate.1 morphospecies.2 Cymbella.spp..  
## pennate.1 179.3699597 8.34072581 -0.971774194  
## morphospecies.2 8.3407258 84.70564516 0.395161290  
## Cymbella.spp.. -0.9717742 0.39516129 0.112903226  
## Cymbella.spp.2. -24.1915323 -2.32661290 0.169354839  
## Scenedesmus.spp..3 -9.3135081 5.86895161 0.681451613  
## morphospecies.3 -4.5564516 -1.59677419 -0.064516129  
## morphospecies.4 2.1955645 -2.22983871 -0.056451613  
## morphospecies.6 7.3377016 -0.98185484 0.028225806  
## morphospecies.8 0.0000000 0.00000000 0.000000000  
## Dolichospermum.spp.. -2.9435484 0.33870968 -0.032258065  
## Tabellaria.spp.. -2.1743952 -1.37701613 -0.084677419  
## morphospecies.10 -12.0967742 -2.54838710 0.580645161  
## morphospecies.11 -0.9213710 0.97177419 -0.008064516  
## morphospecies.12 -1.0786290 3.09274194 0.459677419  
## morphospecies.13 14.3961694 3.22379032 0.229838710  
## pennate.3 -23.3618952 1.77217742 0.875000000  
## morphospecies.14 -1.7258065 -0.16129032 0.096774194  
## morphospecies.15 -5.4082661 7.76814516 1.173387097  
## morphospecies.16 1.8689516 -2.83467742 0.185483871  
## Coconeis.spp. -10.4314516 -0.78225806 0.016129032  
## Staurastrum.spp. 0.4112903 -0.95161290 0.032258065  
## morphospecies.17 24.5877016 -16.41733871 0.512096774  
## Selenastrum.spp... 79.4495968 -27.18951613 -0.782258065  
## morphospecies.18 -3.3951613 2.75806452 -0.032258065  
## Staurastrum.spp..2 -0.5342742 -0.09274194 -0.008064516  
## morphospecies.44 -0.7137097 0.45967742 0.016129032  
## morphospecies.45 0.3598790 0.78024194 -0.012096774  
## morphospecies.20 -7.7469758 0.05846774 -0.116935484  
## morphospecies.21 -0.1290323 -3.38709677 -0.129032258  
## morphospecies.22 2.1491935 -5.87903226 -0.177419355  
## morphospecies.23 -1.5564516 -0.82258065 -0.032258065  
## pennate.4 -4.5272177 1.78024194 0.084677419  
## morphospecies.24 1.7147177 -0.47782258 -0.012096774  
## morphospecies.25 -0.3407258 -0.31854839 0.024193548  
## morphospecies.26 -0.2026210 0.87298387 0.028225806  
## morphospecies.27 -2.6854839 -0.59677419 -0.032258065  
## Asterionella.spp.. -0.5413306 -2.70766129 -0.068548387  
## morphospecies.28 -1.8094758 -1.75201613 -0.044354839  
## morphospecies.29 6.9395161 4.89516129 0.048387097  
## pennate.5 -2.5171371 -2.33669355 -0.068548387  
## morphospecies.30 -0.2116935 -0.31854839 -0.008064516  
## Cosmarium.spp. -0.1008065 -0.25000000 -0.016129032  
## morphospecies.31 0.0000000 0.00000000 0.000000000  
## pennate.6 10.9294355 12.81854839 -0.088709677  
## morphospecies.31.1 4.9858871 -4.77822581 -0.120967742  
## morphospecies.32 8.0846774 -1.78225806 -0.048387097  
## Scenedesmus.spp..3.1 4.5403226 -1.27419355 -0.032258065  
## morphospecies.33 0.0000000 0.00000000 0.000000000  
## morphospecies.34 0.6270161 -0.31854839 -0.008064516  
## Selenastrum.spp.. 0.4102823 -0.12701613 -0.004032258  
## morphospecies.35 1.9818548 -0.31854839 -0.008064516  
## morphospecies.36 32.7006048 -5.25604839 -0.133064516  
## morphospecies.37 0.9909274 -0.15927419 -0.004032258  
## morphospecies.38 0.9264113 -0.15927419 -0.004032258  
## pennate.7 0.9264113 -0.15927419 -0.004032258  
## morphospecies.38.1 0.0000000 0.00000000 0.000000000  
## morphospecies.39 0.0000000 0.00000000 0.000000000  
## pennate.8 0.0000000 0.00000000 0.000000000  
## pennate.9 0.0000000 0.00000000 0.000000000  
## Scenedesmus.spp..2. 4.6129032 -3.29032258 -0.129032258  
## morphospecies.40 -2.7116935 -0.77016129 -0.104838710  
## Scenedesmus.spp.1. 47.2842742 343.36693548 2.459677419  
## Cyclotella.spp... 232.7177419 -15.88709677 -1.096774194  
## pennate.2 -32.6270161 58.41532258 0.427419355  
## Fragillaria.spp. -88.5252016 319.35685484 -6.423387097  
## morphospecies.7 131.8497984 -2.84475806 -0.762096774  
## morphospecies.41 34.2439516 -9.64919355 -0.250000000  
## Peridinium.spp... -5.5504032 7.81048387 0.056451613  
## morphospecies.1 -32.8991935 16.66935484 -0.016129032  
## Nitzschia.spp. 32.5967742 57.06451613 0.000000000  
## morphospecies.43 14.8639113 -2.38911290 -0.060483871  
## Pinnularia.spp... -6.7449597 -0.23588710 -0.012096774  
## Microcystis.spp. -384.7298387 -87.63709677 2.919354839  
## Synedra.spp.. -29.1895161 -26.00806452 -0.919354839  
## morphospecies.19 -8.8850806 -0.32661290 -0.024193548  
## morphospecies.9 7.0504032 -3.81048387 -0.024193548  
## Pediastrum.spp. -5.6814516 11.78225806 -0.274193548  
## Cymbella.spp.2. Scenedesmus.spp..3 morphospecies.3  
## pennate.1 -24.19153226 -9.313508e+00 -4.556451613  
## morphospecies.2 -2.32661290 5.868952e+00 -1.596774194  
## Cymbella.spp.. 0.16935484 6.814516e-01 -0.064516129  
## Cymbella.spp.2. 12.70564516 2.820565e+00 2.370967742  
## Scenedesmus.spp..3 2.82056452 5.977319e+01 -0.701612903  
## morphospecies.3 2.37096774 -7.016129e-01 2.838709677  
## morphospecies.4 -0.58467742 -1.598790e+00 -0.370967742  
## morphospecies.6 2.19556452 9.492944e+00 1.346774194  
## morphospecies.8 0.00000000 0.000000e+00 0.000000000  
## Dolichospermum.spp.. 0.27419355 -5.725806e-01 -0.032258065  
## Tabellaria.spp.. 1.83266129 -1.704637e+00 0.766129032  
## morphospecies.10 3.48387097 8.258065e+00 -0.032258065  
## morphospecies.11 -0.09274194 -2.560484e-01 -0.080645161  
## morphospecies.12 -1.16532258 1.022379e+01 -0.919354839  
## morphospecies.13 -2.82459677 2.998992e+00 -0.572580645  
## pennate.3 -4.24395161 1.520867e+01 -1.733870968  
## morphospecies.14 0.51612903 1.451613e-01 0.161290323  
## morphospecies.15 4.68750000 3.819556e+00 -0.620967742  
## morphospecies.16 -1.44758065 1.824597e+00 -0.564516129  
## Coconeis.spp. 4.89516129 5.431452e+00 0.774193548  
## Staurastrum.spp. -0.46774194 8.064516e-03 -0.225806452  
## morphospecies.17 -2.36895161 1.146169e+00 3.604838710  
## Selenastrum.spp... -14.96370968 -2.114315e+01 -4.274193548  
## morphospecies.18 -0.17741935 -1.024194e+00 -0.193548387  
## Staurastrum.spp..2 0.19758065 -2.560484e-01 0.016129032  
## morphospecies.44 0.71774194 6.854839e-02 0.258064516  
## morphospecies.45 0.15120968 2.288306e-01 -0.024193548  
## morphospecies.20 -0.95766129 -3.615927e+00 -0.040322581  
## morphospecies.21 -2.32258065 -3.903226e+00 0.645161290  
## morphospecies.22 -2.20161290 -3.278226e+00 0.032258065  
## morphospecies.23 -0.46774194 -9.596774e-01 0.161290323  
## pennate.4 2.86088710 8.256048e-01 0.717741935  
## morphospecies.24 -0.30040323 -3.840726e-01 -0.088709677  
## morphospecies.25 0.32661290 -3.024194e-02 -0.016129032  
## morphospecies.26 0.14717742 3.326613e-02 0.056451613  
## morphospecies.27 1.27419355 -1.854839e-01 0.064516129  
## Asterionella.spp.. 2.01814516 3.397177e-01 1.475806452  
## morphospecies.28 2.26411290 1.011089e+00 0.459677419  
## morphospecies.29 -1.68548387 -5.846774e-01 -0.580645161  
## pennate.5 2.06653226 7.573589e+00 -0.846774194  
## morphospecies.30 0.16532258 5.826613e-01 -0.080645161  
## Cosmarium.spp. 0.49193548 5.846774e-01 0.129032258  
## morphospecies.31 0.00000000 0.000000e+00 0.000000000  
## pennate.6 -2.34274194 6.028226e-01 -0.822580645  
## morphospecies.31.1 -3.32661290 -3.840726e+00 -1.177419355  
## morphospecies.32 -1.00806452 -1.471774e+00 -0.096774194  
## Scenedesmus.spp..3.1 -0.79032258 -1.024194e+00 -0.322580645  
## morphospecies.33 0.00000000 0.000000e+00 0.000000000  
## morphospecies.34 -0.09274194 -2.560484e-01 -0.016129032  
## Selenastrum.spp.. -0.07862903 -1.280242e-01 -0.008064516  
## morphospecies.35 -0.15725806 -2.560484e-01 -0.080645161  
## morphospecies.36 -2.59475806 -4.224798e+00 -1.330645161  
## morphospecies.37 -0.07862903 -1.280242e-01 -0.040322581  
## morphospecies.38 -0.07862903 -9.576613e-02 0.088709677  
## pennate.7 -0.07862903 -9.576613e-02 0.088709677  
## morphospecies.38.1 0.00000000 0.000000e+00 0.000000000  
## morphospecies.39 0.00000000 0.000000e+00 0.000000000  
## pennate.8 0.00000000 0.000000e+00 0.000000000  
## pennate.9 0.00000000 0.000000e+00 0.000000000  
## Scenedesmus.spp..2. -2.51612903 5.193548e+00 -0.774193548  
## morphospecies.40 -0.86693548 -2.627016e+00 0.112903226  
## Scenedesmus.spp.1. 11.39919355 2.153770e+02 -2.887096774  
## Cyclotella.spp... -38.85483871 -2.320161e+01 -0.516129032  
## pennate.2 16.47983871 1.122379e+01 0.693548387  
## Fragillaria.spp. 52.01814516 2.840010e+02 17.604838710  
## morphospecies.7 -13.40927419 6.464718e+00 -2.427419355  
## morphospecies.41 -5.84274194 -7.518145e+00 -0.500000000  
## Peridinium.spp... 5.42338710 3.598790e+00 1.177419355  
## morphospecies.1 17.79838710 2.612500e+01 4.129032258  
## Nitzschia.spp. -2.03225806 8.098387e+01 -1.838709677  
## morphospecies.43 -1.17943548 -1.920363e+00 -0.604838710  
## Pinnularia.spp... 2.10282258 9.465726e-01 0.717741935  
## Microcystis.spp. 46.65322581 -1.075927e+02 -12.483870968  
## Synedra.spp.. 26.66935484 -3.133065e+00 13.322580645  
## morphospecies.19 2.73790323 -3.427419e-02 0.919354839  
## morphospecies.9 -0.10080645 -4.858871e-01 0.080645161  
## Pediastrum.spp. -3.18548387 -8.705645e+00 -1.677419355  
## morphospecies.4 morphospecies.6 morphospecies.8  
## pennate.1 2.19556452 7.337701613 0  
## morphospecies.2 -2.22983871 -0.981854839 0  
## Cymbella.spp.. -0.05645161 0.028225806 0  
## Cymbella.spp.2. -0.58467742 2.195564516 0  
## Scenedesmus.spp..3 -1.59879032 9.492943548 0  
## morphospecies.3 -0.37096774 1.346774194 0  
## morphospecies.4 1.93145161 -0.707661290 0  
## morphospecies.6 -0.70766129 6.853830645 0  
## morphospecies.8 0.00000000 0.000000000 0  
## Dolichospermum.spp.. 0.01612903 -0.137096774 0  
## Tabellaria.spp.. -0.13508065 -0.690524194 0  
## morphospecies.10 -0.77419355 1.580645161 0  
## morphospecies.11 -0.02822581 -0.082661290 0  
## morphospecies.12 -0.42338710 0.663306452 0  
## morphospecies.13 -0.88911290 1.105846774 0  
## pennate.3 -1.50201613 -0.168346774 0  
## morphospecies.14 0.29032258 0.306451613 0  
## morphospecies.15 -1.34475806 -1.150201613 0  
## morphospecies.16 0.55241935 -0.002016129 0  
## Coconeis.spp. -0.39516129 2.149193548 0  
## Staurastrum.spp. 0.27419355 -0.072580645 0  
## morphospecies.17 -1.53024194 7.716733871 0  
## Selenastrum.spp... 3.06854839 -2.840725806 0  
## morphospecies.18 -0.11290323 -0.362903226 0  
## Staurastrum.spp..2 -0.02822581 -0.050403226 0  
## morphospecies.44 -0.05645161 0.350806452 0  
## morphospecies.45 -0.04233871 -0.059475806 0  
## morphospecies.20 -0.21572581 -1.295362903 0  
## morphospecies.21 -0.32258065 -0.451612903 0  
## morphospecies.22 0.12096774 -0.625000000 0  
## morphospecies.23 0.01612903 -0.169354839 0  
## pennate.4 -0.26814516 0.924395161 0  
## morphospecies.24 -0.04233871 0.101814516 0  
## morphospecies.25 -0.02822581 0.046370968 0  
## morphospecies.26 -0.01411290 0.055443548 0  
## morphospecies.27 -0.04838710 0.120967742 0  
## Asterionella.spp.. 0.46975806 2.587701613 0  
## morphospecies.28 -0.15524194 1.513104839 0  
## morphospecies.29 2.50806452 -0.318548387 0  
## pennate.5 -0.32056452 0.128024194 0  
## morphospecies.30 -0.02822581 -0.018145161 0  
## Cosmarium.spp. -0.05645161 0.479838710 0  
## morphospecies.31 0.00000000 0.000000000 0  
## pennate.6 -0.11693548 0.219758065 0  
## morphospecies.31.1 -0.42338710 2.566532258 0  
## morphospecies.32 0.15322581 0.020161290 0  
## Scenedesmus.spp..3.1 0.69354839 -0.233870968 0  
## morphospecies.33 0.00000000 0.000000000 0  
## morphospecies.34 0.35887097 -0.147177419 0  
## Selenastrum.spp.. -0.01411290 -0.073588710 0  
## morphospecies.35 -0.02822581 -0.018145161 0  
## morphospecies.36 -0.46572581 -0.299395161 0  
## morphospecies.37 -0.01411290 -0.009072581 0  
## morphospecies.38 -0.01411290 0.216733871 0  
## pennate.7 -0.01411290 0.216733871 0  
## morphospecies.38.1 0.00000000 0.000000000 0  
## morphospecies.39 0.00000000 0.000000000 0  
## pennate.8 0.00000000 0.000000000 0  
## pennate.9 0.00000000 0.000000000 0  
## Scenedesmus.spp..2. -0.45161290 -0.548387097 0  
## morphospecies.40 0.03629032 -2.614919355 0  
## Scenedesmus.spp.1. -16.56854839 30.316532258 0  
## Cyclotella.spp... 15.69354839 14.911290323 0  
## pennate.2 -1.35887097 -1.530241935 0  
## Fragillaria.spp. -37.33669355 74.539314516 0  
## morphospecies.7 8.17137097 9.623991935 0  
## morphospecies.41 2.86693548 1.889112903 0  
## Peridinium.spp... -0.44758065 3.030241935 0  
## morphospecies.1 -1.75000000 5.487903226 0  
## Nitzschia.spp. -3.70967742 8.887096774 0  
## morphospecies.43 -0.21169355 -0.136088710 0  
## Pinnularia.spp... -0.57459677 0.480846774 0  
## Microcystis.spp. 14.75000000 -55.310483871 0  
## Synedra.spp.. -0.87903226 3.326612903 0  
## morphospecies.19 -0.29435484 -0.239919355 0  
## morphospecies.9 -0.22983871 1.437500000 0  
## Pediastrum.spp. 5.23387097 -3.875000000 0  
## Dolichospermum.spp.. Tabellaria.spp..  
## pennate.1 -2.943548387 -2.174395161  
## morphospecies.2 0.338709677 -1.377016129  
## Cymbella.spp.. -0.032258065 -0.084677419  
## Cymbella.spp.2. 0.274193548 1.832661290  
## Scenedesmus.spp..3 -0.572580645 -1.704637097  
## morphospecies.3 -0.032258065 0.766129032  
## morphospecies.4 0.016129032 -0.135080645  
## morphospecies.6 -0.137096774 -0.690524194  
## morphospecies.8 0.000000000 0.000000000  
## Dolichospermum.spp.. 0.387096774 0.120967742  
## Tabellaria.spp.. 0.120967742 3.684475806  
## morphospecies.10 -0.258064516 1.645161290  
## morphospecies.11 0.112903226 -0.074596774  
## morphospecies.12 -0.241935484 -0.344758065  
## morphospecies.13 -0.411290323 0.295362903  
## pennate.3 0.330645161 -1.753024194  
## morphospecies.14 0.000000000 -0.274193548  
## morphospecies.15 -0.169354839 -0.291330645  
## morphospecies.16 -0.145161290 -0.413306452  
## Coconeis.spp. 0.322580645 -0.350806452  
## Staurastrum.spp. -0.032258065 -0.201612903  
## morphospecies.17 -0.846774194 3.882056452  
## Selenastrum.spp... -1.564516129 -4.703629032  
## morphospecies.18 0.322580645 0.024193548  
## Staurastrum.spp..2 -0.016129032 0.247983871  
## morphospecies.44 0.032258065 0.302419355  
## morphospecies.45 -0.024193548 0.242943548  
## morphospecies.20 0.250000000 -0.113911290  
## morphospecies.21 -0.032258065 -0.096774194  
## morphospecies.22 -0.129032258 -0.641129032  
## morphospecies.23 0.096774194 0.024193548  
## pennate.4 0.395161290 0.130040323  
## morphospecies.24 -0.024193548 -0.047379032  
## morphospecies.25 0.048387097 0.022177419  
## morphospecies.26 -0.008064516 -0.005040323  
## morphospecies.27 0.129032258 -0.008064516  
## Asterionella.spp.. -0.137096774 -0.150201613  
## morphospecies.28 0.491935484 0.234879032  
## morphospecies.29 -0.225806452 -0.754032258  
## pennate.5 -0.201612903 -0.093750000  
## morphospecies.30 -0.016129032 -0.010080645  
## Cosmarium.spp. 0.096774194 0.141129032  
## morphospecies.31 0.000000000 0.000000000  
## pennate.6 -0.177419355 -0.530241935  
## morphospecies.31.1 -0.241935484 -1.054435484  
## morphospecies.32 -0.096774194 -0.447580645  
## Scenedesmus.spp..3.1 -0.064516129 -0.298387097  
## morphospecies.33 0.000000000 0.000000000  
## morphospecies.34 -0.016129032 -0.010080645  
## Selenastrum.spp.. -0.008064516 -0.037298387  
## morphospecies.35 -0.016129032 -0.074596774  
## morphospecies.36 -0.266129032 -1.230846774  
## morphospecies.37 -0.008064516 -0.037298387  
## morphospecies.38 -0.008064516 -0.037298387  
## pennate.7 -0.008064516 -0.037298387  
## morphospecies.38.1 0.000000000 0.000000000  
## morphospecies.39 0.000000000 0.000000000  
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## morphospecies.12 4.93548387 -0.060483871 4.770161290  
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## pennate.3 10.45161290 0.550403226 8.449596774  
## morphospecies.14 0.41935484 -0.032258065 0.096774194  
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## pennate.3 1.62802419 27.35383065 -0.20967742  
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## pennate.7 -0.06350806 -0.04737903 -0.01612903  
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## pennate.5 -0.201612903 -2.847782e+00 -3.67943548  
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## morphospecies.32 0.032258065 9.556452e-01 10.36290323  
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## morphospecies.39 0.000000000 0.000000e+00 0.00000000  
## pennate.8 0.000000000 0.000000e+00 0.00000000  
## pennate.9 0.000000000 0.000000e+00 0.00000000  
## Scenedesmus.spp..2. -0.258064516 -3.645161e+00 -6.51612903  
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## Cyclotella.spp... 5.354838710 5.765323e+01 231.17741935  
## pennate.2 -2.177419355 -2.577218e+01 -60.35080645  
## Fragillaria.spp. -13.427419355 -2.046875e+01 -185.30846774  
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## morphospecies.41 0.241935484 8.034274e+00 26.13306452  
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## Staurastrum.spp..2 0.016129032 0.060483871 0.024193548  
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## morphospecies.20 0.056451613 0.135080645 -0.116935484  
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## morphospecies.26 -0.008064516 -0.002016129 0.028225806  
## morphospecies.27 -0.064516129 -0.016129032 0.032258065  
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## morphospecies.29 -0.225806452 -0.056451613 0.048387097  
## pennate.5 -0.201612903 -0.050403226 -0.068548387  
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## morphospecies.32 -0.096774194 -0.024193548 -0.048387097  
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## morphospecies.38 -0.008064516 -0.002016129 -0.004032258  
## pennate.7 -0.008064516 -0.002016129 -0.004032258  
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## morphospecies.39 0.000000000 0.000000000 0.000000000  
## pennate.8 0.000000000 0.000000000 0.000000000  
## pennate.9 0.000000000 0.000000000 0.000000000  
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## morphospecies.23 0.41935484 0.322580645 -0.120967742  
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## pennate.7 -0.01209677 0.024193548 -0.019153226  
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## morphospecies.39 0.00000000 0.000000000 0.000000000  
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## morphospecies.41 3.83064516 -0.080645161 -1.187500000  
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## Synedra.spp.. 6.50000000 -1.000000000 7.012096774  
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## morphospecies.9 1.28225806 -0.209677419 0.006048387  
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## morphospecies.2 -0.477822581 -0.318548387 0.872983871  
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## Cymbella.spp.2. -0.300403226 0.326612903 0.147177419  
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## pennate.7 -0.008064516 -0.017137097 -0.01108871  
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## morphospecies.39 0.000000000 0.000000000 0.00000000  
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## Synedra.spp.. 4.000000000 4.423387097 5.97983871  
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## Synedra.spp.. 1.435483871 0 2.25000000  
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## morphospecies.31.1 morphospecies.32  
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## Cymbella.spp.2. -3.32661290 -1.00806452  
## Scenedesmus.spp..3 -3.84072581 -1.47177419  
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## morphospecies.6 2.56653226 0.02016129  
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## Tabellaria.spp.. -1.05443548 -0.44758065  
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## morphospecies.26 -0.03024194 -0.01209677  
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## Fragillaria.spp. -25.99798387 -15.10887097  
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## Tabellaria.spp.. -0.298387097 0  
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## morphospecies.12 -0.241935484 0  
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## morphospecies.14 0.193548387 0  
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## Staurastrum.spp..2 -0.016129032 0  
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## morphospecies.45 -0.024193548 0  
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## morphospecies.22 0.483870968 0  
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## morphospecies.27 -0.064516129 0  
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## morphospecies.29 2.677419355 0  
## pennate.5 -0.201612903 0  
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## Selenastrum.spp.. -0.008064516 0  
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## morphospecies.37 0.088709677 0  
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## morphospecies.32 0.052419355 0 0  
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## pennate.7 0.031250000 0 0  
## morphospecies.38.1 0.000000000 0 0  
## morphospecies.39 0.000000000 0 0  
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## pennate.9 0.000000000 0 0  
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## Cyclotella.spp... 1.846774194 0 0  
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## Fragillaria.spp. -1.646169355 0 0  
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## morphospecies.41 0.356854839 0 0  
## Peridinium.spp... -0.050403226 0 0  
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## Nitzschia.spp. -0.274193548 0 0  
## morphospecies.43 -0.015120968 0 0  
## Pinnularia.spp... -0.043346774 0 0  
## Microcystis.spp. -2.504032258 0 0  
## Synedra.spp.. -0.125000000 0 0  
## morphospecies.19 -0.030241935 0 0  
## morphospecies.9 -0.062500000 0 0  
## Pediastrum.spp. -0.068548387 0 0  
## pennate.8 pennate.9 Scenedesmus.spp..2.  
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## morphospecies.4 0 0 -0.45161290  
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## morphospecies.8 0 0 0.00000000  
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## Tabellaria.spp.. 0 0 -1.19354839  
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## morphospecies.11 0 0 -0.06451613  
## morphospecies.12 0 0 -0.19354839  
## morphospecies.13 0 0 0.80645161  
## pennate.3 0 0 0.54838710  
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## morphospecies.16 0 0 -0.58064516  
## Coconeis.spp. 0 0 -0.64516129  
## Staurastrum.spp. 0 0 -0.25806452  
## morphospecies.17 0 0 -3.64516129  
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## morphospecies.26 0 0 -0.03225806  
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## Scenedesmus.spp..3 -2.62701613 215.3770161 -2.320161e+01  
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## morphospecies.4 0.03629032 -16.5685484 1.569355e+01  
## morphospecies.6 -2.61491935 30.3165323 1.491129e+01  
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## Tabellaria.spp.. 10.71572581 4.1149194 -6.088710e+00  
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## morphospecies.12 0.48790323 33.3346774 -1.758065e+00  
## morphospecies.13 -4.23991935 28.2802419 7.338710e-01  
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## morphospecies.45 0.78427419 3.1270161 4.758065e-01  
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## Fragillaria.spp. 117.85282258 2027.6875000 -3.563468e+02  
## morphospecies.7 -4.59072581 75.0987903 2.425887e+02  
## morphospecies.41 0.19758065 -79.6008065 1.058226e+02  
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## Pinnularia.spp... -3.36088710 11.6915323 -1.281452e+01  
## Microcystis.spp. -94.62096774 -333.1532258 -7.794516e+02  
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## morphospecies.9 -2.12500000 -21.5040323 4.080645e+00  
## Pediastrum.spp. -9.75000000 -77.7983871 1.132258e+01  
## pennate.2 Fragillaria.spp. morphospecies.7  
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## Scenedesmus.spp..3 11.22379032 284.0010081 6.46471774  
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## morphospecies.6 -1.53024194 74.5393145 9.62399194  
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## Tabellaria.spp.. 5.71975806 46.4788306 -5.90423387  
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## Staurastrum.spp..2 0.26209677 2.1270161 -1.44556452  
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## morphospecies.37 -0.35282258 -0.5171371 0.37399194  
## morphospecies.38 -0.35282258 -1.6461694 0.69657258  
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## pennate.8 0.00000000 0.0000000 0.00000000  
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## Peridinium.spp... 13.77822581 76.4657258 0.76411290  
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## Nitzschia.spp. 66.19354839 859.1774194 44.79032258  
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## Microcystis.spp. 106.10483871 -4440.2459677 -206.16532258  
## Synedra.spp.. 16.37903226 134.6814516 3.11693548  
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## morphospecies.32 3.70161290 -0.54032258 -2.725806452  
## Scenedesmus.spp..3.1 4.01612903 -0.24193548 -1.806451613  
## morphospecies.33 0.00000000 0.00000000 0.000000000  
## morphospecies.34 -0.06048387 -0.10080645 -0.379032258  
## Selenastrum.spp.. 0.16330645 -0.05040323 -0.157258065  
## morphospecies.35 0.52016129 -0.10080645 -0.572580645  
## morphospecies.36 8.58266129 -1.66330645 -9.447580645  
## morphospecies.37 0.26008065 -0.05040323 -0.286290323  
## morphospecies.38 0.35685484 -0.05040323 -0.286290323  
## pennate.7 0.35685484 -0.05040323 -0.286290323  
## morphospecies.38.1 0.00000000 0.00000000 0.000000000  
## morphospecies.39 0.00000000 0.00000000 0.000000000  
## pennate.8 0.00000000 0.00000000 0.000000000  
## pennate.9 0.00000000 0.00000000 0.000000000  
## Scenedesmus.spp..2. -2.00000000 -1.35483871 -4.000000000  
## morphospecies.40 0.19758065 -3.16532258 2.750000000  
## Scenedesmus.spp.1. -79.60080645 63.40725806 348.508064516  
## Cyclotella.spp... 105.82258065 -13.20967742 -81.677419355  
## pennate.2 -18.84274194 13.77822581 61.314516129  
## Fragillaria.spp. -107.54637097 76.46572581 314.294354839  
## morphospecies.7 49.47782258 0.76411290 11.826612903  
## morphospecies.41 23.73790323 -2.41532258 -14.556451613  
## Peridinium.spp... -2.41532258 6.44758065 14.911290323  
## morphospecies.1 -14.55645161 14.91129032 117.338709677  
## Nitzschia.spp. -17.00000000 6.38709677 66.129032258  
## morphospecies.43 3.90120968 -0.75604839 -4.294354839  
## Pinnularia.spp... -2.46169355 1.89717742 7.302419355  
## Microcystis.spp. -69.31451613 4.50806452 81.822580645  
## Synedra.spp.. -3.52419355 12.94354839 67.112903226  
## morphospecies.19 -1.87500000 1.58467742 11.346774194  
## morphospecies.9 -0.16532258 0.45564516 -3.072580645  
## Pediastrum.spp. -2.99193548 -2.29838710 -16.241935484  
## Nitzschia.spp. morphospecies.43 Pinnularia.spp...  
## pennate.1 32.59677419 14.86391129 -6.744959677  
## morphospecies.2 57.06451613 -2.38911290 -0.235887097  
## Cymbella.spp.. 0.00000000 -0.06048387 -0.012096774  
## Cymbella.spp.2. -2.03225806 -1.17943548 2.102822581  
## Scenedesmus.spp..3 80.98387097 -1.92036290 0.946572581  
## morphospecies.3 -1.83870968 -0.60483871 0.717741935  
## morphospecies.4 -3.70967742 -0.21169355 -0.574596774  
## morphospecies.6 8.88709677 -0.13608871 0.480846774  
## morphospecies.8 0.00000000 0.00000000 0.000000000  
## Dolichospermum.spp.. -1.51612903 -0.12096774 0.008064516  
## Tabellaria.spp.. 1.59677419 -0.55947581 -0.281250000  
## morphospecies.10 -0.03225806 -0.96774194 0.000000000  
## morphospecies.11 -0.54838710 -0.03024194 0.042338710  
## morphospecies.12 12.19354839 -0.45362903 -0.139112903  
## morphospecies.13 3.33870968 0.98286290 -1.214717742  
## pennate.3 -1.56451613 -1.67842742 -1.134072581  
## morphospecies.14 -1.87096774 -0.24193548 0.629032258  
## morphospecies.15 28.75806452 -1.64818548 -0.176411290  
## morphospecies.16 -4.67741935 -0.27217742 -0.489919355  
## Coconeis.spp. 2.83870968 -0.66532258 1.060483871  
## Staurastrum.spp. -2.06451613 -0.12096774 -0.217741935  
## morphospecies.17 -23.46774194 -1.70866935 -0.317540323  
## Selenastrum.spp... -45.58064516 13.27620968 -5.909274194  
## morphospecies.18 -1.90322581 -0.12096774 0.233870968  
## Staurastrum.spp..2 -0.29032258 -0.03024194 -0.086693548  
## morphospecies.44 0.00000000 -0.06048387 0.116935484  
## morphospecies.45 1.20967742 -0.04536290 0.095766129  
## morphospecies.20 -7.01612903 -0.43850806 -0.031250000  
## morphospecies.21 -8.06451613 0.48387097 1.419354839  
## morphospecies.22 -9.19354839 0.30241935 0.834677419  
## morphospecies.23 -1.96774194 -0.12096774 0.201612903  
## pennate.4 -0.20967742 -0.28729839 0.918346774  
## morphospecies.24 -0.82258065 0.43850806 -0.130040323  
## morphospecies.25 0.35483871 -0.03024194 0.074596774  
## morphospecies.26 0.08064516 -0.01512097 -0.011088710  
## morphospecies.27 -1.22580645 -0.12096774 0.137096774  
## Asterionella.spp.. -1.30645161 -0.25705645 1.359879032  
## morphospecies.28 -0.46774194 -0.16633065 0.716733871  
## morphospecies.29 2.12903226 -0.42338710 -0.794354839  
## pennate.5 4.08064516 -0.37802419 2.432459677  
## morphospecies.30 0.09677419 -0.03024194 0.235887097  
## Cosmarium.spp. 1.25806452 -0.06048387 0.245967742  
## morphospecies.31 0.00000000 0.00000000 0.000000000  
## pennate.6 16.12903226 -0.33266129 0.046370968  
## morphospecies.31.1 -8.22580645 -0.45362903 -1.300403226  
## morphospecies.32 -3.29032258 1.75403226 -0.391129032  
## Scenedesmus.spp..3.1 -2.19354839 1.33064516 -0.346774194  
## morphospecies.33 0.00000000 0.00000000 0.000000000  
## morphospecies.34 -0.54838710 -0.03024194 -0.086693548  
## Selenastrum.spp.. -0.27419355 -0.01512097 -0.011088710  
## morphospecies.35 -0.54838710 0.93750000 -0.086693548  
## morphospecies.36 -9.04838710 15.46875000 -1.430443548  
## morphospecies.37 -0.27419355 0.46875000 -0.043346774  
## morphospecies.38 -0.27419355 -0.01512097 -0.043346774  
## pennate.7 -0.27419355 -0.01512097 -0.043346774  
## morphospecies.38.1 0.00000000 0.00000000 0.000000000  
## morphospecies.39 0.00000000 0.00000000 0.000000000  
## pennate.8 0.00000000 0.00000000 0.000000000  
## pennate.9 0.00000000 0.00000000 0.000000000  
## Scenedesmus.spp..2. 30.70967742 -0.48387097 -1.387096774  
## morphospecies.40 9.09677419 -0.27217742 -3.360887097  
## Scenedesmus.spp.1. 650.19354839 -16.78427419 11.691532258  
## Cyclotella.spp... -25.06451613 28.66935484 -12.814516129  
## pennate.2 66.19354839 -5.29233871 1.667338710  
## Fragillaria.spp. 859.17741935 -7.75705645 37.150201613  
## morphospecies.7 44.79032258 5.60987903 -5.950604839  
## morphospecies.41 -17.00000000 3.90120968 -2.461693548  
## Peridinium.spp... 6.38709677 -0.75604839 1.897177419  
## morphospecies.1 66.12903226 -4.29435484 7.302419355  
## Nitzschia.spp. 260.83870968 -4.11290323 0.790322581  
## morphospecies.43 -4.11290323 7.03125000 -0.650201613  
## Pinnularia.spp... 0.79032258 -0.65020161 3.265120968  
## Microcystis.spp. -303.19354839 -38.52822581 11.552419355  
## Synedra.spp.. -9.19354839 -1.39112903 10.915322581  
## morphospecies.19 -4.06451613 -0.45362903 0.506048387  
## morphospecies.9 -4.58064516 0.03024194 0.538306452  
## Pediastrum.spp. -18.64516129 -1.02822581 -0.657258065  
## Microcystis.spp. Synedra.spp.. morphospecies.19  
## pennate.1 -3.847298e+02 -29.18951613 -8.885080645  
## morphospecies.2 -8.763710e+01 -26.00806452 -0.326612903  
## Cymbella.spp.. 2.919355e+00 -0.91935484 -0.024193548  
## Cymbella.spp.2. 4.665323e+01 26.66935484 2.737903226  
## Scenedesmus.spp..3 -1.075927e+02 -3.13306452 -0.034274194  
## morphospecies.3 -1.248387e+01 13.32258065 0.919354839  
## morphospecies.4 1.475000e+01 -0.87903226 -0.294354839  
## morphospecies.6 -5.531048e+01 3.32661290 -0.239919355  
## morphospecies.8 0.000000e+00 0.00000000 0.000000000  
## Dolichospermum.spp.. 3.870968e-01 -0.77419355 -0.112903226  
## Tabellaria.spp.. -1.739113e+01 2.53629032 0.106854839  
## morphospecies.10 -7.548387e+00 -3.03225806 -0.903225806  
## morphospecies.11 -7.137097e+00 -1.02419355 -0.060483871  
## morphospecies.12 -2.121774e+01 -5.42741935 -0.907258065  
## morphospecies.13 -1.495968e+00 -8.77822581 -0.582661290  
## pennate.3 -2.265726e+01 -25.48790323 -1.453629032  
## morphospecies.14 1.377419e+01 1.00000000 -0.064516129  
## morphospecies.15 7.886694e+01 -9.14112903 -0.006048387  
## morphospecies.16 7.217742e+00 -3.70161290 -0.544354839  
## Coconeis.spp. 2.969355e+01 15.79032258 2.024193548  
## Staurastrum.spp. -7.645161e+00 -0.16129032 -0.241935484  
## morphospecies.17 -1.895363e+02 -8.41532258 -2.578629032  
## Selenastrum.spp... -4.410403e+02 39.23387097 -4.737903226  
## morphospecies.18 -2.103226e+01 -3.03225806 -0.209677419  
## Staurastrum.spp..2 -1.911290e+00 -0.44354839 -0.060483871  
## morphospecies.44 -3.048387e+00 0.88709677 0.040322581  
## morphospecies.45 -4.576613e+00 0.52822581 0.070564516  
## morphospecies.20 3.977016e+01 -6.65725806 -0.328629032  
## morphospecies.21 1.029032e+01 0.35483871 -0.096774194  
## morphospecies.22 -3.725806e+00 6.50000000 0.282258065  
## morphospecies.23 1.119355e+01 -1.00000000 -0.048387097  
## pennate.4 1.068548e+00 7.01209677 0.522177419  
## morphospecies.24 -4.479839e+00 -0.24596774 -0.090725806  
## morphospecies.25 3.250000e+00 0.42741935 -0.028225806  
## morphospecies.26 -5.241935e-02 -0.12500000 0.066532258  
## morphospecies.27 1.138710e+01 4.00000000 0.435483871  
## Asterionella.spp.. 5.495968e+00 4.42338710 -0.094758065  
## morphospecies.28 8.104839e-01 5.97983871 0.022177419  
## morphospecies.29 1.485484e+01 -4.46774194 -0.362903226  
## pennate.5 1.091532e+01 7.13306452 2.856854839  
## morphospecies.30 1.185484e+00 0.65322581 0.262096774  
## Cosmarium.spp. -1.338710e+00 1.43548387 -0.024193548  
## morphospecies.31 0.000000e+00 0.00000000 0.000000000  
## pennate.6 -4.663710e+01 2.25000000 -0.665322581  
## morphospecies.31.1 -8.647581e+01 -0.04032258 -0.907258065  
## morphospecies.32 -2.559677e+01 1.27419355 -0.362903226  
## Scenedesmus.spp..3.1 -7.096774e-01 -1.38709677 -0.241935484  
## morphospecies.33 0.000000e+00 0.00000000 0.000000000  
## morphospecies.34 2.419355e-02 0.20161290 -0.060483871  
## Selenastrum.spp.. -3.278226e+00 0.58467742 -0.030241935  
## morphospecies.35 -5.137097e+00 -0.18548387 -0.060483871  
## morphospecies.36 -8.476210e+01 -3.06048387 -0.997983871  
## morphospecies.37 -2.568548e+00 -0.09274194 -0.030241935  
## morphospecies.38 -2.504032e+00 -0.12500000 -0.030241935  
## pennate.7 -2.504032e+00 -0.12500000 -0.030241935  
## morphospecies.38.1 0.000000e+00 0.00000000 0.000000000  
## morphospecies.39 0.000000e+00 0.00000000 0.000000000  
## pennate.8 0.000000e+00 0.00000000 0.000000000  
## pennate.9 0.000000e+00 0.00000000 0.000000000  
## Scenedesmus.spp..2. -4.890323e+01 -13.54838710 -0.967741935  
## morphospecies.40 -9.462097e+01 -26.41129032 -3.737903226  
## Scenedesmus.spp.1. -3.331532e+02 -59.91129032 3.689516129  
## Cyclotella.spp... -7.794516e+02 7.45161290 -14.500000000  
## pennate.2 1.061048e+02 16.37903226 7.512096774  
## Fragillaria.spp. -4.440246e+03 134.68145161 -36.772177419  
## morphospecies.7 -2.061653e+02 3.11693548 -3.264112903  
## morphospecies.41 -6.931452e+01 -3.52419355 -1.875000000  
## Peridinium.spp... 4.508065e+00 12.94354839 1.584677419  
## morphospecies.1 8.182258e+01 67.11290323 11.346774194  
## Nitzschia.spp. -3.031935e+02 -9.19354839 -4.064516129  
## morphospecies.43 -3.852823e+01 -1.39112903 -0.453629032  
## Pinnularia.spp... 1.155242e+01 10.91532258 0.506048387  
## Microcystis.spp. 4.486629e+03 -68.20967742 42.556451613  
## Synedra.spp.. -6.820968e+01 194.82258065 15.153225806  
## morphospecies.19 4.255645e+01 15.15322581 4.254032258  
## morphospecies.9 -8.443548e+00 1.25000000 -0.520161290  
## Pediastrum.spp. -1.277903e+02 -14.11290323 -2.056451613  
## morphospecies.9 Pediastrum.spp.  
## pennate.1 7.050403226 -5.68145161  
## morphospecies.2 -3.810483871 11.78225806  
## Cymbella.spp.. -0.024193548 -0.27419355  
## Cymbella.spp.2. -0.100806452 -3.18548387  
## Scenedesmus.spp..3 -0.485887097 -8.70564516  
## morphospecies.3 0.080645161 -1.67741935  
## morphospecies.4 -0.229838710 5.23387097  
## morphospecies.6 1.437500000 -3.87500000  
## morphospecies.8 0.000000000 0.00000000  
## Dolichospermum.spp.. -0.209677419 1.70967742  
## Tabellaria.spp.. 0.429435484 -1.50403226  
## morphospecies.10 0.580645161 -4.38709677  
## morphospecies.11 -0.060483871 2.12096774  
## morphospecies.12 -0.197580645 -2.05645161  
## morphospecies.13 5.997983871 -4.31854839  
## pennate.3 -1.905241935 5.97177419  
## morphospecies.14 0.258064516 -0.03225806  
## morphospecies.15 -1.812500000 -7.47177419  
## morphospecies.16 1.068548387 -1.20161290  
## Coconeis.spp. -0.233870968 -3.01612903  
## Staurastrum.spp. 0.112903226 1.54838710  
## morphospecies.17 -1.481854839 -7.74596774  
## Selenastrum.spp... 6.875000000 19.79838710  
## morphospecies.18 -0.145161290 6.22580645  
## Staurastrum.spp..2 0.004032258 -0.13709677  
## morphospecies.44 0.169354839 -0.27419355  
## morphospecies.45 0.102822581 -0.20564516  
## morphospecies.20 -0.812500000 -0.85887097  
## morphospecies.21 -0.161290323 -2.16129032  
## morphospecies.22 1.282258065 -2.85483871  
## morphospecies.23 -0.209677419 -0.54838710  
## pennate.4 0.006048387 -0.17338710  
## morphospecies.24 0.360887097 -0.20564516  
## morphospecies.25 0.004032258 -0.13709677  
## morphospecies.26 -0.030241935 -0.06854839  
## morphospecies.27 -0.306451613 -0.54838710  
## Asterionella.spp.. 2.066532258 0.89919355  
## morphospecies.28 0.344758065 -0.75403226  
## morphospecies.29 -0.782258065 -1.91935484  
## pennate.5 1.243951613 -1.71370968  
## morphospecies.30 0.133064516 -0.13709677  
## Cosmarium.spp. 0.104838710 -0.27419355  
## morphospecies.31 0.000000000 0.00000000  
## pennate.6 0.270161290 -0.44354839  
## morphospecies.31.1 2.221774194 -2.05645161  
## morphospecies.32 -0.040322581 -0.69354839  
## Scenedesmus.spp..3.1 -0.145161290 -0.54838710  
## morphospecies.33 0.000000000 0.00000000  
## morphospecies.34 0.004032258 1.92741935  
## Selenastrum.spp.. 0.034274194 -0.03629032  
## morphospecies.35 0.004032258 -0.13709677  
## morphospecies.36 0.066532258 -2.26209677  
## morphospecies.37 0.002016129 -0.06854839  
## morphospecies.38 -0.062500000 -0.06854839  
## pennate.7 -0.062500000 -0.06854839  
## morphospecies.38.1 0.000000000 0.00000000  
## morphospecies.39 0.000000000 0.00000000  
## pennate.8 0.000000000 0.00000000  
## pennate.9 0.000000000 0.00000000  
## Scenedesmus.spp..2. -0.967741935 -2.19354839  
## morphospecies.40 -2.125000000 -9.75000000  
## Scenedesmus.spp.1. -21.504032258 -77.79838710  
## Cyclotella.spp... 4.080645161 11.32258065  
## pennate.2 -3.778225806 -10.63709677  
## Fragillaria.spp. -17.223790323 321.18951613  
## morphospecies.7 1.219758065 -18.66532258  
## morphospecies.41 -0.165322581 -2.99193548  
## Peridinium.spp... 0.455645161 -2.29838710  
## morphospecies.1 -3.072580645 -16.24193548  
## Nitzschia.spp. -4.580645161 -18.64516129  
## morphospecies.43 0.030241935 -1.02822581  
## Pinnularia.spp... 0.538306452 -0.65725806  
## Microcystis.spp. -8.443548387 -127.79032258  
## Synedra.spp.. 1.250000000 -14.11290323  
## morphospecies.19 -0.520161290 -2.05645161  
## morphospecies.9 4.834677419 -0.95967742  
## Pediastrum.spp. -0.959677419 67.91935484

# Eigen analysis with R base functions  
ford.eigen=eigen(ford.cov)  
ford.eigen

## eigen() decomposition  
## $values  
## [1] 1.419418e+04 3.575197e+03 2.251520e+03 4.492760e+02 2.779117e+02  
## [6] 1.709184e+02 1.603520e+02 1.205462e+02 9.202290e+01 7.760889e+01  
## [11] 6.719583e+01 4.131001e+01 4.047256e+01 3.154241e+01 2.872785e+01  
## [16] 2.547210e+01 2.075938e+01 1.843364e+01 1.415263e+01 1.107293e+01  
## [21] 7.744505e+00 7.505492e+00 5.465840e+00 4.398346e+00 3.751381e+00  
## [26] 2.051689e+00 1.486248e+00 1.133885e+00 6.714918e-01 3.699174e-01  
## [31] 1.801750e-12 5.012229e-14 4.778428e-14 4.020684e-14 3.698064e-14  
## [36] 3.452684e-14 3.267760e-14 2.134464e-14 2.117357e-14 1.938620e-14  
## [41] 1.141000e-14 7.207245e-15 5.728685e-15 5.258041e-15 4.812320e-15  
## [46] 2.938137e-15 1.719555e-15 1.637502e-15 8.787478e-16 1.419980e-16  
## [51] 1.006244e-16 6.255884e-17 5.090681e-17 4.467208e-17 4.104552e-17  
## [56] 3.762422e-17 3.475175e-17 2.876059e-17 2.547364e-17 8.496135e-18  
## [61] 4.488007e-32 -4.796156e-32 -2.414593e-17 -2.480778e-17 -5.169234e-17  
## [66] -7.926801e-17 -1.501007e-16 -3.852568e-15 -4.682598e-15 -1.461907e-14  
## [71] -1.462794e-14 -1.542554e-14 -6.744091e-14 -7.760750e-14 -1.252176e-13  
## [76] -2.379625e-13 -5.381073e-13  
##   
## $vectors  
## [,1] [,2] [,3] [,4]  
## [1,] -6.274031e-03 -9.921426e-02 -1.589846e-01 -1.888249e-01  
## [2,] -2.740351e-02 6.545603e-02 -8.085229e-02 1.300402e-02  
## [3,] 4.540329e-04 8.562919e-04 -1.012552e-03 4.473959e-03  
## [4,] -2.091528e-03 1.890512e-02 2.150295e-02 1.953449e-02  
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## [73,] 1.202659e-02 1.778533e-02 0.0059386057 -0.020107409 0.024634271  
## [74,] 5.255389e-02 7.987869e-02 0.0580358983 -0.052003776 0.001423021  
## [75,] -9.138069e-02 1.837285e-01 -0.0676133218 0.031665286 -0.163186808  
## [76,] -1.250778e-01 2.638048e-01 0.0575398913 -0.220904465 -0.071602277  
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## [8,] 0.197259303 0.0447704077 -3.943276e-01 -0.0752601641 -0.025505216  
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## [37,] 3.153319e-03 1.193820e-02 1.070700e-02 -0.191081286 -3.811782e-01  
## [38,] 1.112975e-01 3.322656e-02 -1.831998e-01 0.108791301 -2.039095e-01  
## [39,] 9.721822e-03 4.392944e-03 -4.922734e-02 0.007255741 -1.180613e-01  
## [40,] 6.175943e-03 2.014076e-02 -2.885222e-02 0.030359674 -5.439581e-02  
## [41,] -5.764006e-02 -9.691945e-02 -7.438017e-02 0.001555210 -5.368487e-02  
## [42,] -1.116216e-01 3.684248e-02 3.094458e-02 0.156930930 -1.080655e-01  
## [43,] 6.119749e-01 -4.097215e-01 -1.693246e-01 0.009976703 4.766977e-02  
## [44,] -8.633574e-03 -4.171665e-03 -5.500985e-02 -0.121224627 -1.923748e-01  
## [45,] 3.468726e-03 -7.269006e-03 -3.374043e-02 -0.099575233 -4.294325e-02  
## [46,] 1.484197e-01 -5.320056e-02 -2.425941e-01 -0.042861205 -5.456343e-02  
## [47,] -7.799307e-02 -9.573363e-02 -2.643437e-01 0.238713996 -3.452980e-03  
## [48,] -4.887416e-02 -4.459624e-01 8.222507e-02 -0.003098716 -1.558365e-04  
## [49,] 8.230713e-03 -2.187926e-01 1.683948e-01 0.133838591 -3.728351e-02  
## [50,] -1.499726e-01 -1.607683e-01 -8.502458e-02 -0.089187615 -1.123206e-01  
## [51,] -5.307600e-02 -3.310545e-01 8.223817e-02 0.071012721 7.433464e-02  
## [52,] -8.485785e-03 -2.750080e-03 2.311907e-02 -0.224643543 2.706137e-02  
## [53,] -1.919909e-01 -9.267402e-02 -1.593733e-01 0.024163413 1.235457e-02  
## [54,] -8.160253e-02 -5.277011e-02 -2.417200e-01 -0.071903681 -9.550501e-02  
## [55,] -2.316146e-01 -3.622871e-01 -2.225582e-01 -0.060215681 -9.781682e-02  
## [56,] 7.752080e-02 -1.718131e-01 2.703826e-01 0.000000000 0.000000e+00  
## [57,] 2.225021e-01 4.702868e-01 1.761351e-03 0.000000000 0.000000e+00  
## [58,] 2.789435e-15 -1.412065e-15 2.498002e-16 0.000000000 0.000000e+00  
## [59,] 2.650657e-15 -1.790235e-15 6.140921e-16 0.000000000 0.000000e+00  
## [60,] -3.234990e-03 4.669135e-03 3.229194e-02 -0.021472289 -7.176659e-02  
## [61,] -7.287193e-03 -1.690351e-04 1.616202e-02 -0.047289127 1.640722e-02  
## [62,] -1.661616e-03 7.538134e-04 -1.327782e-03 -0.006140552 -2.346684e-02  
## [63,] 1.292686e-03 2.658247e-03 1.897140e-02 0.058277806 3.545180e-02  
## [64,] 6.155705e-03 2.647336e-03 7.438078e-03 0.001738831 -6.200938e-02  
## [65,] 1.743326e-04 7.191793e-05 2.960590e-03 -0.003458567 -6.304434e-03  
## [66,] -3.019203e-03 -8.261850e-04 1.634332e-02 -0.018084857 8.016757e-05  
## [67,] -4.867902e-03 1.942655e-02 1.679908e-02 -0.161382970 -1.122276e-01  
## [68,] 2.186378e-02 -1.679135e-02 3.488841e-03 -0.022912135 2.814603e-01  
## [69,] 6.372357e-03 -3.324156e-03 -2.568072e-02 0.052699014 6.209225e-02  
## [70,] 3.673525e-03 -1.911686e-03 -7.175871e-03 -0.036061204 5.473304e-02  
## [71,] 1.688585e-02 6.373993e-02 -5.499206e-02 0.171390164 -1.576913e-01  
## [72,] -1.161731e-02 -6.115035e-03 1.798981e-01 -0.122311850 2.233951e-01  
## [73,] 1.490022e-03 9.723006e-04 3.398276e-03 -0.016144356 -1.712461e-02  
## [74,] -1.244762e-03 5.284715e-03 -1.415771e-02 -0.015187364 -5.886583e-02  
## [75,] -2.597538e-02 -1.209915e-02 1.193180e-01 -0.039537714 8.494198e-02  
## [76,] -4.039729e-02 -1.152363e-02 -6.429239e-02 0.073364457 3.240939e-01  
## [77,] 5.172360e-03 3.531480e-03 -3.572180e-02 -0.079926133 -5.322542e-02  
## [,70] [,71] [,72] [,73] [,74]  
## [1,] 0.000000e+00 0.0000000000 0.000000000 0.0000000000 0.0000000000  
## [2,] -2.349129e-02 -0.0723500290 -0.004587308 -0.0166416948 0.0749154263  
## [3,] -1.989445e-02 0.0649876890 0.018563422 -0.0904285703 -0.0181277112  
## [4,] 3.639954e-02 -0.0450477733 -0.003154809 -0.1376521379 -0.0282651511  
## [5,] -4.139284e-04 -0.0742514542 -0.121374102 -0.0655677077 0.0172218232  
## [6,] -4.907710e-02 0.3281312943 -0.085150990 0.0595587970 -0.0005230508  
## [7,] -2.908880e-01 0.0923518185 -0.169200102 0.1017580881 0.3001443480  
## [8,] -9.331173e-02 0.2143821248 0.129578681 0.1868873997 0.0456191679  
## [9,] -2.141016e-01 -0.2060338986 0.018060912 -0.3527283882 0.2263253599  
## [10,] 3.397838e-02 0.1902979819 0.040686687 -0.0278780111 0.0699890099  
## [11,] -1.307415e-01 0.0439857168 0.013054848 0.1845991612 -0.0323202878  
## [12,] -1.289210e-01 0.1205794012 0.226632114 0.1817829607 -0.0133912660  
## [13,] -1.030289e-01 -0.0474008909 0.005755086 -0.1854127602 -0.7192566714  
## [14,] 2.081638e-01 0.3938736909 0.012581459 -0.2548729332 0.2715322976  
## [15,] -6.184576e-02 0.0049188093 0.053934127 0.0183722992 -0.0236225603  
## [16,] -5.533841e-02 -0.1670946490 -0.033709259 0.1157519260 -0.1087503113  
## [17,] 9.603726e-02 0.0009075085 0.104875925 0.3755340806 -0.0848343032  
## [18,] -5.783861e-02 -0.0379147735 -0.079897611 -0.0139506655 0.0327808115  
## [19,] 1.538502e-01 0.1472484562 -0.152243220 -0.2207590219 -0.0766848046  
## [20,] -6.624731e-02 -0.2470657962 0.058322057 0.0198274860 0.0799801765  
## [21,] -2.993656e-02 -0.1083033189 0.041225077 0.2613613168 -0.0790416671  
## [22,] -1.785245e-03 0.0328160796 -0.093096343 -0.0056248314 -0.0730503237  
## [23,] -1.923870e-02 0.0814851607 -0.044295079 0.0052106608 -0.0175642061  
## [24,] 1.710326e-01 -0.1863608712 0.017463711 0.0235458726 0.2295048009  
## [25,] -2.329272e-01 -0.3447870345 0.102369773 -0.2310177642 0.0739614557  
## [26,] -1.192017e-01 0.1113783614 -0.437491063 0.2657867763 0.0145327252  
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## [30,] -2.545154e-01 0.0117688618 0.111168357 -0.0183411665 -0.0460010325  
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## [32,] 2.109683e-01 -0.0166838070 0.309932825 -0.0530651103 0.0793118658  
## [33,] 5.036463e-02 -0.0184115395 0.100244202 0.0232435947 0.0413800149  
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## [36,] -2.672164e-02 -0.0176700732 0.134939152 0.0208294435 -0.0682000586  
## [37,] -3.455745e-02 -0.0103465544 -0.011946262 -0.1871584105 -0.0260265284  
## [38,] -1.678723e-01 -0.0346466873 0.028037038 -0.1599816635 0.0215436379  
## [39,] 6.695668e-02 0.0500297110 0.181241671 0.1292947970 -0.1050309084  
## [40,] -1.061014e-02 0.1530666512 -0.006505502 0.0360698628 -0.0020860679  
## [41,] -1.820949e-02 0.0126207745 -0.011819686 0.0097072438 0.0069780239  
## [42,] -7.970685e-02 -0.0204912837 -0.019759760 -0.0437325592 0.0119469328  
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## [44,] -5.652164e-02 0.0615854842 -0.178525108 -0.0590589288 -0.0639796195  
## [45,] 5.084662e-02 0.0234016864 -0.029067500 -0.0085444976 -0.0328482376  
## [46,] 1.510171e-01 0.0078853753 0.121072892 -0.0007585051 0.0165987569  
## [47,] -2.360375e-01 0.0445971479 -0.240097217 -0.0458896329 -0.1281780130  
## [48,] 7.840574e-04 0.0000000000 -0.001142676 0.0000000000 0.0000000000  
## [49,] -8.920288e-02 -0.0086619913 -0.112833786 0.0031413648 -0.0288342412  
## [50,] 9.044271e-02 -0.0131025132 0.107766686 0.0276110102 0.0266687682  
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## [52,] 4.920141e-02 0.0942165526 0.056566394 -0.0476143137 -0.1256567363  
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## [60,] 3.222990e-02 0.0331814951 -0.143295084 -0.0507745687 0.0112792112  
## [61,] 5.378851e-02 -0.0325466342 -0.033616271 -0.0648869800 0.0034034410  
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## [63,] 1.924640e-02 -0.0452300822 0.010102555 -0.0088850337 0.0079154466  
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## [65,] 1.670871e-05 0.0126306885 -0.011088292 0.0013639350 -0.0022350293  
## [66,] 6.364942e-03 -0.0203071680 0.016487555 0.0362458837 -0.0307030257  
## [67,] -9.238262e-02 0.1172180150 -0.168993635 -0.0893822468 0.0935734044  
## [68,] 1.799604e-01 0.0147051004 -0.161928921 -0.0308596264 -0.0986155554  
## [69,] -2.313513e-04 -0.0968970868 0.030285437 -0.0188953067 0.0661714470  
## [70,] 7.962405e-03 -0.0198465276 0.085150739 0.0334578380 -0.0132657531  
## [71,] -1.024253e-01 -0.1353727549 -0.167638301 0.2100800218 0.1788261286  
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## [4,] 0.2480553542 0.1852819257 -0.224327960  
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## [20,] 0.0282232816 -0.0263558382 -0.257979825  
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## [42,] -0.0055285115 0.0041724402 0.001821155  
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## [67,] -0.0009517539 -0.0944914994 -0.054244527  
## [68,] -0.0051968193 0.0502184762 0.154128191  
## [69,] -0.0513075137 -0.1640429956 -0.056651551  
## [70,] -0.0206747074 0.0439260449 -0.055457531  
## [71,] 0.0365746536 -0.0086114836 0.062268865  
## [72,] -0.1092342280 0.0155773520 -0.007321346  
## [73,] -0.0065039277 0.0163036719 0.042619117  
## [74,] -0.0496837823 0.0437934258 0.101894617  
## [75,] 0.0519876338 0.1024477740 -0.112744604  
## [76,] -0.0677997626 0.0151799991 0.049342976  
## [77,] -0.0748737606 0.0087357313 0.007369910

ford.scores=as.matrix(fordcounts[,4:80])%\*%as.matrix(ford.eigen$vectors)  
  
par(mfrow=c(1,1))  
ford.pca=rda(fordcounts[,4:80])  
class(ford.pca)

## [1] "rda" "cca"

str(ford.pca)

## List of 10  
## $ colsum : Named num [1:77] 13.393 9.204 0.336 3.564 7.731 ...  
## ..- attr(\*, "names")= chr [1:77] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...  
## $ tot.chi : num 21703  
## $ Ybar : num [1:32, 1:77] 1.39 -1.67 -1.67 -1.13 -2.74 ...  
## ..- attr(\*, "scaled:center")= Named num [1:77] 16.281 4.938 0.125 3.438 3.969 ...  
## .. ..- attr(\*, "names")= chr [1:77] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. ..$ : chr [1:77] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...  
## ..- attr(\*, "METHOD")= chr "PCA"  
## $ method : chr "rda"  
## $ call : language rda(X = fordcounts[, 4:80])  
## $ pCCA : NULL  
## $ CCA : NULL  
## $ CA :List of 7  
## ..$ eig : Named num [1:30] 14194 3575 2252 449 278 ...  
## .. ..- attr(\*, "names")= chr [1:30] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ poseig : NULL  
## ..$ u : num [1:32, 1:30] -0.0831 0.0702 0.0702 -0.2075 0.0153 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:30] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ v : num [1:77, 1:30] -0.006274 -0.027404 0.000454 -0.002092 -0.024186 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:77] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...  
## .. .. ..$ : chr [1:30] "PC1" "PC2" "PC3" "PC4" ...  
## ..$ rank : int 30  
## ..$ tot.chi: num 21703  
## ..$ Xbar : num [1:32, 1:77] 1.39 -1.67 -1.67 -1.13 -2.74 ...  
## .. ..- attr(\*, "scaled:center")= Named num [1:77] 16.281 4.938 0.125 3.438 3.969 ...  
## .. .. ..- attr(\*, "names")= chr [1:77] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## .. .. ..$ : chr [1:32] "2" "3" "4" "5" ...  
## .. .. ..$ : chr [1:77] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...  
## .. ..- attr(\*, "METHOD")= chr "PCA"  
## $ inertia : chr "variance"  
## $ regularization: chr "this is a vegan::rda result object"  
## - attr(\*, "class")= chr [1:2] "rda" "cca"

summary(ford.pca)

##   
## Call:  
## rda(X = fordcounts[, 4:80])   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 21703 1  
## Unconstrained 21703 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 14194.182 3575.1972 2251.5197 449.2760 277.91174  
## Proportion Explained 0.654 0.1647 0.1037 0.0207 0.01281  
## Cumulative Proportion 0.654 0.8187 0.9225 0.9432 0.95599  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 1.709e+02 1.604e+02 1.205e+02 92.02290 77.608892  
## Proportion Explained 7.875e-03 7.388e-03 5.554e-03 0.00424 0.003576  
## Cumulative Proportion 9.639e-01 9.713e-01 9.768e-01 0.98105 0.984624  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 67.195826 41.310005 40.472562 31.542406 28.727849  
## Proportion Explained 0.003096 0.001903 0.001865 0.001453 0.001324  
## Cumulative Proportion 0.987720 0.989623 0.991488 0.992941 0.994265  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 25.472097 2.076e+01 1.843e+01 1.415e+01 1.107e+01  
## Proportion Explained 0.001174 9.565e-04 8.493e-04 6.521e-04 5.102e-04  
## Cumulative Proportion 0.995439 9.964e-01 9.972e-01 9.979e-01 9.984e-01  
## PC21 PC22 PC23 PC24 PC25  
## Eigenvalue 7.7445053 7.5054916 5.4658396 4.3983462 3.7513806  
## Proportion Explained 0.0003568 0.0003458 0.0002518 0.0002027 0.0001728  
## Cumulative Proportion 0.9987636 0.9991094 0.9993612 0.9995639 0.9997368  
## PC26 PC27 PC28 PC29 PC30  
## Eigenvalue 2.052e+00 1.486e+00 1.134e+00 6.715e-01 3.699e-01  
## Proportion Explained 9.453e-05 6.848e-05 5.224e-05 3.094e-05 1.704e-05  
## Cumulative Proportion 9.998e-01 9.999e-01 1.000e+00 1.000e+00 1.000e+00  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 28.63991   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4  
## pennate.1 -1.453e-01 -1.153e+00 1.467e+00 7.781e-01  
## morphospecies.2 -6.347e-01 7.609e-01 7.458e-01 -5.359e-02  
## Cymbella.spp.. 1.052e-02 9.954e-03 9.340e-03 -1.844e-02  
## Cymbella.spp.2. -4.844e-02 2.198e-01 -1.984e-01 -8.049e-02  
## Scenedesmus.spp..3 -5.602e-01 4.379e-01 4.396e-01 -1.911e-01  
## morphospecies.3 -3.316e-02 -1.801e-02 -2.175e-02 -3.092e-02  
## morphospecies.4 6.966e-02 -4.403e-02 1.252e-03 1.432e-01  
## morphospecies.6 -1.557e-01 -3.067e-02 1.121e-01 5.513e-02  
## morphospecies.8 2.112e-16 4.408e-16 -6.801e-17 -4.808e-16  
## Dolichospermum.spp.. -3.461e-02 1.051e-02 -6.248e-02 1.297e-02  
## Tabellaria.spp.. -8.095e-02 9.988e-03 -3.735e-02 -5.535e-02  
## morphospecies.10 -3.807e-02 3.287e-02 -5.571e-02 -2.508e-01  
## morphospecies.11 -3.826e-02 -5.009e-03 -3.329e-02 2.166e-03  
## morphospecies.12 -6.279e-02 4.673e-02 1.005e-01 -1.156e-01  
## morphospecies.13 1.946e-02 3.937e-02 1.285e-01 -5.159e-02  
## pennate.3 -1.443e-01 4.680e-02 -1.860e-01 -3.978e-01  
## morphospecies.14 2.919e-02 2.775e-02 1.260e-02 4.747e-02  
## morphospecies.15 5.913e-02 3.931e-01 1.007e-01 -1.117e-01  
## morphospecies.16 6.110e-02 -4.988e-02 -1.251e-03 3.186e-02  
## Coconeis.spp. -4.156e-02 1.571e-01 -7.678e-02 2.626e-02  
## Staurastrum.spp. 1.664e-02 -4.800e-02 1.905e-02 -7.800e-03  
## morphospecies.17 -6.436e-02 -7.108e-01 1.088e-01 -4.063e-01  
## Selenastrum.spp... 4.708e-02 -1.953e+00 7.783e-01 4.359e-01  
## morphospecies.18 -1.149e-01 -1.412e-02 -1.028e-01 2.948e-03  
## Staurastrum.spp..2 -4.181e-03 -3.043e-03 -3.856e-03 -1.482e-02  
## morphospecies.44 -1.636e-02 9.493e-03 3.865e-03 -5.626e-03  
## morphospecies.45 -1.127e-02 -2.232e-05 1.162e-02 -9.703e-03  
## morphospecies.20 8.115e-02 5.747e-02 -8.882e-02 -5.093e-02  
## morphospecies.21 6.435e-02 -6.384e-02 -5.875e-02 4.467e-03  
## morphospecies.22 9.051e-02 -1.560e-01 1.800e-03 1.114e-01  
## morphospecies.23 3.230e-02 2.626e-03 -1.827e-02 1.014e-02  
## pennate.4 -6.441e-02 7.251e-02 -2.750e-02 1.409e-02  
## morphospecies.24 2.623e-03 -2.503e-02 6.861e-03 1.159e-02  
## morphospecies.25 -1.092e-03 8.287e-03 -1.323e-02 9.481e-03  
## morphospecies.26 -2.483e-04 9.138e-03 1.510e-02 -3.927e-03  
## morphospecies.27 2.095e-03 3.309e-02 -3.754e-02 9.437e-03  
## Asterionella.spp.. -5.080e-03 1.332e-02 -2.188e-02 6.219e-02  
## morphospecies.28 -6.643e-02 4.245e-02 -6.641e-02 5.089e-02  
## morphospecies.29 5.408e-02 7.538e-03 1.421e-01 3.559e-01  
## pennate.5 2.503e-02 6.745e-02 4.318e-02 -6.870e-02  
## morphospecies.30 4.562e-03 3.474e-03 1.921e-03 -7.479e-03  
## Cosmarium.spp. -2.988e-02 2.258e-02 -7.431e-03 2.047e-02  
## morphospecies.31 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## pennate.6 -1.075e-01 3.079e-04 2.149e-01 5.851e-02  
## morphospecies.31.1 -5.900e-03 -3.689e-01 1.347e-01 6.685e-02  
## morphospecies.32 9.974e-03 -1.265e-01 5.431e-02 6.882e-02  
## Scenedesmus.spp..3.1 2.580e-02 -5.235e-02 1.880e-02 1.231e-01  
## morphospecies.33 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## morphospecies.34 8.827e-03 -1.128e-02 4.697e-03 1.170e-02  
## Selenastrum.spp.. -2.148e-04 -1.302e-02 4.899e-03 -2.032e-03  
## morphospecies.35 -1.174e-03 -2.232e-02 1.020e-02 1.501e-02  
## morphospecies.36 -1.937e-02 -3.683e-01 1.683e-01 2.476e-01  
## morphospecies.37 -5.870e-04 -1.116e-02 5.101e-03 7.504e-03  
## morphospecies.38 1.078e-03 -1.110e-02 6.453e-03 3.353e-03  
## pennate.7 1.078e-03 -1.110e-02 6.453e-03 3.353e-03  
## morphospecies.38.1 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## morphospecies.39 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## pennate.8 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## pennate.9 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## Scenedesmus.spp..2. -1.139e-01 2.301e-02 1.224e-01 -2.577e-01  
## morphospecies.40 -2.446e-01 -8.928e-02 1.067e-01 -1.061e-01  
## Scenedesmus.spp.1. -4.125e+00 6.990e+00 6.585e+00 -2.551e-01  
## Cyclotella.spp... 6.187e-02 -3.316e+00 2.482e+00 2.957e+00  
## pennate.2 -2.981e-01 1.205e+00 4.584e-01 -1.521e-01  
## Fragillaria.spp. -2.056e+01 1.977e+00 -3.306e+00 8.699e-01  
## morphospecies.7 2.176e-01 -7.965e-01 1.561e+00 1.529e+00  
## morphospecies.41 1.371e-01 -5.268e-01 2.142e-01 5.721e-01  
## Peridinium.spp... -1.284e-01 2.118e-01 5.497e-02 3.750e-02  
## morphospecies.1 -5.169e-01 1.235e+00 3.744e-01 2.010e-01  
## Nitzschia.spp. -1.679e+00 1.303e+00 1.413e+00 1.271e-01  
## morphospecies.43 -8.804e-03 -1.674e-01 7.651e-02 1.126e-01  
## Pinnularia.spp... -5.003e-02 9.082e-02 -6.541e-02 -6.578e-03  
## Microcystis.spp. 9.610e+00 7.652e+00 -3.955e+00 1.714e+00  
## Synedra.spp.. -2.258e-01 -1.929e-01 -2.743e-01 2.462e-01  
## morphospecies.19 8.080e-02 1.035e-01 -3.730e-02 -2.768e-02  
## morphospecies.9 2.645e-02 -8.478e-02 -1.553e-02 -1.275e-04  
## Pediastrum.spp. -5.285e-01 -2.811e-01 -5.026e-01 2.230e-01  
## PC5 PC6  
## pennate.1 5.458e-01 -7.493e-01  
## morphospecies.2 3.459e-01 5.712e-01  
## Cymbella.spp.. 9.710e-03 7.978e-03  
## Cymbella.spp.2. -3.855e-01 2.938e-02  
## Scenedesmus.spp..3 -3.788e-03 -3.785e-01  
## morphospecies.3 -1.429e-01 3.724e-02  
## morphospecies.4 1.867e-02 5.233e-03  
## morphospecies.6 -2.647e-02 -6.743e-02  
## morphospecies.8 -8.092e-18 2.476e-17  
## Dolichospermum.spp.. 1.206e-02 1.102e-02  
## Tabellaria.spp.. -2.767e-02 2.499e-02  
## morphospecies.10 7.885e-02 1.174e-01  
## morphospecies.11 1.841e-02 1.269e-02  
## morphospecies.12 9.964e-02 2.353e-02  
## morphospecies.13 1.276e-01 -9.639e-03  
## pennate.3 4.004e-01 2.506e-01  
## morphospecies.14 -1.363e-02 3.666e-02  
## morphospecies.15 6.849e-02 -3.725e-01  
## morphospecies.16 6.978e-02 -7.869e-03  
## Coconeis.spp. -1.981e-01 1.794e-02  
## Staurastrum.spp. -9.753e-03 3.285e-02  
## morphospecies.17 4.040e-01 4.453e-02  
## Selenastrum.spp... -9.541e-01 3.117e-01  
## morphospecies.18 5.857e-02 5.534e-02  
## Staurastrum.spp..2 7.021e-03 1.255e-02  
## morphospecies.44 -1.355e-02 1.353e-02  
## morphospecies.45 -3.392e-03 7.461e-03  
## morphospecies.20 9.059e-02 7.497e-02  
## morphospecies.21 4.637e-02 4.205e-02  
## morphospecies.22 -8.833e-02 4.264e-02  
## morphospecies.23 1.959e-02 1.307e-02  
## pennate.4 -9.357e-02 3.233e-02  
## morphospecies.24 1.789e-03 4.984e-03  
## morphospecies.25 -3.625e-03 -9.782e-03  
## morphospecies.26 -2.368e-03 1.027e-02  
## morphospecies.27 -5.426e-02 8.037e-03  
## Asterionella.spp.. -7.781e-02 -4.314e-02  
## morphospecies.28 -6.570e-02 -7.557e-03  
## morphospecies.29 9.668e-02 -2.190e-02  
## pennate.5 -1.615e-01 -8.457e-02  
## morphospecies.30 -1.441e-02 -7.452e-03  
## Cosmarium.spp. -1.926e-02 -5.495e-03  
## morphospecies.31 0.000e+00 0.000e+00  
## pennate.6 -1.404e-03 8.267e-02  
## morphospecies.31.1 -1.048e-01 1.615e-01  
## morphospecies.32 -1.766e-02 -1.505e-02  
## Scenedesmus.spp..3.1 3.352e-02 -1.102e-02  
## morphospecies.33 0.000e+00 0.000e+00  
## morphospecies.34 -1.852e-03 1.252e-02  
## Selenastrum.spp.. -1.219e-02 -3.532e-03  
## morphospecies.35 3.778e-03 5.807e-03  
## morphospecies.36 6.233e-02 9.582e-02  
## morphospecies.37 1.889e-03 2.904e-03  
## morphospecies.38 6.205e-03 -2.322e-03  
## pennate.7 6.205e-03 -2.322e-03  
## morphospecies.38.1 0.000e+00 0.000e+00  
## morphospecies.39 0.000e+00 0.000e+00  
## pennate.8 0.000e+00 0.000e+00  
## pennate.9 0.000e+00 0.000e+00  
## Scenedesmus.spp..2. 1.467e-01 -4.441e-01  
## morphospecies.40 3.020e-01 1.723e-01  
## Scenedesmus.spp.1. 4.718e-03 4.319e-01  
## Cyclotella.spp... 3.794e-01 9.173e-01  
## pennate.2 -4.643e-01 2.331e-02  
## Fragillaria.spp. 1.024e-01 2.525e-03  
## morphospecies.7 -3.127e-01 -1.449e+00  
## morphospecies.41 1.170e-01 -7.380e-02  
## Peridinium.spp... -1.971e-01 5.769e-02  
## morphospecies.1 -1.210e+00 -5.112e-02  
## Nitzschia.spp. 1.122e-01 -1.209e+00  
## morphospecies.43 2.833e-02 4.355e-02  
## Pinnularia.spp... -1.343e-01 3.013e-02  
## Microcystis.spp. 1.683e-01 4.234e-02  
## Synedra.spp.. -2.492e+00 1.554e-01  
## morphospecies.19 -2.320e-01 2.885e-02  
## morphospecies.9 -2.532e-02 -4.278e-02  
## Pediastrum.spp. 2.803e-01 4.188e-01  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -2.3790 -6.08937 -2.4468 -4.6508 0.09103 -4.3316  
## 3 2.0105 -1.35517 0.2360 -7.5915 4.05657 3.0606  
## 4 2.0105 -1.35517 0.2360 -7.5915 4.05657 3.0606  
## 5 -5.9416 -5.15459 -1.7867 -6.5342 1.09138 5.7050  
## 6 0.4393 -0.64991 -4.9633 1.6681 -1.34179 3.5225  
## 7 4.9567 3.71393 -4.4111 0.2824 4.80698 5.4602  
## 8 -15.6905 -2.05425 -13.6535 0.8883 7.55015 5.2030  
## 9 5.8622 5.90208 -0.6501 3.6228 1.64766 8.4664  
## 10 2.5124 2.65819 -1.3759 -5.6258 4.66758 4.5884  
## 11 3.6198 1.16292 -0.4478 -3.0156 5.21319 -5.6382  
## 12 4.8084 3.37916 -5.1921 3.2827 1.79371 -8.0046  
## 13 5.4481 4.09269 2.0586 -1.7042 4.22927 -3.6771  
## 14 5.4334 1.23811 -3.5787 0.5128 2.06368 -4.4793  
## 15 3.0948 4.06852 -0.4997 -2.8196 1.53888 4.1062  
## 16 4.9633 2.90722 -1.7629 -2.2377 -10.69915 0.4872  
## 17 -1.9073 0.00636 -4.2320 -3.6806 -13.14827 0.6754  
## 18 1.9408 4.62607 -6.2402 5.1553 -7.09943 -1.3725  
## 19 -5.7044 3.41782 -5.6602 4.4937 -4.76694 -0.0190  
## 20 -1.5731 2.02812 -1.7649 0.6476 -5.49579 -3.0137  
## 21 1.8711 1.42459 0.7879 -3.0672 -5.90959 -3.0563  
## 22 -0.2037 7.49559 12.3816 -3.2215 -1.94215 8.4269  
## 23 -5.1712 3.71169 10.5266 1.6423 2.03618 3.4715  
## 24 -11.5295 9.65343 6.9900 7.1586 -0.76613 -1.4556  
## 25 -8.9667 3.63038 5.7398 -1.0334 1.42139 -10.7868  
## 26 -0.9054 -0.42378 2.2705 -8.4628 4.53866 -11.5836  
## 27 2.8998 -0.97869 -2.4499 1.5095 2.98406 -2.9641  
## 28 4.5216 -3.09523 0.5735 16.4983 4.56942 -3.2371  
## 29 3.6202 -4.62426 1.9262 4.7968 -0.75963 5.1349  
## 30 -0.1762 -10.67911 4.0184 -1.6666 -10.00088 -2.8975  
## 31 -0.4815 -9.15537 4.1840 6.1549 1.54925 2.3816  
## 32 -0.2669 -10.40059 3.8932 1.8388 -3.06581 4.6710  
## 33 0.8841 -9.10137 5.2934 2.7500 5.08996 -1.9044

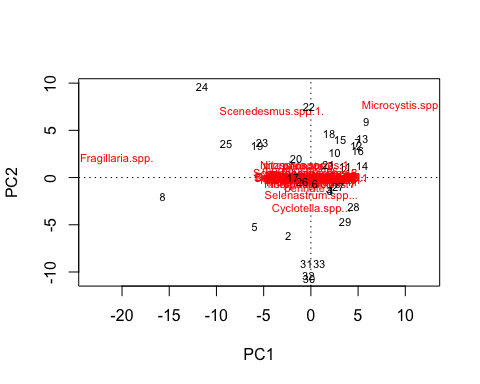
eigenvals(ford.pca)

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 14194.182 3575.197 2251.520 449.276 277.912 170.918 160.352   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 120.546 92.023 77.609 67.196 41.310 40.473 31.542   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 28.728 25.472 20.759 18.434 14.153 11.073 7.745   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 7.505 5.466 4.398 3.751 2.052 1.486 1.134   
## PC29 PC30   
## 0.671 0.370

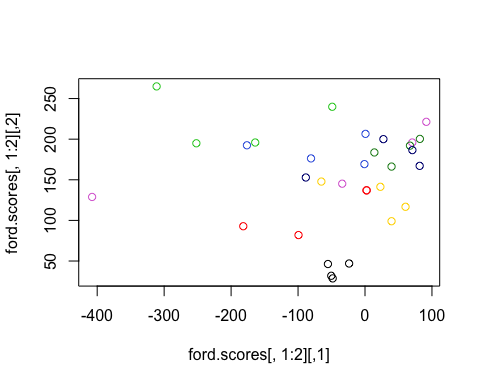
eigenvals(ford.pca)/sum(eigenvals(ford.pca))

## PC1 PC2 PC3 PC4 PC5 PC6 PC7   
## 0.6540117 0.1647309 0.1037411 0.0207009 0.0128051 0.0078752 0.0073884   
## PC8 PC9 PC10 PC11 PC12 PC13 PC14   
## 0.0055543 0.0042401 0.0035759 0.0030961 0.0019034 0.0018648 0.0014533   
## PC15 PC16 PC17 PC18 PC19 PC20 PC21   
## 0.0013237 0.0011737 0.0009565 0.0008493 0.0006521 0.0005102 0.0003568   
## PC22 PC23 PC24 PC25 PC26 PC27 PC28   
## 0.0003458 0.0002518 0.0002027 0.0001728 0.0000945 0.0000685 0.0000522   
## PC29 PC30   
## 0.0000309 0.0000170

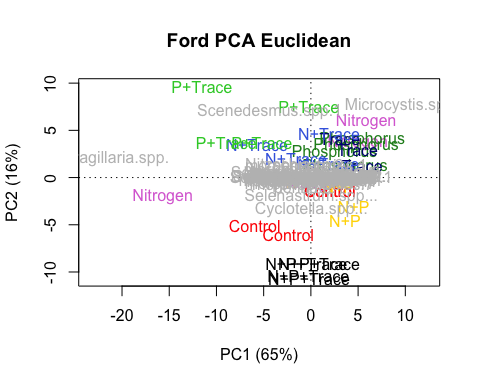
plot(ford.pca)



plot(ford.scores[,1:2],col=colors)



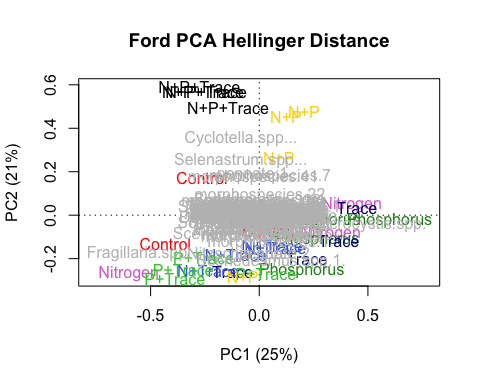
plot(ford.pca,type="none",xlab="PC1 (65%)",ylab="PC2 (16%)",main="Ford PCA Euclidean")  
text(ford.pca,labels=fordcounts$Treatment,col=colors)  
text(ford.pca,display="species",col=8)



# Hellinger distance-based PCA  
ford.hel=decostand(fordcounts[,4:80],method="hellinger")  
ford.hel.pca=rda(ford.hel)  
summary(ford.hel.pca)

##   
## Call:  
## rda(X = ford.hel)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.2114 1  
## Unconstrained 0.2114 1  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## PC1 PC2 PC3 PC4 PC5 PC6  
## Eigenvalue 0.0522 0.04537 0.01791 0.01688 0.01335 0.008896  
## Proportion Explained 0.2470 0.21465 0.08475 0.07984 0.06316 0.042089  
## Cumulative Proportion 0.2470 0.46162 0.54637 0.62621 0.68938 0.731467  
## PC7 PC8 PC9 PC10 PC11 PC12  
## Eigenvalue 0.008225 0.00609 0.005065 0.004773 0.00457 0.003711  
## Proportion Explained 0.038914 0.02881 0.023963 0.022580 0.02162 0.017558  
## Cumulative Proportion 0.770381 0.79919 0.823155 0.845736 0.86736 0.884915  
## PC13 PC14 PC15 PC16 PC17  
## Eigenvalue 0.003491 0.003054 0.002599 0.002452 0.002122  
## Proportion Explained 0.016517 0.014449 0.012296 0.011600 0.010038  
## Cumulative Proportion 0.901432 0.915881 0.928177 0.939777 0.949815  
## PC18 PC19 PC20 PC21 PC22  
## Eigenvalue 0.001878 0.001662 0.001401 0.001107 0.0009864  
## Proportion Explained 0.008886 0.007861 0.006627 0.005236 0.0046668  
## Cumulative Proportion 0.958701 0.966562 0.973190 0.978425 0.9830923  
## PC23 PC24 PC25 PC26 PC27  
## Eigenvalue 0.0008123 0.0007625 0.0005378 0.0004941 0.0004048  
## Proportion Explained 0.0038432 0.0036074 0.0025444 0.0023375 0.0019152  
## Cumulative Proportion 0.9869355 0.9905430 0.9930874 0.9954249 0.9973401  
## PC28 PC29 PC30  
## Eigenvalue 0.0002662 0.0002006 9.544e-05  
## Proportion Explained 0.0012592 0.0009492 4.515e-04  
## Cumulative Proportion 0.9985993 0.9995485 1.000e+00  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.599925   
##   
##   
## Species scores  
##   
## PC1 PC2 PC3 PC4  
## pennate.1 -3.153e-02 1.893e-01 -1.610e-01 -2.388e-03  
## morphospecies.2 1.137e-02 -1.031e-01 -1.006e-01 -3.256e-02  
## Cymbella.spp.. 6.785e-03 -8.686e-03 -5.651e-03 -6.567e-03  
## Cymbella.spp.2. 1.907e-02 -6.918e-02 8.094e-02 5.013e-02  
## Scenedesmus.spp..3 -5.329e-02 -8.693e-02 -5.472e-02 4.299e-02  
## morphospecies.3 -1.961e-02 2.179e-03 6.376e-02 3.347e-02  
## morphospecies.4 2.710e-02 3.721e-02 4.321e-03 1.246e-02  
## morphospecies.6 -6.021e-02 1.371e-02 -1.347e-02 -5.630e-03  
## morphospecies.8 -2.842e-18 4.449e-19 -3.319e-17 -8.144e-18  
## Dolichospermum.spp.. -1.948e-03 -1.446e-02 2.157e-02 -1.692e-02  
## Tabellaria.spp.. 9.528e-03 -2.196e-02 2.983e-02 7.763e-03  
## morphospecies.10 -3.246e-03 -7.663e-02 -8.008e-04 -4.311e-02  
## morphospecies.11 -1.295e-02 -5.736e-03 5.504e-03 -1.352e-02  
## morphospecies.12 -2.111e-02 -3.138e-02 -3.257e-02 -2.540e-02  
## morphospecies.13 -1.680e-02 -5.159e-03 -4.960e-02 -2.917e-02  
## pennate.3 -4.101e-03 -5.782e-02 7.074e-03 -1.258e-01  
## morphospecies.14 1.535e-02 1.233e-02 3.042e-03 1.797e-02  
## morphospecies.15 3.782e-02 -9.214e-02 -7.088e-02 2.503e-02  
## morphospecies.16 9.609e-03 3.327e-02 -4.283e-03 -1.875e-02  
## Coconeis.spp. 8.032e-03 -6.585e-02 3.946e-02 5.810e-02  
## Staurastrum.spp. -3.191e-03 3.175e-02 -6.825e-05 -1.355e-03  
## morphospecies.17 -3.847e-02 4.989e-02 4.789e-02 -1.052e-01  
## Selenastrum.spp... -8.505e-02 2.540e-01 -2.927e-03 6.444e-02  
## morphospecies.18 -2.212e-02 -1.130e-02 1.621e-02 -2.827e-02  
## Staurastrum.spp..2 -3.612e-03 -7.171e-03 3.599e-03 -1.377e-02  
## morphospecies.44 -1.219e-02 -1.284e-02 3.448e-03 9.162e-03  
## morphospecies.45 -9.984e-03 -7.364e-03 -3.651e-03 5.439e-03  
## morphospecies.20 5.824e-02 -1.941e-02 3.256e-02 -7.155e-02  
## morphospecies.21 1.578e-02 5.192e-02 5.315e-02 -3.718e-02  
## morphospecies.22 3.289e-03 9.209e-02 4.966e-02 1.792e-02  
## morphospecies.23 2.142e-02 1.241e-02 2.594e-02 -2.233e-02  
## pennate.4 -1.667e-02 -3.721e-02 2.539e-02 3.429e-02  
## morphospecies.24 -7.669e-03 2.589e-02 -3.504e-03 -6.420e-04  
## morphospecies.25 1.245e-03 -5.755e-03 3.883e-03 3.902e-03  
## morphospecies.26 4.424e-04 -3.933e-03 -5.966e-03 5.142e-03  
## morphospecies.27 7.157e-03 -2.091e-02 2.816e-02 2.942e-02  
## Asterionella.spp.. 1.963e-03 1.291e-02 6.354e-03 2.671e-02  
## morphospecies.28 -1.292e-02 -1.542e-02 1.348e-02 1.718e-02  
## morphospecies.29 -6.234e-05 1.389e-02 -4.829e-02 2.832e-02  
## pennate.5 -3.444e-03 -2.467e-02 -9.548e-03 4.988e-02  
## morphospecies.30 1.437e-03 -3.410e-03 5.554e-04 1.065e-02  
## Cosmarium.spp. -1.100e-02 -1.135e-02 2.178e-03 1.180e-02  
## morphospecies.31 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## pennate.6 -3.313e-02 2.962e-02 -3.606e-02 2.172e-02  
## morphospecies.31.1 -2.598e-02 6.459e-02 -5.561e-03 3.376e-03  
## morphospecies.32 -1.698e-02 6.561e-02 -1.122e-02 7.965e-03  
## Scenedesmus.spp..3.1 5.560e-04 3.532e-02 -1.087e-02 4.223e-03  
## morphospecies.33 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## morphospecies.34 3.233e-03 1.191e-02 6.475e-04 4.761e-03  
## Selenastrum.spp.. -4.860e-03 1.067e-02 6.069e-04 4.810e-03  
## morphospecies.35 -5.971e-03 1.395e-02 -4.262e-03 -4.429e-05  
## morphospecies.36 -2.426e-02 5.668e-02 -1.731e-02 -1.799e-04  
## morphospecies.37 -4.222e-03 9.867e-03 -3.014e-03 -3.132e-05  
## morphospecies.38 -2.683e-03 9.198e-03 -2.007e-03 -3.038e-03  
## pennate.7 -2.683e-03 9.198e-03 -2.007e-03 -3.038e-03  
## morphospecies.38.1 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## morphospecies.39 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## pennate.8 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## pennate.9 0.000e+00 0.000e+00 0.000e+00 0.000e+00  
## Scenedesmus.spp..2. -2.229e-02 -3.701e-02 -5.939e-02 -8.874e-03  
## morphospecies.40 -2.681e-03 2.736e-02 -1.617e-02 -1.061e-01  
## Scenedesmus.spp.1. 5.508e-02 -2.133e-01 -2.017e-01 6.135e-02  
## Cyclotella.spp... -8.417e-02 3.528e-01 -2.488e-02 3.272e-02  
## pennate.2 6.946e-02 -1.824e-01 -2.176e-02 7.168e-02  
## Fragillaria.spp. -5.521e-01 -1.772e-01 1.120e-01 -7.277e-02  
## morphospecies.7 5.031e-02 1.806e-01 -1.065e-01 1.092e-01  
## morphospecies.41 -2.829e-02 1.755e-01 -2.867e-02 1.427e-02  
## Peridinium.spp... -2.198e-02 -6.830e-02 1.318e-02 7.337e-02  
## morphospecies.1 4.266e-02 -1.240e-01 4.068e-02 1.685e-01  
## Nitzschia.spp. -1.026e-01 -1.782e-01 -1.209e-01 9.623e-02  
## morphospecies.43 -1.635e-02 3.822e-02 -1.167e-02 -1.213e-04  
## Pinnularia.spp... -1.217e-02 -4.071e-02 5.053e-02 3.340e-02  
## Microcystis.spp. 5.082e-01 -4.246e-02 1.255e-01 -5.453e-02  
## Synedra.spp.. -7.239e-02 6.890e-02 1.742e-01 2.254e-01  
## morphospecies.19 2.764e-02 -3.361e-02 6.029e-02 6.723e-02  
## morphospecies.9 -6.026e-03 3.880e-02 -2.120e-03 -4.758e-03  
## Pediastrum.spp. -4.609e-02 3.431e-02 2.622e-02 -3.271e-02  
## PC5 PC6  
## pennate.1 1.038e-02 -8.437e-02  
## morphospecies.2 -9.377e-02 1.033e-01  
## Cymbella.spp.. 3.079e-02 6.324e-03  
## Cymbella.spp.2. 1.424e-02 -7.836e-04  
## Scenedesmus.spp..3 1.532e-01 5.895e-02  
## morphospecies.3 1.894e-02 -7.698e-03  
## morphospecies.4 -1.724e-02 -1.023e-02  
## morphospecies.6 7.235e-02 -1.911e-04  
## morphospecies.8 -5.457e-18 -4.085e-18  
## Dolichospermum.spp.. -2.543e-02 -8.682e-03  
## Tabellaria.spp.. -1.485e-02 -3.735e-02  
## morphospecies.10 9.711e-02 2.938e-02  
## morphospecies.11 -1.569e-02 3.140e-03  
## morphospecies.12 9.107e-02 3.351e-02  
## morphospecies.13 4.347e-02 3.171e-02  
## pennate.3 7.284e-02 8.077e-02  
## morphospecies.14 3.201e-02 1.267e-02  
## morphospecies.15 4.011e-02 -7.670e-02  
## morphospecies.16 5.195e-02 1.502e-02  
## Coconeis.spp. 4.176e-02 3.004e-02  
## Staurastrum.spp. 7.796e-03 3.875e-02  
## morphospecies.17 1.970e-01 -4.990e-02  
## Selenastrum.spp... -8.020e-02 1.297e-01  
## morphospecies.18 -2.075e-02 1.202e-02  
## Staurastrum.spp..2 -1.227e-03 4.298e-03  
## morphospecies.44 5.727e-03 -2.154e-03  
## morphospecies.45 5.364e-03 3.149e-03  
## morphospecies.20 -3.686e-02 4.248e-03  
## morphospecies.21 1.909e-02 -1.837e-02  
## morphospecies.22 1.555e-03 -4.621e-03  
## morphospecies.23 1.153e-02 -1.203e-02  
## pennate.4 -4.886e-03 -1.655e-02  
## morphospecies.24 -6.147e-03 5.452e-03  
## morphospecies.25 3.788e-03 -1.196e-02  
## morphospecies.26 -1.012e-04 2.817e-03  
## morphospecies.27 -9.478e-03 3.770e-03  
## Asterionella.spp.. -1.149e-03 -1.003e-02  
## morphospecies.28 6.124e-03 -1.164e-02  
## morphospecies.29 3.626e-03 -1.124e-02  
## pennate.5 1.253e-02 2.485e-03  
## morphospecies.30 2.994e-03 -4.462e-04  
## Cosmarium.spp. 3.349e-03 -4.804e-03  
## morphospecies.31 0.000e+00 0.000e+00  
## pennate.6 -1.475e-02 3.695e-02  
## morphospecies.31.1 -1.629e-02 3.100e-02  
## morphospecies.32 3.797e-05 -7.245e-03  
## Scenedesmus.spp..3.1 -3.772e-03 -1.198e-02  
## morphospecies.33 0.000e+00 0.000e+00  
## morphospecies.34 -7.380e-03 8.057e-03  
## Selenastrum.spp.. -4.077e-03 4.462e-03  
## morphospecies.35 -3.611e-03 8.319e-04  
## morphospecies.36 -1.467e-02 3.379e-03  
## morphospecies.37 -2.553e-03 5.883e-04  
## morphospecies.38 9.113e-03 -6.451e-03  
## pennate.7 9.113e-03 -6.451e-03  
## morphospecies.38.1 0.000e+00 0.000e+00  
## morphospecies.39 0.000e+00 0.000e+00  
## pennate.8 0.000e+00 0.000e+00  
## pennate.9 0.000e+00 0.000e+00  
## Scenedesmus.spp..2. -6.181e-03 -5.127e-02  
## morphospecies.40 2.011e-02 -1.165e-02  
## Scenedesmus.spp.1. 4.065e-02 1.006e-01  
## Cyclotella.spp... 9.841e-02 5.442e-02  
## pennate.2 -7.656e-02 -3.891e-02  
## Fragillaria.spp. -3.827e-02 -5.027e-02  
## morphospecies.7 -1.654e-02 -1.240e-01  
## morphospecies.41 1.494e-03 -1.695e-02  
## Peridinium.spp... -1.131e-02 -3.376e-04  
## morphospecies.1 2.114e-02 2.369e-02  
## Nitzschia.spp. 5.926e-02 -5.686e-02  
## morphospecies.43 -9.889e-03 2.278e-03  
## Pinnularia.spp... 2.940e-02 9.091e-03  
## Microcystis.spp. 2.395e-02 -1.777e-02  
## Synedra.spp.. 7.135e-02 2.632e-02  
## morphospecies.19 4.304e-03 6.990e-03  
## morphospecies.9 1.279e-02 -7.483e-03  
## Pediastrum.spp. -9.923e-02 4.982e-02  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## PC1 PC2 PC3 PC4 PC5 PC6  
## 2 -0.26304 0.17149 0.399906 -0.182137 0.192811 -0.55760  
## 3 0.04175 -0.07169 -0.007448 -0.321685 0.736565 0.33413  
## 4 0.04175 -0.07169 -0.007448 -0.321685 0.736565 0.33413  
## 5 -0.43219 -0.12966 0.207613 -0.264087 0.171097 0.02082  
## 6 -0.03103 -0.02974 0.419445 -0.126672 -0.029792 -0.13872  
## 7 0.32940 -0.08285 0.262816 -0.373205 0.015929 0.48264  
## 8 -0.60016 -0.26590 0.255165 -0.626786 -0.727342 0.14555  
## 9 0.42582 0.04711 0.171836 -0.018086 0.192885 0.34335  
## 10 0.19548 -0.25456 0.002004 -0.475722 -0.214087 0.20276  
## 11 0.26778 -0.02290 -0.319072 -0.366130 -0.230484 -0.27879  
## 12 0.26490 -0.11138 0.033695 0.038587 0.140334 -0.52439  
## 13 0.59965 -0.02569 -0.482180 -0.063344 -0.259221 -0.04779  
## 14 0.44963 0.03172 0.114760 -0.210711 -0.216322 -0.38246  
## 15 0.21901 -0.19958 0.032092 0.009977 -0.269650 0.26369  
## 16 0.36663 -0.11835 0.283158 0.485824 -0.156461 0.16920  
## 17 -0.12292 -0.26137 0.539627 0.432556 -0.143360 -0.09925  
## 18 0.07400 -0.15217 0.343196 0.347391 0.051919 -0.03839  
## 19 -0.23626 -0.25494 0.222207 0.217573 0.086725 -0.17550  
## 20 -0.10854 -0.18287 0.161211 0.334321 0.101120 -0.17146  
## 21 0.06003 -0.14249 0.023209 0.444934 0.125102 -0.01865  
## 22 0.03035 -0.26978 -0.409232 0.352660 -0.006940 0.19319  
## 23 -0.25640 -0.19501 -0.543285 0.174214 0.022382 0.22202  
## 24 -0.34936 -0.25016 -0.405741 0.155104 -0.006091 0.12874  
## 25 -0.38850 -0.29091 -0.431180 0.183238 0.153887 0.01091  
## 26 -0.07658 -0.28178 -0.467715 -0.178068 -0.135493 -0.57118  
## 27 0.08996 0.26324 0.035433 -0.080859 -0.037163 -0.05833  
## 28 0.20582 0.47667 -0.147707 0.111862 0.017011 -0.34006  
## 29 0.12330 0.45415 0.024697 0.181567 -0.281488 0.30730  
## 30 -0.25796 0.56642 0.032214 0.255298 -0.216419 0.23686  
## 31 -0.24360 0.56928 -0.173864 -0.001807 -0.147315 0.03394  
## 32 -0.27493 0.59265 -0.061879 0.048645 -0.154904 0.31894  
## 33 -0.14375 0.49277 -0.107534 -0.162765 0.488201 -0.34561

ford.hel.pca.scores=scores(ford.hel.pca,choices=1:18,display="sites")  
plot(ford.hel.pca,type="none",xlab="PC1 (25%)",ylab="PC2 (21%)",main="Ford PCA Hellinger Distance")  
text(ford.hel.pca,labels=fordcounts$Treatment,col=colors)  
text(ford.hel.pca,display="species",col=8)

 Interpretation: In the euclidean PCA, Microcystis, Scenedesmus and Fragillaria spp. fall outside of the species cluster. Scenedesmus spp. is associated with P+trace treatments, while the other don’t seems to be closely associated with a particular treatment. In the hellinger PCA, Fragillaria again stands out but not with a particular treatment. Cyclotello and Selenastrum appear to be associated with N+P and N+P+trace treatments. The N+P+trace and N+P treatments cluster tightly near the top of the ordination, away from the other treatments. This PCA explains moderate to above moderate variation, so this pattern may be genuinely meaningful. It will be interesting to see how diversity is influenced by these treatments.

# Non-metric Multidimensional Scaling (NMDS)

MAUMEE

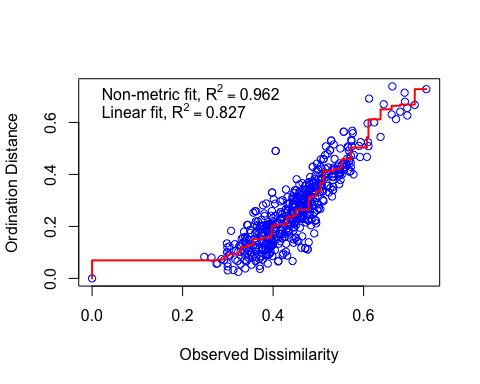
# NMDS of Hellinger distance matrix  
maum.hel=decostand(maumcounts[,4:70],method="hellinger")  
maum.dist.hel=vegdist(maum.hel,method="euclidean")  
maum.hel.nmds=metaMDS(maum.dist.hel, k=2, trymax=100, wascores=TRUE)

## Run 0 stress 0.1938467   
## Run 1 stress 0.1992267   
## Run 2 stress 0.2198868   
## Run 3 stress 0.1938466   
## ... New best solution  
## ... Procrustes: rmse 0.0001109001 max resid 0.0002810261   
## ... Similar to previous best  
## Run 4 stress 0.1992263   
## Run 5 stress 0.2207508   
## Run 6 stress 0.1938466   
## ... New best solution  
## ... Procrustes: rmse 8.483193e-05 max resid 0.0002132394   
## ... Similar to previous best  
## Run 7 stress 0.1938466   
## ... Procrustes: rmse 2.422289e-05 max resid 5.627998e-05   
## ... Similar to previous best  
## Run 8 stress 0.1938466   
## ... Procrustes: rmse 3.866188e-05 max resid 8.493845e-05   
## ... Similar to previous best  
## Run 9 stress 0.1938467   
## ... Procrustes: rmse 0.0001624686 max resid 0.0003627469   
## ... Similar to previous best  
## Run 10 stress 0.1938466   
## ... New best solution  
## ... Procrustes: rmse 3.075484e-05 max resid 8.975958e-05   
## ... Similar to previous best  
## Run 11 stress 0.1938467   
## ... Procrustes: rmse 0.000136017 max resid 0.0003194481   
## ... Similar to previous best  
## Run 12 stress 0.2387458   
## Run 13 stress 0.1992263   
## Run 14 stress 0.2290279   
## Run 15 stress 0.1992263   
## Run 16 stress 0.205348   
## Run 17 stress 0.2225153   
## Run 18 stress 0.1992263   
## Run 19 stress 0.1991984   
## Run 20 stress 0.2171505   
## \*\*\* Solution reached

maum.hel.nmds$stress

## [1] 0.1938466

stressplot(maum.hel.nmds)



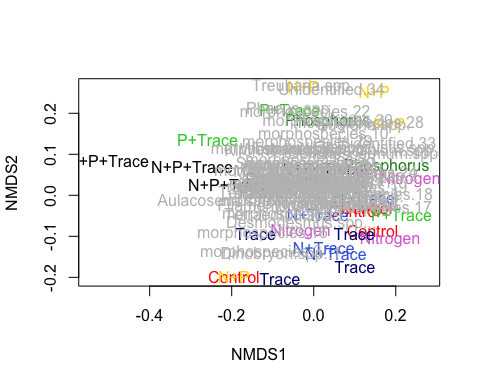
#stress is 0.1938  
goodness(maum.hel.nmds)

## [1] 0.05049700 0.02751932 0.02970628 0.03044860 0.03589216 0.02976932  
## [7] 0.05712001 0.04122201 0.03131695 0.03197419 0.03230590 0.02978328  
## [13] 0.02000039 0.03005812 0.03375953 0.03587917 0.02532275 0.02685321  
## [19] 0.02903650 0.02453513 0.03226935 0.03790049 0.03186435 0.03088675  
## [25] 0.03492389 0.05049692 0.03672432 0.04286404 0.02880673 0.02344485  
## [31] 0.03183439 0.03249382

plot(maum.hel.nmds, type="none")

## species scores not available

text(maum.hel.nmds, labels=maumcounts$Treatment,col=colors)  
maum.hel.nmds.spwa=wascores(scores(maum.hel.nmds), maumcounts[,4:70])  
text(maum.hel.nmds.spwa[,1:2],labels=rownames(maum.hel.nmds.spwa),col=8)



# Bray-Curtis NMDS  
maum.dist.bc=vegdist(maumcounts[,4:70], method="bray")  
maum.bc.nmds=metaMDS(maum.dist.bc, k=2, trymax=100)

## Run 0 stress 0.1387396   
## Run 1 stress 0.1387399   
## ... Procrustes: rmse 0.0002949 max resid 0.001380517   
## ... Similar to previous best  
## Run 2 stress 0.1405215   
## Run 3 stress 0.1387396   
## ... Procrustes: rmse 4.829539e-05 max resid 0.0002260463   
## ... Similar to previous best  
## Run 4 stress 0.1387403   
## ... Procrustes: rmse 0.0004376068 max resid 0.002048382   
## ... Similar to previous best  
## Run 5 stress 0.1387401   
## ... Procrustes: rmse 0.0002988694 max resid 0.001380912   
## ... Similar to previous best  
## Run 6 stress 0.1387397   
## ... Procrustes: rmse 0.0001604938 max resid 0.0007528934   
## ... Similar to previous best  
## Run 7 stress 0.1387422   
## ... Procrustes: rmse 0.000862637 max resid 0.004038836   
## ... Similar to previous best  
## Run 8 stress 0.1405215   
## Run 9 stress 0.1387398   
## ... Procrustes: rmse 0.0002581876 max resid 0.001209328   
## ... Similar to previous best  
## Run 10 stress 0.1387397   
## ... Procrustes: rmse 9.570032e-05 max resid 0.0004162175   
## ... Similar to previous best  
## Run 11 stress 0.1405217   
## Run 12 stress 0.1387411   
## ... Procrustes: rmse 0.0006679637 max resid 0.00313495   
## ... Similar to previous best  
## Run 13 stress 0.1387401   
## ... Procrustes: rmse 0.0003610818 max resid 0.001690301   
## ... Similar to previous best  
## Run 14 stress 0.1387399   
## ... Procrustes: rmse 0.0002754359 max resid 0.001290225   
## ... Similar to previous best  
## Run 15 stress 0.1387397   
## ... Procrustes: rmse 0.0001605285 max resid 0.0007495373   
## ... Similar to previous best  
## Run 16 stress 0.1405214   
## Run 17 stress 0.1387398   
## ... Procrustes: rmse 0.0002236949 max resid 0.001044566   
## ... Similar to previous best  
## Run 18 stress 0.1405217   
## Run 19 stress 0.1387396   
## ... Procrustes: rmse 0.0001001631 max resid 0.0004688705   
## ... Similar to previous best  
## Run 20 stress 0.1387396   
## ... Procrustes: rmse 4.592061e-05 max resid 0.0002095121   
## ... Similar to previous best  
## \*\*\* Solution reached

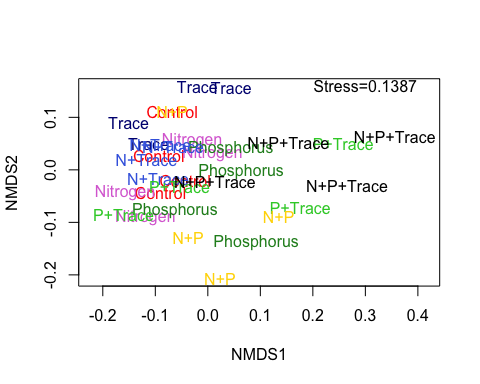
maum.bc.nmds$stress

## [1] 0.1387396

#0.1387 stress  
plot(maum.bc.nmds, type="none")

## species scores not available

text(maum.bc.nmds, labels=maumcounts$Treatment,col=colors)  
text(matrix(c(0.3,0.16),nrow=1),labels="Stress=0.1387")

 Interpretation: The hellinger transformed NMDS is garbage. It’s stress is nearly higher than acceptable (0.1938, when above 0.2 is bad), and there isn’t a pattern in the treatment positions. The BC trandofrmed is better, with a stress of 0.1387 and most of the P containing treatments pulling away from the rest on the NMDS1 axis. Phosphorus may be shifting the community.

NORTH ERIE

# NMDS of Hellinger distance matrix  
str(necounts)

## 'data.frame': 32 obs. of 147 variables:  
## $ Sample : Factor w/ 37 levels "1","10","11",..: 1 12 23 31 32 33 34 35 36 2 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Counter : Factor w/ 3 levels "Brian","Jordyn",..: 2 2 2 2 1 3 2 2 3 3 ...  
## $ Total : int 520 422 458 423 400 467 470 479 418 432 ...  
## $ Cyclotella.spp. : int 34 22 17 18 10 10 14 15 13 37 ...  
## $ Peridinium.spp. : int 0 1 1 0 0 1 0 2 0 0 ...  
## $ Cocconeis.spp. : int 0 1 1 0 0 0 0 0 0 2 ...  
## $ Selenastrum. : int 0 3 1 3 2 6 7 3 0 1 ...  
## $ Gomphenema. : int 0 0 1 0 0 0 0 1 0 0 ...  
## $ pennate.1 : int 0 0 1 0 0 0 0 1 0 1 ...  
## $ pennate.2 : int 0 0 0 0 0 0 0 1 0 0 ...  
## $ pennate.3 : int 0 0 0 0 0 0 1 1 0 1 ...  
## $ pennate.4 : int 0 0 0 0 0 0 0 0 0 1 ...  
## $ Unidentified.3.5 : int 5 5 2 2 2 1 3 2 1 1 ...  
## $ Aphanizomenon : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.4.5 : int 0 0 0 0 0 0 4 0 0 0 ...  
## $ Synedra. : int 0 2 1 0 1 0 1 0 0 2 ...  
## $ Unidentified.4 : int 0 0 0 0 0 0 0 2 0 0 ...  
## $ Dinobryon. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.5 : int 0 11 0 0 7 2 2 0 1 0 ...  
## $ Unidentified.6 : int 0 2 0 0 0 1 0 0 0 0 ...  
## $ Unidentified.6.5 : int 0 0 0 1 0 0 0 0 1 2 ...  
## $ Unidentified.7 : int 0 15 8 24 0 1 2 0 1 0 ...  
## $ Synedra..1 : int 0 0 1 0 0 0 1 0 0 0 ...  
## $ Unidentified.8 : int 1 0 1 0 4 0 0 1 0 0 ...  
## $ Unidentified.9 : int 1 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.10 : int 0 1 4 1 5 2 2 0 3 2 ...  
## $ Unidentified.14 : int 0 0 0 3 0 7 6 0 0 0 ...  
## $ Unidentified.15 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Tabellaria. : int 0 1 1 0 0 0 0 1 0 0 ...  
## $ Gomphonema. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ centric.1 : int 4 3 4 0 4 0 2 5 0 2 ...  
## $ Unidentified.16 : int 0 0 0 0 0 0 2 2 0 0 ...  
## $ pennate.4.5 : int 0 0 0 0 0 0 0 0 1 0 ...  
## $ Glaucocystis.spp...: int 1 0 0 0 0 0 0 0 8 8 ...  
## $ Unidentified.18 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.19 : int 0 0 0 0 3 0 0 0 0 4 ...  
## $ Unidentified.20 : int 0 0 0 0 1 0 0 0 0 0 ...  
## $ Unidentified.21 : int 0 0 0 0 0 0 0 0 0 4 ...  
## $ Unidentified.22 : int 0 0 4 0 0 4 0 0 4 0 ...  
## $ Aulacoseria. : int 0 0 2 0 0 0 0 10 0 2 ...  
## $ centric.2 : int 0 3 0 0 0 0 0 0 4 1 ...  
## $ pennate.5 : int 1 1 2 0 0 0 0 0 0 0 ...  
## $ Unidentified.23 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.24 : int 0 0 0 1 0 0 0 0 3 0 ...  
## $ Unidentified.25 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.28 : int 0 0 0 0 0 0 0 0 0 2 ...  
## $ Stephanodiscus. : int 0 2 1 0 0 0 2 0 3 1 ...  
## $ Unidentified.29 : int 0 0 1 2 2 1 0 0 1 2 ...  
## $ Unidentified.30 : int 0 0 0 0 0 0 0 0 0 4 ...  
## $ Unidentified.31 : int 0 0 0 0 3 0 0 0 0 2 ...  
## $ Unidentified.32 : int 0 0 0 0 0 0 0 0 0 2 ...  
## $ Unidentified.33 : int 0 1 1 0 0 0 0 1 0 1 ...  
## $ pennate.6 : int 0 1 1 0 0 0 0 0 0 1 ...  
## $ Unidentified.35 : int 0 3 1 0 0 0 1 1 2 5 ...  
## $ pennate.7 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.36 : int 0 0 0 0 0 0 0 0 0 1 ...  
## $ Unidentified.36.5 : int 0 0 0 0 0 0 0 0 0 1 ...  
## $ Unidentified.37 : int 0 0 0 0 0 0 0 0 0 6 ...  
## $ Unidentified.39 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.40 : int 0 0 0 0 3 1 0 0 0 0 ...  
## $ Unidentified.41 : int 0 0 0 0 1 0 0 0 0 0 ...  
## $ Unidentified.42 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.8 : int 0 0 0 0 1 0 0 0 0 0 ...  
## $ Unidentified.44 : int 0 6 16 0 0 0 0 0 0 0 ...  
## $ Unidentified.45 : int 0 5 0 0 1 0 0 0 0 0 ...  
## $ Unidentified.46 : int 0 0 9 0 0 0 0 0 0 0 ...  
## $ Unidentified.47 : int 0 0 1 0 0 0 0 0 0 0 ...  
## $ pennate.9 : int 0 0 1 0 0 0 0 1 0 0 ...  
## $ Unidentified.48 : int 0 0 2 2 1 3 2 0 0 0 ...  
## $ Unidentified.50 : int 0 0 0 2 0 0 0 0 0 0 ...  
## $ Unidentified.51 : int 0 0 0 5 1 0 0 0 0 0 ...  
## $ Unidentified.52 : int 0 0 0 4 0 0 0 0 0 0 ...  
## $ Unidentified.53 : int 0 0 0 8 0 0 1 0 0 0 ...  
## $ Unidentified.54 : int 0 0 0 1 7 0 1 0 0 0 ...  
## $ Unidentified.55 : int 0 0 0 0 0 1 0 0 0 0 ...  
## $ Unidentified.56 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.57 : int 0 0 0 1 2 0 0 0 0 0 ...  
## $ Unidentified.58 : int 0 0 0 3 0 0 0 0 0 0 ...  
## $ Unidentified.59 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.60 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.61 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.62 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.63 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.64 : int 0 0 0 2 1 1 0 0 0 0 ...  
## $ Unidentified.65 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ Unidentified.66 : int 0 0 0 1 1 0 0 0 0 0 ...  
## $ Unidentified.67 : int 0 0 0 4 7 0 0 0 0 0 ...  
## $ Unidentified.68 : int 0 0 0 1 1 0 1 0 0 0 ...  
## $ centric.3 : int 0 0 0 2 0 0 0 0 0 0 ...  
## $ Unidentified.69 : int 0 0 0 4 0 0 0 0 0 0 ...  
## $ centric.4 : int 0 0 0 0 2 0 0 0 0 0 ...  
## $ Unidentified.70 : int 0 0 0 0 3 0 1 0 0 0 ...  
## $ Unidentified.71 : int 0 0 0 0 3 0 3 0 0 0 ...  
## $ Unidentified.72 : int 0 0 0 0 2 0 0 0 0 0 ...  
## $ Unidentified.73 : int 0 0 0 0 0 1 0 0 0 0 ...  
## $ Unidentified.74 : int 0 0 0 0 5 60 0 0 0 0 ...  
## $ Unidentified.75 : int 0 0 0 0 0 2 0 0 0 0 ...  
## $ Unidentified.76 : int 0 0 0 0 0 0 1 0 0 0 ...  
## [list output truncated]

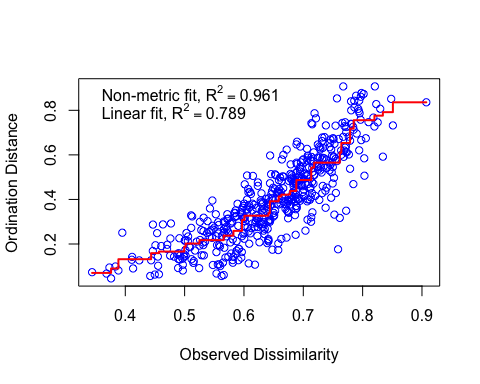
ne.hel=decostand(necounts[,5:147],method="hellinger")  
ne.dist.hel=vegdist(ne.hel,method="euclidean")  
ne.hel.nmds=metaMDS(ne.dist.hel, k=2, trymax=100, wascores=TRUE)

## Run 0 stress 0.1970826   
## Run 1 stress 0.2466387   
## Run 2 stress 0.1977042   
## Run 3 stress 0.2086884   
## Run 4 stress 0.2019214   
## Run 5 stress 0.2517136   
## Run 6 stress 0.2297404   
## Run 7 stress 0.2070092   
## Run 8 stress 0.2012291   
## Run 9 stress 0.2012166   
## Run 10 stress 0.2019214   
## Run 11 stress 0.2464141   
## Run 12 stress 0.2349899   
## Run 13 stress 0.2480743   
## Run 14 stress 0.2426376   
## Run 15 stress 0.2367742   
## Run 16 stress 0.2019214   
## Run 17 stress 0.2019214   
## Run 18 stress 0.2012291   
## Run 19 stress 0.2157715   
## Run 20 stress 0.2019219   
## Run 21 stress 0.2369525   
## Run 22 stress 0.1970826   
## ... Procrustes: rmse 0.0001374394 max resid 0.0006127843   
## ... Similar to previous best  
## \*\*\* Solution reached

ne.hel.nmds$stress

## [1] 0.1970826

stressplot(ne.hel.nmds)



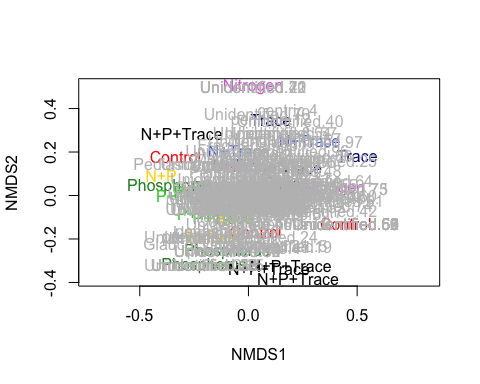
#stress is 0.1970  
goodness(ne.hel.nmds)

## [1] 0.04382294 0.03135363 0.02489752 0.04662494 0.04589518 0.03453066  
## [7] 0.02622317 0.02987173 0.02928714 0.02737840 0.04755408 0.02873325  
## [13] 0.03464503 0.04443097 0.05306688 0.02155992 0.02889643 0.03799975  
## [19] 0.03314728 0.02242982 0.02276021 0.02357584 0.02885185 0.02028610  
## [25] 0.04225407 0.01893099 0.02284729 0.03165946 0.04569496 0.03612226  
## [31] 0.04234037 0.04542738

plot(ne.hel.nmds, type="none")

## species scores not available

text(ne.hel.nmds, labels=necounts$Treatment,col=colors)  
ne.hel.nmds.spwa=wascores(scores(ne.hel.nmds), necounts[,5:147])  
text(ne.hel.nmds.spwa[,1:2],labels=rownames(ne.hel.nmds.spwa),col=8)  
text(matrix(c(-1.1,0.4),nrow=1),labels="Stress=0.1970")



# Bray-Curtis NMDS  
ne.dist.bc=vegdist(necounts[,5:147], method="bray")  
ne.bc.nmds=metaMDS(ne.dist.bc, k=2, trymax=100)

## Run 0 stress 0.2005545   
## Run 1 stress 0.2347838   
## Run 2 stress 0.2189891   
## Run 3 stress 0.2047513   
## Run 4 stress 0.2092188   
## Run 5 stress 0.2022558   
## Run 6 stress 0.193206   
## ... New best solution  
## ... Procrustes: rmse 0.1179031 max resid 0.2887844   
## Run 7 stress 0.1982199   
## Run 8 stress 0.1982199   
## Run 9 stress 0.2200426   
## Run 10 stress 0.2046644   
## Run 11 stress 0.2250171   
## Run 12 stress 0.2188422   
## Run 13 stress 0.1967262   
## Run 14 stress 0.2022741   
## Run 15 stress 0.2082906   
## Run 16 stress 0.2123625   
## Run 17 stress 0.2245814   
## Run 18 stress 0.2032809   
## Run 19 stress 0.2017095   
## Run 20 stress 0.1980554   
## Run 21 stress 0.1939732   
## Run 22 stress 0.2269368   
## Run 23 stress 0.1976509   
## Run 24 stress 0.193973   
## Run 25 stress 0.1999853   
## Run 26 stress 0.2022558   
## Run 27 stress 0.2017095   
## Run 28 stress 0.2257138   
## Run 29 stress 0.2009828   
## Run 30 stress 0.2036261   
## Run 31 stress 0.1967262   
## Run 32 stress 0.2042266   
## Run 33 stress 0.210281   
## Run 34 stress 0.2000832   
## Run 35 stress 0.2004174   
## Run 36 stress 0.2232177   
## Run 37 stress 0.2055404   
## Run 38 stress 0.2012624   
## Run 39 stress 0.193973   
## Run 40 stress 0.1967262   
## Run 41 stress 0.2012624   
## Run 42 stress 0.2017095   
## Run 43 stress 0.1982199   
## Run 44 stress 0.2009828   
## Run 45 stress 0.2039418   
## Run 46 stress 0.210966   
## Run 47 stress 0.2022979   
## Run 48 stress 0.193973   
## Run 49 stress 0.2005721   
## Run 50 stress 0.2102164   
## Run 51 stress 0.2050344   
## Run 52 stress 0.2005721   
## Run 53 stress 0.2012624   
## Run 54 stress 0.2087701   
## Run 55 stress 0.1982201   
## Run 56 stress 0.1965825   
## Run 57 stress 0.2023894   
## Run 58 stress 0.2056815   
## Run 59 stress 0.193973   
## Run 60 stress 0.2036675   
## Run 61 stress 0.2038011   
## Run 62 stress 0.2223597   
## Run 63 stress 0.2011588   
## Run 64 stress 0.1996425   
## Run 65 stress 0.2036246   
## Run 66 stress 0.2340684   
## Run 67 stress 0.1976509   
## Run 68 stress 0.1996645   
## Run 69 stress 0.2283356   
## Run 70 stress 0.2032643   
## Run 71 stress 0.2202851   
## Run 72 stress 0.2003798   
## Run 73 stress 0.2015624   
## Run 74 stress 0.1976508   
## Run 75 stress 0.2017847   
## Run 76 stress 0.2084496   
## Run 77 stress 0.196154   
## Run 78 stress 0.193206   
## ... New best solution  
## ... Procrustes: rmse 4.496561e-06 max resid 1.483906e-05   
## ... Similar to previous best  
## \*\*\* Solution reached

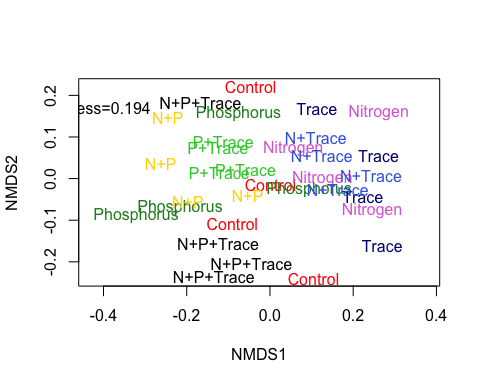
ne.bc.nmds$stress

## [1] 0.193206

# 0.194 stress  
plot(ne.bc.nmds, type="none")

## species scores not available

text(ne.bc.nmds, labels=necounts$Treatment,col=colors)  
text(matrix(c(-0.4,0.17),nrow=1),labels="Stress=0.194")

 Interpretation: Both the hellinger and BC transformed NMDS’s have terrible stresses, but interesting patterns emerging. N+P+trace treatments cluster strongly, and there generally seems to be a seperate between P treatments and N and trace treatments. The controls are all over- I’m not sure what that is indicative of. Perhaps the control, or lack of nutrient treatment showing no community pattern, and then the clustering of various treatments is overall indicative that there is an effect of nutrient treatments on the community.

GREEN BAY

# NMDS of Hellinger distance matrix  
str(gbcounts)

## 'data.frame': 32 obs. of 52 variables:  
## $ Sample.ID : Factor w/ 37 levels "1","10","11",..: 1 12 23 31 32 33 34 35 36 2 ...  
## $ Counter : Factor w/ 4 levels "Alyssa","Brian",..: 4 1 1 4 4 4 2 2 2 2 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Total.Counted : int 401 480 546 436 559 634 299 400 400 412 ...  
## $ Chlamydonaceae : int 2 0 0 0 3 1 0 0 0 0 ...  
## $ Aulacoseira.spp. : int 122 81 143 4 170 102 37 50 54 10 ...  
## $ morphospecies.1 : int 0 0 0 0 0 0 16 0 0 0 ...  
## $ Meloseira.spp... : int 28 16 0 0 30 0 0 24 28 22 ...  
## $ centric.1 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.3 : int 5 7 9 10 8 14 1 2 2 9 ...  
## $ Actinastrum.spp. : int 0 0 0 1 0 0 0 0 0 1 ...  
## $ morphospecies.2 : int 0 0 0 0 2 0 0 0 0 0 ...  
## $ morphospecies.3 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.4 : int 2 1 1 0 0 0 0 3 0 0 ...  
## $ morphospecies.5 : int 0 0 0 2 0 0 0 0 0 1 ...  
## $ morphospecies.7 : int 0 0 0 0 2 0 0 0 0 1 ...  
## $ Selenastrum.spp. : int 0 0 0 0 1 1 0 0 0 0 ...  
## $ morphospecies.8 : int 0 0 0 0 4 16 0 2 0 0 ...  
## $ Closterium.spp. : int 0 0 0 0 1 0 0 0 0 1 ...  
## $ pennate.4 : int 0 0 0 0 0 1 0 0 0 0 ...  
## $ Pediastrum.spp..1 : int 0 0 0 0 0 24 0 0 0 1 ...  
## $ Staurastrum.spp. : int 0 0 0 0 0 1 0 0 0 0 ...  
## $ Pediastrum.spp..2 : int 0 0 0 0 0 16 0 0 0 0 ...  
## $ Cosmarium.spp. : int 0 0 0 0 0 1 0 0 0 1 ...  
## $ Merismopedia.spp. : int 0 0 0 0 0 0 4 48 0 0 ...  
## $ Gomphoneis.spp... : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Atractomorpha.spp... : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.9 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.10 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.11 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pediastrum.spp..3 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Treubaria.spp. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.12 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ mophospecies.13 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Staurastrum.spp..3 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Dinobryon.spp.. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Cyclotella.spp. : int 7 11 7 6 40 10 9 25 15 20 ...  
## $ Scenedesmum.spp. : int 6 6 6 4 12 36 24 11 4 8 ...  
## $ Microcystis.spp. : int 226 221 252 380 201 351 162 217 273 312 ...  
## $ Navicula.spp... : int 1 4 1 1 1 1 1 0 0 0 ...  
## $ Stephanodiscus.spp. : int 0 2 2 1 4 3 0 0 1 2 ...  
## $ Pseudoanabaena.spp. : int 0 12 2 8 6 2 0 15 3 10 ...  
## $ Fragillaria.spp... : int 0 32 0 0 0 0 0 0 0 1 ...  
## $ Micractinium.spp. : int 0 0 2 0 0 0 0 0 0 0 ...  
## $ Staurastrum.spp..2 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pediastrum.spp. : int 0 8 48 15 0 22 0 1 0 0 ...  
## $ filamentous.cyanobacteria: int 0 64 66 0 71 31 41 0 15 10 ...  
## $ Coconeis.spp. : int 1 2 0 0 0 0 0 0 1 1 ...  
## $ Dolichospermum.spp. : int 1 10 5 2 3 1 3 1 3 1 ...  
## $ Planktothrix.spp.. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Diatoma.spp. : int 0 3 2 0 0 0 0 0 1 0 ...  
## $ Selenastrum.spp... : int 0 0 0 1 0 0 1 1 0 0 ...

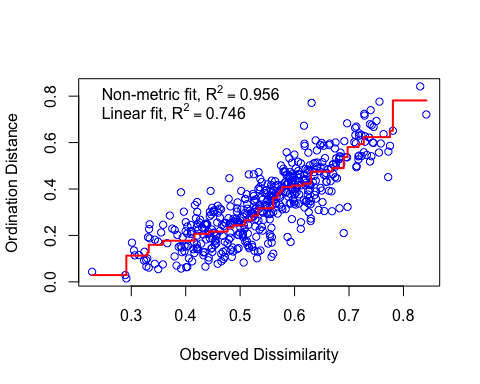
gb.hel=decostand(gbcounts[,5:52],method="hellinger")  
gb.dist.hel=vegdist(gb.hel,method="euclidean")  
gb.hel.nmds=metaMDS(gb.dist.hel, k=2, trymax=100, wascores=TRUE)

## Run 0 stress 0.2104263   
## Run 1 stress 0.210959   
## Run 2 stress 0.2109589   
## Run 3 stress 0.2104267   
## ... Procrustes: rmse 0.0003158966 max resid 0.001411695   
## ... Similar to previous best  
## Run 4 stress 0.2104261   
## ... New best solution  
## ... Procrustes: rmse 0.0003399906 max resid 0.001639561   
## ... Similar to previous best  
## Run 5 stress 0.2677709   
## Run 6 stress 0.2104262   
## ... Procrustes: rmse 8.679255e-05 max resid 0.0003587175   
## ... Similar to previous best  
## Run 7 stress 0.2109592   
## Run 8 stress 0.210426   
## ... New best solution  
## ... Procrustes: rmse 0.0001276728 max resid 0.0005014714   
## ... Similar to previous best  
## Run 9 stress 0.2332335   
## Run 10 stress 0.2111891   
## Run 11 stress 0.267216   
## Run 12 stress 0.2607238   
## Run 13 stress 0.210426   
## ... New best solution  
## ... Procrustes: rmse 0.0001718834 max resid 0.0008351217   
## ... Similar to previous best  
## Run 14 stress 0.2104262   
## ... Procrustes: rmse 0.0002616871 max resid 0.001194526   
## ... Similar to previous best  
## Run 15 stress 0.2109591   
## Run 16 stress 0.210427   
## ... Procrustes: rmse 0.0005686995 max resid 0.001902145   
## ... Similar to previous best  
## Run 17 stress 0.2470281   
## Run 18 stress 0.2104261   
## ... Procrustes: rmse 0.0001658525 max resid 0.0007934732   
## ... Similar to previous best  
## Run 19 stress 0.210426   
## ... New best solution  
## ... Procrustes: rmse 8.514024e-05 max resid 0.0003945102   
## ... Similar to previous best  
## Run 20 stress 0.2104265   
## ... Procrustes: rmse 0.0001115553 max resid 0.0004708331   
## ... Similar to previous best  
## \*\*\* Solution reached

gb.hel.nmds$stress

## [1] 0.210426

stressplot(gb.hel.nmds)



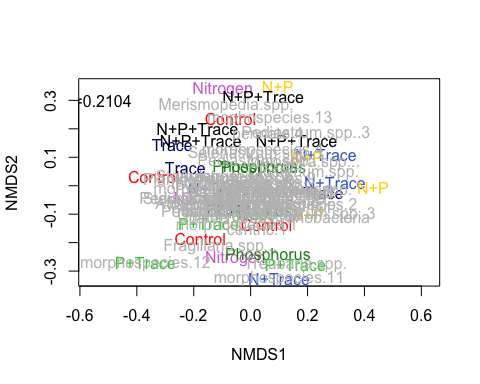
#stress is 0.2104  
goodness(gb.hel.nmds)

## [1] 0.03628637 0.04128432 0.04218111 0.05578625 0.04825701 0.03392356  
## [7] 0.03682294 0.03883096 0.02812497 0.04128838 0.02735895 0.02831576  
## [13] 0.03579102 0.02364341 0.02913893 0.02363491 0.02612836 0.04317523  
## [19] 0.03902335 0.03897705 0.04332221 0.02989534 0.05822478 0.03872573  
## [25] 0.03291564 0.02406900 0.03709968 0.04690286 0.02704615 0.03355671  
## [31] 0.03652407 0.03240140

plot(gb.hel.nmds, type="none")

## species scores not available

text(gb.hel.nmds, labels=gbcounts$Treatment,col=colors)  
gb.hel.nmds.spwa=wascores(scores(gb.hel.nmds), gbcounts[,5:52])  
text(gb.hel.nmds.spwa[,1:2],labels=rownames(gb.hel.nmds.spwa),col=8)  
text(matrix(c(-0.6,0.3),nrow=1),labels="Stress=0.2104")



# Bray-Curtis NMDS  
gb.dist.bc=vegdist(gbcounts[,5:52], method="bray")  
gb.bc.nmds=metaMDS(gb.dist.bc, k=2, trymax=100)

## Run 0 stress 0.2161621   
## Run 1 stress 0.2207585   
## Run 2 stress 0.2161621   
## ... New best solution  
## ... Procrustes: rmse 4.544796e-05 max resid 0.0001466107   
## ... Similar to previous best  
## Run 3 stress 0.2472028   
## Run 4 stress 0.2161621   
## ... Procrustes: rmse 4.395715e-05 max resid 0.0001346206   
## ... Similar to previous best  
## Run 5 stress 0.2208692   
## Run 6 stress 0.2161622   
## ... Procrustes: rmse 0.0001563283 max resid 0.0004500396   
## ... Similar to previous best  
## Run 7 stress 0.2208692   
## Run 8 stress 0.2218517   
## Run 9 stress 0.2214162   
## Run 10 stress 0.2214162   
## Run 11 stress 0.2207587   
## Run 12 stress 0.2161621   
## ... Procrustes: rmse 0.0001259951 max resid 0.000355412   
## ... Similar to previous best  
## Run 13 stress 0.22087   
## Run 14 stress 0.2208692   
## Run 15 stress 0.2207591   
## Run 16 stress 0.2161621   
## ... Procrustes: rmse 4.324635e-05 max resid 0.0001217669   
## ... Similar to previous best  
## Run 17 stress 0.2208692   
## Run 18 stress 0.2207574   
## Run 19 stress 0.2161621   
## ... Procrustes: rmse 6.099927e-05 max resid 0.0002327291   
## ... Similar to previous best  
## Run 20 stress 0.2161621   
## ... Procrustes: rmse 6.851633e-05 max resid 0.0002357659   
## ... Similar to previous best  
## \*\*\* Solution reached

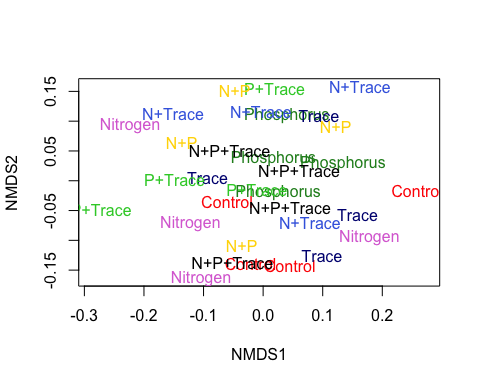
gb.bc.nmds$stress

## [1] 0.2161621

# 0.2161 stress  
plot(gb.bc.nmds, type="none")

## species scores not available

text(gb.bc.nmds, labels=gbcounts$Treatment,col=colors)  
text(matrix(c(-0.45,0.15),nrow=1),labels="Stress=0.2161")

 Intepretation: Both of these NMDSs are really bad- super high stress and no discernable patterns.

FORD

# NMDS of Hellinger distance matrix  
str(fordcounts)

## 'data.frame': 32 obs. of 80 variables:  
## $ Sample.ID : Factor w/ 37 levels "37","38","39",..: 1 2 3 4 5 6 7 8 9 10 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Total.counted : int 420 411 411 519 467 420 657 466 404 403 ...  
## $ pennate.1 : int 24 7 7 10 1 0 2 3 6 30 ...  
## $ morphospecies.2 : int 0 0 0 2 1 7 20 3 5 4 ...  
## $ Cymbella.spp.. : int 0 1 1 0 0 0 0 0 0 0 ...  
## $ Cymbella.spp.2. : int 1 2 2 9 2 1 2 1 4 0 ...  
## $ Scenedesmus.spp..3 : int 0 16 16 0 0 1 0 0 0 0 ...  
## $ morphospecies.3 : int 2 0 0 3 5 2 0 1 0 0 ...  
## $ morphospecies.4 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.6 : int 3 3 3 1 0 1 1 0 2 1 ...  
## $ morphospecies.8 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Dolichospermum.spp..: int 0 0 0 0 1 0 2 0 0 0 ...  
## $ Tabellaria.spp.. : int 2 0 0 10 2 0 0 0 0 2 ...  
## $ morphospecies.10 : int 0 11 11 10 0 3 0 0 3 1 ...  
## $ morphospecies.11 : int 0 0 0 0 0 0 2 0 0 0 ...  
## $ morphospecies.12 : int 0 8 8 1 0 0 0 0 0 0 ...  
## $ morphospecies.13 : int 0 4 4 1 1 2 0 0 1 1 ...  
## $ pennate.3 : int 0 20 20 2 5 11 12 1 6 2 ...  
## $ morphospecies.14 : int 0 1 1 0 0 0 0 3 0 0 ...  
## $ morphospecies.15 : int 0 4 4 0 4 0 0 0 0 10 ...  
## $ morphospecies.16 : int 0 4 4 0 0 0 0 0 0 0 ...  
## $ Coconeis.spp. : int 0 2 2 0 2 0 0 2 1 0 ...  
## $ Staurastrum.spp. : int 0 1 1 0 0 0 0 0 0 0 ...  
## $ morphospecies.17 : int 23 14 14 20 0 0 0 3 0 0 ...  
## $ Selenastrum.spp... : int 0 1 1 2 0 1 1 0 0 1 ...  
## $ morphospecies.18 : int 0 0 0 1 0 0 6 1 0 0 ...  
## $ Staurastrum.spp..2 : int 0 0 0 1 0 0 0 0 1 0 ...  
## $ morphospecies.44 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ morphospecies.45 : int 0 0 0 1 0 0 0 0 0 0 ...  
## $ morphospecies.20 : int 3 0 0 0 4 3 1 3 6 1 ...  
## $ morphospecies.21 : int 10 0 0 0 3 4 0 7 0 0 ...  
## $ morphospecies.22 : int 3 0 0 0 5 1 0 6 0 0 ...  
## $ morphospecies.23 : int 1 0 0 0 1 1 0 2 0 0 ...  
## $ pennate.4 : int 0 0 0 0 1 0 1 0 0 0 ...  
## $ morphospecies.24 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.25 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.26 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.27 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Asterionella.spp.. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.28 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.29 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.5 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.30 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Cosmarium.spp. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.31 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.6 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.31.1 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.32 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Scenedesmus.spp..3.1: int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.33 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.34 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Selenastrum.spp.. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.35 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.36 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.37 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.38 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.7 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.38.1 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.39 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.8 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.9 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Scenedesmus.spp..2. : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.40 : int 8 7 7 37 14 14 4 3 16 17 ...  
## $ Scenedesmus.spp.1. : int 13 49 49 40 23 40 24 80 65 52 ...  
## $ Cyclotella.spp... : int 23 18 18 32 30 12 2 27 2 3 ...  
## $ pennate.2 : int 0 1 1 17 6 1 10 0 13 8 ...  
## $ Fragillaria.spp. : int 152 60 60 223 118 32 476 8 65 39 ...  
## $ morphospecies.7 : int 26 7 7 0 10 3 1 6 2 28 ...  
## $ morphospecies.41 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Peridinium.spp... : int 1 0 0 0 0 0 1 0 2 0 ...  
## $ morphospecies.1 : int 3 3 3 6 0 5 0 7 1 0 ...  
## $ Nitzschia.spp. : int 0 1 1 8 5 0 0 1 0 0 ...  
## $ morphospecies.43 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pinnularia.spp... : int 4 1 1 0 0 1 2 6 0 0 ...  
## $ Microcystis.spp. : int 92 157 157 60 182 257 50 273 202 202 ...  
## $ Synedra.spp.. : int 22 6 6 18 29 3 0 15 0 0 ...  
## $ morphospecies.19 : int 1 0 0 0 2 1 0 1 0 0 ...  
## $ morphospecies.9 : int 2 2 2 3 1 0 1 2 1 1 ...  
## $ Pediastrum.spp. : int 0 0 0 0 0 0 35 0 0 0 ...

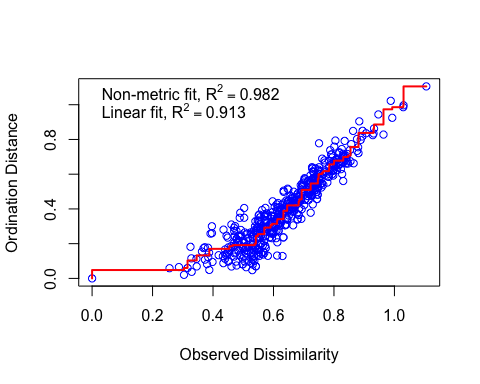
ford.hel=decostand(fordcounts[,4:80],method="hellinger")  
ford.dist.hel=vegdist(ford.hel,method="euclidean")  
ford.hel.nmds=metaMDS(ford.dist.hel, k=2, trymax=100, wascores=TRUE)

## Run 0 stress 0.1358616   
## Run 1 stress 0.1361501   
## ... Procrustes: rmse 0.01157264 max resid 0.05142904   
## Run 2 stress 0.1361492   
## ... Procrustes: rmse 0.01147344 max resid 0.05075779   
## Run 3 stress 0.1915179   
## Run 4 stress 0.1360643   
## ... Procrustes: rmse 0.009285148 max resid 0.03921429   
## Run 5 stress 0.192353   
## Run 6 stress 0.1360643   
## ... Procrustes: rmse 0.009286059 max resid 0.03921524   
## Run 7 stress 0.1360644   
## ... Procrustes: rmse 0.009282641 max resid 0.03915138   
## Run 8 stress 0.1358617   
## ... Procrustes: rmse 0.0001037882 max resid 0.000364595   
## ... Similar to previous best  
## Run 9 stress 0.1358616   
## ... New best solution  
## ... Procrustes: rmse 1.880989e-05 max resid 9.064741e-05   
## ... Similar to previous best  
## Run 10 stress 0.1911887   
## Run 11 stress 0.2028963   
## Run 12 stress 0.1360643   
## ... Procrustes: rmse 0.009287436 max resid 0.039229   
## Run 13 stress 0.1361498   
## ... Procrustes: rmse 0.0116198 max resid 0.05169595   
## Run 14 stress 0.1361506   
## ... Procrustes: rmse 0.01176303 max resid 0.05232641   
## Run 15 stress 0.202946   
## Run 16 stress 0.1358617   
## ... Procrustes: rmse 4.782732e-05 max resid 0.0001557018   
## ... Similar to previous best  
## Run 17 stress 0.1358617   
## ... Procrustes: rmse 2.672834e-05 max resid 9.812034e-05   
## ... Similar to previous best  
## Run 18 stress 0.1361494   
## ... Procrustes: rmse 0.011507 max resid 0.0509777   
## Run 19 stress 0.1358616   
## ... Procrustes: rmse 3.870353e-05 max resid 0.000179841   
## ... Similar to previous best  
## Run 20 stress 0.1358619   
## ... Procrustes: rmse 0.000214041 max resid 0.001030145   
## ... Similar to previous best  
## \*\*\* Solution reached

ford.hel.nmds$stress

## [1] 0.1358616

stressplot(ford.hel.nmds)



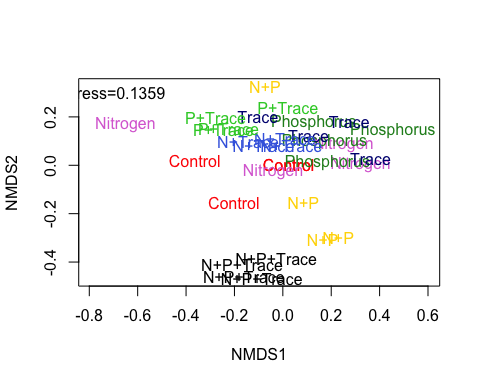
#stress is 0.1359  
goodness(ford.hel.nmds)

## [1] 0.02136401 0.02419324 0.02419324 0.01908777 0.02625189 0.02112193  
## [7] 0.02361854 0.01930015 0.02580321 0.02805833 0.02058167 0.02681647  
## [13] 0.02204595 0.02432849 0.03057561 0.03524257 0.02159214 0.01822677  
## [19] 0.01714983 0.02314565 0.02615990 0.02603191 0.01923597 0.02142999  
## [25] 0.03326873 0.02138516 0.02062656 0.02518984 0.02391461 0.02195731  
## [31] 0.02308755 0.02280419

plot(ford.hel.nmds, type="none")

## species scores not available

text(ford.hel.nmds, labels=fordcounts$Treatment,col=colors)  
ford.hel.nmds.spwa=wascores(scores(ford.hel.nmds), fordcounts[,4:80])  
#text(ford.hel.nmds.spwa[,1:2],labels=rownames(ford.hel.nmds.spwa),col=8)  
text(matrix(c(-0.7,0.3),nrow=1),labels="Stress=0.1359")



# Bray-Curtis NMDS  
ford.dist.bc=vegdist(fordcounts[,4:80], method="bray")  
ford.bc.nmds=metaMDS(ford.dist.bc, k=2, trymax=100)

## Run 0 stress 0.1125374   
## Run 1 stress 0.112453   
## ... New best solution  
## ... Procrustes: rmse 0.003754912 max resid 0.01742839   
## Run 2 stress 0.1125371   
## ... Procrustes: rmse 0.003723703 max resid 0.01728557   
## Run 3 stress 0.1124529   
## ... New best solution  
## ... Procrustes: rmse 0.0001900634 max resid 0.0009342683   
## ... Similar to previous best  
## Run 4 stress 0.1124531   
## ... Procrustes: rmse 0.0001096338 max resid 0.0005370942   
## ... Similar to previous best  
## Run 5 stress 0.1124536   
## ... Procrustes: rmse 0.0002595144 max resid 0.001272364   
## ... Similar to previous best  
## Run 6 stress 0.1740624   
## Run 7 stress 0.1125371   
## ... Procrustes: rmse 0.003703553 max resid 0.01713894   
## Run 8 stress 0.1125373   
## ... Procrustes: rmse 0.003623011 max resid 0.01662097   
## Run 9 stress 0.1125374   
## ... Procrustes: rmse 0.003685088 max resid 0.01693511   
## Run 10 stress 0.2129849   
## Run 11 stress 0.1125372   
## ... Procrustes: rmse 0.003706646 max resid 0.01714512   
## Run 12 stress 0.1124529   
## ... New best solution  
## ... Procrustes: rmse 4.635522e-06 max resid 1.469215e-05   
## ... Similar to previous best  
## Run 13 stress 0.1125373   
## ... Procrustes: rmse 0.003781326 max resid 0.01761816   
## Run 14 stress 0.1125373   
## ... Procrustes: rmse 0.003704532 max resid 0.01715615   
## Run 15 stress 0.208388   
## Run 16 stress 0.1125373   
## ... Procrustes: rmse 0.00370894 max resid 0.01710636   
## Run 17 stress 0.1125375   
## ... Procrustes: rmse 0.003720602 max resid 0.01724173   
## Run 18 stress 0.1124529   
## ... New best solution  
## ... Procrustes: rmse 5.602738e-05 max resid 0.0002642131   
## ... Similar to previous best  
## Run 19 stress 0.1124531   
## ... Procrustes: rmse 0.0001736127 max resid 0.0008456398   
## ... Similar to previous best  
## Run 20 stress 0.1124529   
## ... New best solution  
## ... Procrustes: rmse 3.801649e-05 max resid 0.0001716994   
## ... Similar to previous best  
## \*\*\* Solution reached

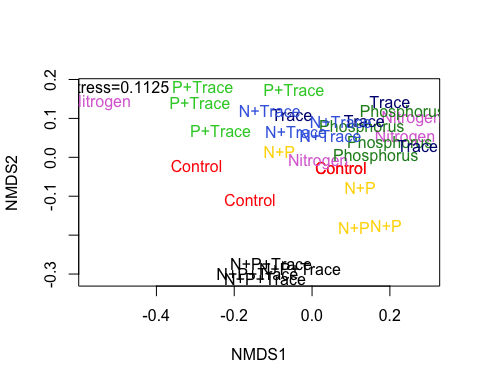
ford.bc.nmds$stress

## [1] 0.1124529

# 0.1125 stress  
plot(ford.bc.nmds, type="none")

## species scores not available

text(ford.bc.nmds, labels=fordcounts$Treatment,col=colors)  
text(matrix(c(-0.5,0.18),nrow=1),labels="Stress=0.1125")

 Interpretation: Both of these NMDSs have great stress values and depict a very clear divergence in the N+P+trace treatment communities from the rest of the treatments. The rest of the treatments cluster, with replicates generally being close to one another. N+P and P+trace treatments cluster on the outer edge of the larger cluster that the rest of the treatments fall within. They may have been begining to separate/exhibit a community composition change during the experiment. Considering the experiment only last 72 hours, there is a chance the communities would have futher shifted if given more time. The reason we ended the experiment at 72 hours is that any longer other effects start to skew results, namely herbivory.

RDA Maumee

#new vegan update installed  
library(vegan)  
  
#MAUMEE  
#add columns for treatments n,p,trace as y/n for analysis of interactive effects  
#deleted morphospecies 12 and renamed mougeotia to filamentous chlorophyte  
maumcounts<- read.csv("~/Desktop/USGS/Maumee Species Counts\_no12.csv")  
maumcounts<-maumcounts[which(maumcounts$Treatment!='Chelex'& maumcounts$Treatment!='Initial'),]  
  
maumcounts$trace<-grepl("Trace", maumcounts$Treatment)   
maumcounts$nitrogen<-grepl("N", maumcounts$Treatment)   
maumcounts$phosphorus<-grepl("P", maumcounts$Treatment)   
  
dim(maumcounts)

## [1] 32 72

names(maumcounts)

## [1] "Lowest.taxonimic.Sample.ID" "Treatment"   
## [3] "Total.counted" "Microcystis.spp."   
## [5] "Nitzschia.spp." "Pseudoanabaena.spp."   
## [7] "Glaucocystis.spp..." "morphospecies.10"   
## [9] "Aulacoseria.spp." "Filamentous.Chlorophyte"   
## [11] "Diatoma.spp..." "morphospecies.1"   
## [13] "pollen." "Selenastraceae"   
## [15] "morphospecies.2" "morphospecies.3"   
## [17] "Cyclotella.spp." "morphospecies.4"   
## [19] "Dolichospermum.spp." "Aphanocapsa.spp.."   
## [21] "morphospecies.5" "Merismopedia.spp."   
## [23] "Scenedesmus.spp." "morphospecies.6"   
## [25] "morphospecies.7" "morphospecies.8"   
## [27] "clamydomonadaceae.1" "morphospecies.11"   
## [29] "morphospecies.13" "Westella.spp.."   
## [31] "Melosira.spp..." "morphospecies.14"   
## [33] "morphospecies.15" "morphospecies.16"   
## [35] "Unidentified.13" "Spirulina.spp..."   
## [37] "Tetraedron.spp." "Cycyotella.spp..2.."   
## [39] "Thalassiosira.spp." "Micractinium.spp..."   
## [41] "morphospecies.17" "morphospecies.18"   
## [43] "morphospecies.19" "morphospecies.20"   
## [45] "clamydomonadaceae.2" "morphospecies.21"   
## [47] "Dinobryon.spp." "morphospecies.22"   
## [49] "morphospecies.23" "morphospecies.24"   
## [51] "morphospecies.25" "morphospecies.26"   
## [53] "morphospecies.27" "morphospecies.28"   
## [55] "morphospecies.29" "Tetraselmis.spp..."   
## [57] "morphospecies.30" "morphospecies.31"   
## [59] "Kirchneriella.spp." "morphospecies.32"   
## [61] "Tetraedron.spp..2" "Dinobryon.spp..1"   
## [63] "Desmodesmus.spp..." "Selenastrum.spp."   
## [65] "Unidentified.33" "Euglena.spp."   
## [67] "Phacus.spp." "Unidentified.34"   
## [69] "Treubaria.spp." "trace"   
## [71] "nitrogen" "phosphorus"

maum.colsums=apply(maumcounts[,4:69],2,sum)  
maum.rowsums=apply(maumcounts[,4:69],1,sum)  
min(maum.rowsums)

## [1] 399

min=min(maum.rowsums)  
n=nrow(maumcounts)  
  
# Rarefaction and Hellinger distance transformation  
maum.rare=rrarefy(maumcounts[,4:69],sample=min)  
str(maum.rare)

## int [1:32, 1:66] 153 192 166 174 134 127 200 155 154 130 ...  
## - attr(\*, "dimnames")=List of 2  
## ..$ : chr [1:32] "2" "3" "4" "5" ...  
## ..$ : chr [1:66] "Microcystis.spp." "Nitzschia.spp." "Pseudoanabaena.spp." "Glaucocystis.spp..." ...

maum.rare.hel1=cbind(maumcounts[,1:3],decostand(maum.rare,method="hellinger"))  
#maum.stands.hel.dist=vegdist(maum.rare.hel[4:70],method="euclidean")  
maum.rare.hel=cbind(maumcounts[,70:72],maum.rare.hel1)  
str(maum.rare.hel)

## 'data.frame': 32 obs. of 72 variables:  
## $ trace : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ nitrogen : logi FALSE FALSE FALSE FALSE TRUE TRUE ...  
## $ phosphorus : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ Lowest.taxonimic.Sample.ID: Factor w/ 37 levels "37","38","39",..: 1 2 3 4 5 6 7 8 9 10 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Total.counted : int 453 439 403 400 461 411 408 430 407 399 ...  
## $ Microcystis.spp. : num 0.619 0.694 0.645 0.66 0.58 ...  
## $ Nitzschia.spp. : num 0.173 0.27 0.255 0.218 0.212 ...  
## $ Pseudoanabaena.spp. : num 0.245 0.194 0.158 0.166 0.194 ...  
## $ Glaucocystis.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.10 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Aulacoseria.spp. : num 0.194 0 0 0 0 ...  
## $ Filamentous.Chlorophyte : num 0.467 0.388 0.41 0.453 0.467 ...  
## $ Diatoma.spp... : num 0.0501 0 0 0 0.1001 ...  
## $ morphospecies.1 : num 0 0 0.0501 0 0 ...  
## $ pollen. : num 0 0 0 0 0.0867 ...  
## $ Selenastraceae : num 0.1416 0.0501 0.0867 0.0501 0.1001 ...  
## $ morphospecies.2 : num 0 0 0.0501 0 0.0501 ...  
## $ morphospecies.3 : num 0.112 0 0 0 0 ...  
## $ Cyclotella.spp. : num 0.181 0.181 0.235 0.173 0.15 ...  
## $ morphospecies.4 : num 0.1502 0 0.0708 0.0708 0 ...  
## $ Dolichospermum.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Aphanocapsa.spp.. : num 0.0708 0 0 0 0.1001 ...  
## $ morphospecies.5 : num 0 0 0.0501 0.0501 0.0501 ...  
## $ Merismopedia.spp. : num 0.112 0 0 0 0.2 ...  
## $ Scenedesmus.spp. : num 0 0.0708 0 0.1001 0 ...  
## $ morphospecies.6 : num 0 0.1001 0 0 0.0867 ...  
## $ morphospecies.7 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.8 : num 0.0501 0.0501 0.0501 0.0501 0.0867 ...  
## $ clamydomonadaceae.1 : num 0.0501 0 0.0501 0.0708 0.0501 ...  
## $ morphospecies.11 : num 0.112 0.132 0.235 0.245 0.181 ...  
## $ morphospecies.13 : num 0 0 0 0 0.0867 ...  
## $ Westella.spp.. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Melosira.spp... : num 0.321 0.313 0.305 0.218 0.288 ...  
## $ morphospecies.14 : num 0.0708 0.0867 0.0501 0.0501 0 ...  
## $ morphospecies.15 : num 0.1119 0 0 0.0501 0 ...  
## $ morphospecies.16 : num 0.1 0 0 0 0 ...  
## $ Unidentified.13 : num 0.0708 0 0 0.0501 0 ...  
## $ Spirulina.spp... : num 0.0867 0 0.0867 0 0.0867 ...  
## $ Tetraedron.spp. : num 0.0501 0 0 0 0 ...  
## $ Cycyotella.spp..2.. : num 0 0.279 0.24 0.255 0.255 ...  
## $ Thalassiosira.spp. : num 0 0.0501 0 0.0867 0.0501 ...  
## $ Micractinium.spp... : num 0 0.0501 0 0 0.0501 ...  
## $ morphospecies.17 : num 0 0 0.0501 0 0 ...  
## $ morphospecies.18 : num 0 0 0.1 0.112 0.112 ...  
## $ morphospecies.19 : num 0 0 0.0867 0 0 ...  
## $ morphospecies.20 : num 0 0 0.0708 0.1001 0.0501 ...  
## $ clamydomonadaceae.2 : num 0 0 0.0708 0.0501 0.0708 ...  
## $ morphospecies.21 : num 0 0 0 0.0501 0.0708 ...  
## $ Dinobryon.spp. : num 0 0 0 0.0867 0 ...  
## $ morphospecies.22 : num 0 0 0 0.0501 0 ...  
## $ morphospecies.23 : num 0 0 0 0 0.1 ...  
## $ morphospecies.24 : num 0 0 0 0 0.0501 ...  
## $ morphospecies.25 : num 0 0 0 0 0.0501 ...  
## $ morphospecies.26 : num 0 0 0 0 0 ...  
## $ morphospecies.27 : num 0 0 0 0 0 ...  
## $ morphospecies.28 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.29 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Tetraselmis.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.30 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.31 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Kirchneriella.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.32 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Tetraedron.spp..2 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Dinobryon.spp..1 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Desmodesmus.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Selenastrum.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.33 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Euglena.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Phacus.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.34 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Treubaria.spp. : num 0 0 0 0 0 0 0 0 0 0 ...

# RDA - Redundancy Analysis -Treatments apart  
rda.maum.rare.hel.all.treats=rda(maum.rare.hel[,7:72]~maum.rare.hel$trace\*maum.rare.hel$nitrogen\*maum.rare.hel$phosphorus)  
 summary(rda.maum.rare.hel.all.treats)

##   
## Call:  
## rda(formula = maum.rare.hel[, 7:72] ~ maum.rare.hel$trace \* maum.rare.hel$nitrogen \* maum.rare.hel$phosphorus)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.10508 1.0000  
## Constrained 0.03509 0.3339  
## Unconstrained 0.06999 0.6661  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.01289 0.008818 0.004013 0.003129 0.002777 0.002051  
## Proportion Explained 0.12265 0.083915 0.038192 0.029780 0.026425 0.019514  
## Cumulative Proportion 0.12265 0.206560 0.244752 0.274532 0.300957 0.320472  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 0.001413 0.01702 0.009268 0.006308 0.005432 0.004751  
## Proportion Explained 0.013448 0.16195 0.088196 0.060031 0.051694 0.045215  
## Cumulative Proportion 0.333920 0.49587 0.584063 0.644093 0.695787 0.741002  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 0.004387 0.003597 0.003163 0.002504 0.001985  
## Proportion Explained 0.041751 0.034228 0.030100 0.023833 0.018892  
## Cumulative Proportion 0.782753 0.816981 0.847082 0.870914 0.889806  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 0.001793 0.00173 0.001252 0.001077 0.001025  
## Proportion Explained 0.017068 0.01646 0.011914 0.010253 0.009755  
## Cumulative Proportion 0.906874 0.92334 0.935249 0.945502 0.955258  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 0.0009198 0.0007791 0.0007224 0.0006151 0.0004914  
## Proportion Explained 0.0087530 0.0074141 0.0068752 0.0058539 0.0046769  
## Cumulative Proportion 0.9640105 0.9714246 0.9782998 0.9841537 0.9888306  
## PC21 PC22 PC23 PC24  
## Eigenvalue 0.000391 0.0003065 0.0002515 0.0002247  
## Proportion Explained 0.003721 0.0029171 0.0023937 0.0021379  
## Cumulative Proportion 0.992551 0.9954683 0.9978621 1.0000000  
##   
## Accumulated constrained eigenvalues  
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.01289 0.008818 0.004013 0.003129 0.002777 0.002051  
## Proportion Explained 0.36729 0.251301 0.114375 0.089183 0.079136 0.058440  
## Cumulative Proportion 0.36729 0.618592 0.732966 0.822149 0.901285 0.959725  
## RDA7  
## Eigenvalue 0.001413  
## Proportion Explained 0.040275  
## Cumulative Proportion 1.000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.343445   
##   
##   
## Species scores  
##   
## RDA1 RDA2 RDA3 RDA4  
## Microcystis.spp. -1.779e-01 -3.984e-02 -0.025507 -0.0013933  
## Nitzschia.spp. 5.136e-02 -7.761e-02 -0.028584 0.0625428  
## Pseudoanabaena.spp. -7.129e-02 -1.030e-01 0.080786 -0.0143416  
## Glaucocystis.spp... -8.047e-04 -1.235e-02 0.009835 -0.0189600  
## morphospecies.10 1.114e-02 -3.102e-05 0.011307 -0.0179876  
## Aulacoseria.spp. 1.456e-01 2.014e-01 0.059889 -0.0255940  
## Filamentous.Chlorophyte -1.094e-01 1.694e-01 -0.030123 0.0052382  
## Diatoma.spp... -7.091e-05 -1.162e-02 0.073098 -0.0933953  
## morphospecies.1 -1.861e-02 -3.244e-04 -0.006629 -0.0274242  
## pollen. -2.009e-02 -3.307e-02 0.038412 0.0433097  
## Selenastraceae 6.205e-02 -2.387e-02 -0.006864 0.0157897  
## morphospecies.2 6.606e-03 -2.204e-03 0.011472 -0.0117833  
## morphospecies.3 -1.363e-02 -3.450e-02 0.005408 -0.0015308  
## Cyclotella.spp. -1.840e-02 -1.416e-02 -0.005878 -0.0448447  
## morphospecies.4 -5.762e-03 -7.738e-02 -0.053963 -0.0174757  
## Dolichospermum.spp. -8.047e-04 -1.235e-02 0.009835 -0.0189600  
## Aphanocapsa.spp.. 2.192e-02 -1.687e-02 0.059303 -0.0043426  
## morphospecies.5 4.916e-02 -4.994e-03 -0.042965 -0.0183101  
## Merismopedia.spp. 7.587e-02 -4.004e-02 0.114506 0.0042821  
## Scenedesmus.spp. 4.802e-02 6.831e-02 0.003586 0.0561931  
## morphospecies.6 -7.145e-03 -3.162e-02 0.024640 -0.0904685  
## morphospecies.7 2.726e-02 -3.998e-03 0.010377 0.0170525  
## morphospecies.8 1.932e-02 -5.039e-02 0.026667 0.0226126  
## clamydomonadaceae.1 -4.934e-03 6.166e-03 0.015744 -0.0174631  
## morphospecies.11 -4.256e-02 -9.157e-02 -0.056482 -0.0280805  
## morphospecies.13 -2.160e-03 5.886e-03 0.036494 0.0103179  
## Westella.spp.. 7.439e-03 -1.480e-02 0.006133 0.0157275  
## Melosira.spp... 3.039e-01 -3.111e-02 -0.054831 0.0107280  
## morphospecies.14 2.056e-02 1.927e-02 -0.025619 -0.0192504  
## morphospecies.15 4.631e-02 -2.900e-02 0.032673 -0.0198744  
## morphospecies.16 -1.694e-03 -4.127e-02 -0.000983 -0.0111926  
## Unidentified.13 -3.099e-02 -5.684e-02 0.034473 0.0295091  
## Spirulina.spp... 6.985e-02 -7.317e-05 0.019074 -0.0333698  
## Tetraedron.spp. -1.464e-03 -1.146e-02 -0.006853 -0.0040758  
## Cycyotella.spp..2.. -1.039e-01 1.025e-01 0.068612 0.0390174  
## Thalassiosira.spp. 2.128e-02 5.404e-03 0.033484 -0.0163880  
## Micractinium.spp... 1.927e-02 -5.704e-02 0.034798 0.0236779  
## morphospecies.17 -5.591e-03 -1.406e-03 -0.009669 0.0016845  
## morphospecies.18 -5.470e-02 -4.338e-02 0.029085 0.0281535  
## morphospecies.19 1.539e-02 -2.531e-03 -0.014992 -0.0348833  
## morphospecies.20 4.714e-02 -6.043e-02 0.021323 0.0495915  
## clamydomonadaceae.2 -1.058e-02 -3.437e-02 0.014310 0.0011003  
## morphospecies.21 -5.441e-03 -3.237e-02 0.047678 0.0389282  
## Dinobryon.spp. 3.937e-03 3.248e-03 -0.011332 -0.0048483  
## morphospecies.22 7.871e-03 -2.743e-02 -0.023246 -0.0150361  
## morphospecies.23 4.111e-02 -4.855e-03 0.015395 0.0176940  
## morphospecies.24 -4.601e-03 -4.145e-03 0.008742 0.0051053  
## morphospecies.25 5.190e-02 -2.036e-02 0.008053 0.0036110  
## morphospecies.26 1.827e-02 1.538e-03 0.007262 0.0285371  
## morphospecies.27 3.240e-02 4.075e-03 0.012411 0.0049908  
## morphospecies.28 6.039e-03 -1.279e-02 0.004731 0.0066457  
## morphospecies.29 3.115e-02 -3.037e-02 0.028769 0.0093408  
## Tetraselmis.spp... 5.980e-02 -1.638e-02 0.007566 -0.0574950  
## morphospecies.30 1.913e-03 -2.741e-03 0.001915 0.0124060  
## morphospecies.31 -2.094e-02 -2.808e-03 0.019270 -0.0292843  
## Kirchneriella.spp. 4.920e-03 -6.159e-03 -0.009175 0.0094038  
## morphospecies.32 6.831e-03 -1.393e-02 0.005524 0.0117844  
## Tetraedron.spp..2 1.913e-03 -2.741e-03 0.001915 0.0124060  
## Dinobryon.spp..1 -3.152e-03 3.035e-02 0.006404 -0.0091200  
## Desmodesmus.spp... 1.101e-02 2.814e-02 0.002027 0.0005379  
## Selenastrum.spp. -1.767e-03 -9.357e-03 -0.030752 -0.0331211  
## Unidentified.33 5.068e-04 -1.554e-02 0.010729 -0.0207909  
## Euglena.spp. 1.409e-02 -3.431e-02 0.009613 -0.0196670  
## Phacus.spp. 0.000e+00 0.000e+00 0.000000 0.0000000  
## Unidentified.34 1.167e-02 -2.842e-02 0.007963 -0.0162927  
## Treubaria.spp. 0.000e+00 0.000e+00 0.000000 0.0000000  
## RDA5 RDA6  
## Microcystis.spp. -0.0193434 0.017645  
## Nitzschia.spp. 0.0540161 -0.006632  
## Pseudoanabaena.spp. 0.0013369 0.019803  
## Glaucocystis.spp... -0.0090512 -0.009691  
## morphospecies.10 -0.0048803 -0.002430  
## Aulacoseria.spp. 0.0108639 0.028852  
## Filamentous.Chlorophyte -0.0218388 -0.013648  
## Diatoma.spp... -0.0166767 0.002614  
## morphospecies.1 0.0181501 -0.003077  
## pollen. 0.0416247 0.046273  
## Selenastraceae 0.0195413 -0.028489  
## morphospecies.2 -0.0073824 0.017940  
## morphospecies.3 -0.0259433 0.008217  
## Cyclotella.spp. 0.0169220 0.003123  
## morphospecies.4 -0.0848418 -0.022416  
## Dolichospermum.spp. -0.0090512 -0.009691  
## Aphanocapsa.spp.. -0.0269675 0.009152  
## morphospecies.5 0.0519205 -0.016191  
## Merismopedia.spp. 0.0255009 -0.018190  
## Scenedesmus.spp. -0.0489597 -0.043560  
## morphospecies.6 0.0433251 0.020420  
## morphospecies.7 -0.0054353 -0.015483  
## morphospecies.8 -0.0008393 0.011369  
## clamydomonadaceae.1 -0.0295023 -0.016962  
## morphospecies.11 0.0797196 -0.039052  
## morphospecies.13 0.0006669 0.012180  
## Westella.spp.. -0.0058560 -0.020770  
## Melosira.spp... -0.0122838 0.023830  
## morphospecies.14 0.0096382 -0.007073  
## morphospecies.15 -0.0141754 0.018328  
## morphospecies.16 -0.0450030 0.011646  
## Unidentified.13 -0.0187963 0.026707  
## Spirulina.spp... 0.0131138 0.001172  
## Tetraedron.spp. -0.0169889 0.003477  
## Cycyotella.spp..2.. 0.0546046 -0.030304  
## Thalassiosira.spp. 0.0015265 -0.051348  
## Micractinium.spp... -0.0351833 -0.003667  
## morphospecies.17 -0.0063834 0.007577  
## morphospecies.18 0.0023968 0.042116  
## morphospecies.19 0.0030201 0.008490  
## morphospecies.20 0.0007922 0.011828  
## clamydomonadaceae.2 0.0141956 -0.029389  
## morphospecies.21 0.0095462 -0.056227  
## Dinobryon.spp. -0.0319042 0.008132  
## morphospecies.22 -0.0099698 -0.002797  
## morphospecies.23 0.0158529 0.014166  
## morphospecies.24 0.0039733 0.010489  
## morphospecies.25 0.0321750 -0.030830  
## morphospecies.26 0.0063981 -0.017673  
## morphospecies.27 -0.0234044 -0.015442  
## morphospecies.28 -0.0078633 -0.013724  
## morphospecies.29 -0.0178790 -0.047555  
## Tetraselmis.spp... 0.0078384 -0.020174  
## morphospecies.30 0.0027422 -0.009624  
## morphospecies.31 -0.0218184 -0.078548  
## Kirchneriella.spp. 0.0129177 -0.010880  
## morphospecies.32 -0.0067275 -0.017711  
## Tetraedron.spp..2 0.0027422 -0.009624  
## Dinobryon.spp..1 -0.0040215 -0.006568  
## Desmodesmus.spp... -0.0082722 0.001140  
## Selenastrum.spp. 0.0508509 -0.012592  
## Unidentified.33 -0.0124220 -0.010994  
## Euglena.spp. -0.0362094 -0.013997  
## Phacus.spp. 0.0000000 0.000000  
## Unidentified.34 -0.0299969 -0.011596  
## Treubaria.spp. 0.0000000 0.000000  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.074068 -0.024686 -0.128586 -0.33627 -0.8789326 0.70453  
## 3 -0.257033 0.003997 -0.339524 0.17485 0.0009097 0.23829  
## 4 -0.227775 -0.134467 -0.561209 0.07204 0.1250379 0.24050  
## 5 -0.395485 -0.047627 -0.364975 0.33230 -0.1675468 -0.09069  
## 6 -0.137710 -0.127581 0.477270 0.12777 0.3030540 0.22212  
## 7 -0.126030 0.124067 0.390390 0.01433 0.4151168 0.34695  
## 8 -0.139428 -0.492674 -0.169438 0.13110 -0.2366554 0.72348  
## 9 -0.260256 -0.101531 0.562401 0.46303 0.0914604 0.22008  
## 10 -0.109137 -0.297960 0.205171 0.36649 0.0825580 -0.31784  
## 11 0.133844 0.154805 0.011155 0.48533 0.1630914 0.04769  
## 12 0.163921 -0.267372 -0.252342 0.51574 -0.0750370 -0.62739  
## 13 0.087207 0.015307 0.312235 0.42148 0.2248248 -0.49037  
## 14 -0.405485 0.104922 -0.058877 0.22980 -0.1084294 -0.08390  
## 15 -0.350479 0.300638 -0.069852 0.12519 -0.3331266 -0.10108  
## 16 -0.085499 0.697643 -0.024683 -0.18301 -0.1487859 -0.09131  
## 17 -0.005016 0.589872 -0.020343 0.08673 -0.2211487 -0.40955  
## 18 -0.248060 0.154677 0.357715 -0.46207 0.2809233 0.03142  
## 19 -0.133752 0.121371 0.479149 -0.22447 0.1266979 -0.31579  
## 20 -0.300012 0.218819 -0.164505 -0.49843 0.1354865 -0.08778  
## 21 -0.275761 -0.226091 0.171667 -0.37444 0.3145280 -0.18924  
## 22 0.481393 0.235381 -0.488076 0.03536 0.4042716 -0.11413  
## 23 0.307687 -0.365502 -0.527004 -0.03543 0.3145508 -0.10049  
## 24 -0.039509 -0.195986 -0.249761 -0.35188 0.0844246 0.25987  
## 25 -0.315886 -0.166773 -0.334439 -0.08099 0.6641387 -0.22627  
## 26 0.317586 -0.286339 -0.027038 -0.09452 -0.5207615 -0.16404  
## 27 0.071988 -0.030187 -0.094303 -0.34373 -0.8744642 0.71508  
## 28 0.171640 -0.632820 -0.009071 0.05273 0.0337984 -0.51359  
## 29 0.033844 -0.499866 0.536423 -0.44515 -0.1679587 -0.62865  
## 30 0.805111 0.402453 0.356003 -0.44410 0.0298402 0.46887  
## 31 0.650306 0.220284 0.239459 0.09976 0.2023340 0.31354  
## 32 0.425761 0.468154 -0.073195 0.19487 0.0036989 0.06085  
## 33 0.087956 0.085074 -0.141818 -0.05438 -0.2678992 -0.04116  
##   
##   
## Site constraints (linear combinations of constraining variables)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.20156 -0.05070 -0.34857 0.06073 -0.230133 0.27316  
## 3 -0.20156 -0.05070 -0.34857 0.06073 -0.230133 0.27316  
## 4 -0.20156 -0.05070 -0.34857 0.06073 -0.230133 0.27316  
## 5 -0.20156 -0.05070 -0.34857 0.06073 -0.230133 0.27316  
## 6 -0.16586 -0.14943 0.31516 0.18406 0.143244 0.37816  
## 7 -0.16586 -0.14943 0.31516 0.18406 0.143244 0.37816  
## 8 -0.16586 -0.14943 0.31516 0.18406 0.143244 0.37816  
## 9 -0.16586 -0.14943 0.31516 0.18406 0.143244 0.37816  
## 10 0.06896 -0.09880 0.06905 0.44726 0.098859 -0.34698  
## 11 0.06896 -0.09880 0.06905 0.44726 0.098859 -0.34698  
## 12 0.06896 -0.09880 0.06905 0.44726 0.098859 -0.34698  
## 13 0.06896 -0.09880 0.06905 0.44726 0.098859 -0.34698  
## 14 -0.21162 0.42327 -0.04344 0.06468 -0.202873 -0.17146  
## 15 -0.21162 0.42327 -0.04344 0.06468 -0.202873 -0.17146  
## 16 -0.21162 0.42327 -0.04344 0.06468 -0.202873 -0.17146  
## 17 -0.21162 0.42327 -0.04344 0.06468 -0.202873 -0.17146  
## 18 -0.23940 0.06719 0.21101 -0.38985 0.214409 -0.14035  
## 19 -0.23940 0.06719 0.21101 -0.38985 0.214409 -0.14035  
## 20 -0.23940 0.06719 0.21101 -0.38985 0.214409 -0.14035  
## 21 -0.23940 0.06719 0.21101 -0.38985 0.214409 -0.14035  
## 22 0.10842 -0.12322 -0.39982 -0.10824 0.366846 -0.04526  
## 23 0.10842 -0.12322 -0.39982 -0.10824 0.366846 -0.04526  
## 24 0.10842 -0.12322 -0.39982 -0.10824 0.366846 -0.04526  
## 25 0.10842 -0.12322 -0.39982 -0.10824 0.366846 -0.04526  
## 26 0.14876 -0.36230 0.10150 -0.20767 -0.382346 -0.14780  
## 27 0.14876 -0.36230 0.10150 -0.20767 -0.382346 -0.14780  
## 28 0.14876 -0.36230 0.10150 -0.20767 -0.382346 -0.14780  
## 29 0.14876 -0.36230 0.10150 -0.20767 -0.382346 -0.14780  
## 30 0.49228 0.29399 0.09511 -0.05096 -0.008007 0.20052  
## 31 0.49228 0.29399 0.09511 -0.05096 -0.008007 0.20052  
## 32 0.49228 0.29399 0.09511 -0.05096 -0.008007 0.20052  
## 33 0.49228 0.29399 0.09511 -0.05096 -0.008007 0.20052  
##   
##   
## Biplot scores for constraining variables  
##   
## RDA1  
## maum.rare.hel$traceTRUE 0.1576  
## maum.rare.hel$nitrogenTRUE 0.2482  
## maum.rare.hel$phosphorusTRUE 0.8615  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE 0.3074  
## maum.rare.hel$traceTRUE:maum.rare.hel$phosphorusTRUE 0.7302  
## maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.7792  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.7835  
## RDA2  
## maum.rare.hel$traceTRUE 0.69607  
## maum.rare.hel$nitrogenTRUE -0.15848  
## maum.rare.hel$phosphorusTRUE -0.30563  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE 0.43903  
## maum.rare.hel$traceTRUE:maum.rare.hel$phosphorusTRUE 0.20758  
## maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE -0.08303  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.46789  
## RDA3  
## maum.rare.hel$traceTRUE -0.1444  
## maum.rare.hel$nitrogenTRUE 0.7609  
## maum.rare.hel$phosphorusTRUE -0.1412  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE 0.3721  
## maum.rare.hel$traceTRUE:maum.rare.hel$phosphorusTRUE -0.3704  
## maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.2390  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.1514  
## RDA4  
## maum.rare.hel$traceTRUE -0.50989  
## maum.rare.hel$nitrogenTRUE -0.48889  
## maum.rare.hel$phosphorusTRUE 0.08462  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE -0.53582  
## maum.rare.hel$traceTRUE:maum.rare.hel$phosphorusTRUE -0.19351  
## maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE -0.31438  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE -0.08111  
## RDA5  
## maum.rare.hel$traceTRUE 0.38989  
## maum.rare.hel$nitrogenTRUE -0.03442  
## maum.rare.hel$phosphorusTRUE 0.07932  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE 0.25089  
## maum.rare.hel$traceTRUE:maum.rare.hel$phosphorusTRUE 0.43618  
## maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE -0.47448  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE -0.01274  
## RDA6  
## maum.rare.hel$traceTRUE -0.16478  
## maum.rare.hel$nitrogenTRUE 0.30584  
## maum.rare.hel$phosphorusTRUE -0.35739  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE 0.07315  
## maum.rare.hel$traceTRUE:maum.rare.hel$phosphorusTRUE 0.18873  
## maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.06409  
## maum.rare.hel$traceTRUE:maum.rare.hel$nitrogenTRUE:maum.rare.hel$phosphorusTRUE 0.31913

anova(rda.maum.rare.hel.all.treats)

## Permutation test for rda under reduced model  
## Permutation: free  
## Number of permutations: 999  
##   
## Model: rda(formula = maum.rare.hel[, 7:72] ~ maum.rare.hel$trace \* maum.rare.hel$nitrogen \* maum.rare.hel$phosphorus)  
## Df Variance F Pr(>F)   
## Model 7 0.035088 1.7188 0.001 \*\*\*  
## Residual 24 0.069991   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

RsquareAdj(rda.maum.rare.hel.all.treats)

## $r.squared  
## [1] 0.3339201  
##   
## $adj.r.squared  
## [1] 0.1396468

#overall significant with adjusted Rsquared of 0.1359  
   
#recode treatments as numerical strings   
#need 2 vectors for 3 factors  
factors<-read.csv("~/Desktop/factors.csv")  
maum.rare.hel.fact<-cbind(factors, maum.rare.hel1)   
dim(maum.rare.hel.fact)

## [1] 32 77

str(maum.rare.hel.fact)

## 'data.frame': 32 obs. of 77 variables:  
## $ Treatment : Factor w/ 8 levels "Control","N+P",..: 1 1 1 1 5 5 5 5 7 7 ...  
## $ N : int -1 -1 -1 -1 1 1 1 1 -1 -1 ...  
## $ P : int -1 -1 -1 -1 -1 -1 -1 -1 1 1 ...  
## $ T : int -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 ...  
## $ Int.NT : int 1 1 1 1 -1 -1 -1 -1 1 1 ...  
## $ Int.PT : int 1 1 1 1 1 1 1 1 -1 -1 ...  
## $ Int.NP : int 1 1 1 1 -1 -1 -1 -1 -1 -1 ...  
## $ Int.NPT : int -1 -1 -1 -1 1 1 1 1 1 1 ...  
## $ Lowest.taxonimic.Sample.ID: Factor w/ 37 levels "37","38","39",..: 1 2 3 4 5 6 7 8 9 10 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Total.counted : int 453 439 403 400 461 411 408 430 407 399 ...  
## $ Microcystis.spp. : num 0.619 0.694 0.645 0.66 0.58 ...  
## $ Nitzschia.spp. : num 0.173 0.27 0.255 0.218 0.212 ...  
## $ Pseudoanabaena.spp. : num 0.245 0.194 0.158 0.166 0.194 ...  
## $ Glaucocystis.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.10 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Aulacoseria.spp. : num 0.194 0 0 0 0 ...  
## $ Filamentous.Chlorophyte : num 0.467 0.388 0.41 0.453 0.467 ...  
## $ Diatoma.spp... : num 0.0501 0 0 0 0.1001 ...  
## $ morphospecies.1 : num 0 0 0.0501 0 0 ...  
## $ pollen. : num 0 0 0 0 0.0867 ...  
## $ Selenastraceae : num 0.1416 0.0501 0.0867 0.0501 0.1001 ...  
## $ morphospecies.2 : num 0 0 0.0501 0 0.0501 ...  
## $ morphospecies.3 : num 0.112 0 0 0 0 ...  
## $ Cyclotella.spp. : num 0.181 0.181 0.235 0.173 0.15 ...  
## $ morphospecies.4 : num 0.1502 0 0.0708 0.0708 0 ...  
## $ Dolichospermum.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Aphanocapsa.spp.. : num 0.0708 0 0 0 0.1001 ...  
## $ morphospecies.5 : num 0 0 0.0501 0.0501 0.0501 ...  
## $ Merismopedia.spp. : num 0.112 0 0 0 0.2 ...  
## $ Scenedesmus.spp. : num 0 0.0708 0 0.1001 0 ...  
## $ morphospecies.6 : num 0 0.1001 0 0 0.0867 ...  
## $ morphospecies.7 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.8 : num 0.0501 0.0501 0.0501 0.0501 0.0867 ...  
## $ clamydomonadaceae.1 : num 0.0501 0 0.0501 0.0708 0.0501 ...  
## $ morphospecies.11 : num 0.112 0.132 0.235 0.245 0.181 ...  
## $ morphospecies.13 : num 0 0 0 0 0.0867 ...  
## $ Westella.spp.. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Melosira.spp... : num 0.321 0.313 0.305 0.218 0.288 ...  
## $ morphospecies.14 : num 0.0708 0.0867 0.0501 0.0501 0 ...  
## $ morphospecies.15 : num 0.1119 0 0 0.0501 0 ...  
## $ morphospecies.16 : num 0.1 0 0 0 0 ...  
## $ Unidentified.13 : num 0.0708 0 0 0.0501 0 ...  
## $ Spirulina.spp... : num 0.0867 0 0.0867 0 0.0867 ...  
## $ Tetraedron.spp. : num 0.0501 0 0 0 0 ...  
## $ Cycyotella.spp..2.. : num 0 0.279 0.24 0.255 0.255 ...  
## $ Thalassiosira.spp. : num 0 0.0501 0 0.0867 0.0501 ...  
## $ Micractinium.spp... : num 0 0.0501 0 0 0.0501 ...  
## $ morphospecies.17 : num 0 0 0.0501 0 0 ...  
## $ morphospecies.18 : num 0 0 0.1 0.112 0.112 ...  
## $ morphospecies.19 : num 0 0 0.0867 0 0 ...  
## $ morphospecies.20 : num 0 0 0.0708 0.1001 0.0501 ...  
## $ clamydomonadaceae.2 : num 0 0 0.0708 0.0501 0.0708 ...  
## $ morphospecies.21 : num 0 0 0 0.0501 0.0708 ...  
## $ Dinobryon.spp. : num 0 0 0 0.0867 0 ...  
## $ morphospecies.22 : num 0 0 0 0.0501 0 ...  
## $ morphospecies.23 : num 0 0 0 0 0.1 ...  
## $ morphospecies.24 : num 0 0 0 0 0.0501 ...  
## $ morphospecies.25 : num 0 0 0 0 0.0501 ...  
## $ morphospecies.26 : num 0 0 0 0 0 ...  
## $ morphospecies.27 : num 0 0 0 0 0 ...  
## $ morphospecies.28 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.29 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Tetraselmis.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.30 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.31 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Kirchneriella.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.32 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Tetraedron.spp..2 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Dinobryon.spp..1 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Desmodesmus.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Selenastrum.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.33 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Euglena.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Phacus.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.34 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Treubaria.spp. : num 0 0 0 0 0 0 0 0 0 0 ...

# If interactions exist, this method only provides marginal tests for the interaction terms  
rda.maum.rare.hel.all.xyz=rda(maum.rare.hel.fact[,12:77],maum.rare.hel.fact[,2:7])  
 summary(rda.maum.rare.hel.all.xyz)

##   
## Call:  
## rda(X = maum.rare.hel.fact[, 12:77], Y = maum.rare.hel.fact[, 2:7])   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.10508 1.0000  
## Constrained 0.03010 0.2864  
## Unconstrained 0.07498 0.7136  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.01262 0.007396 0.003728 0.002777 0.002058 0.001515  
## Proportion Explained 0.12013 0.070387 0.035482 0.026432 0.019589 0.014415  
## Cumulative Proportion 0.12013 0.190513 0.225995 0.252427 0.272015 0.286430  
## PC1 PC2 PC3 PC4 PC5 PC6  
## Eigenvalue 0.01812 0.009976 0.00668 0.005767 0.004953 0.004744  
## Proportion Explained 0.17240 0.094936 0.06358 0.054886 0.047137 0.045144  
## Cumulative Proportion 0.45883 0.553769 0.61734 0.672230 0.719367 0.764511  
## PC7 PC8 PC9 PC10 PC11 PC12  
## Eigenvalue 0.003844 0.00333 0.002578 0.002178 0.001958 0.001765  
## Proportion Explained 0.036580 0.03169 0.024533 0.020723 0.018633 0.016794  
## Cumulative Proportion 0.801091 0.83278 0.857317 0.878040 0.896672 0.913467  
## PC13 PC14 PC15 PC16 PC17  
## Eigenvalue 0.001327 0.001245 0.001073 0.0009838 0.0009067  
## Proportion Explained 0.012629 0.011847 0.010212 0.0093628 0.0086289  
## Cumulative Proportion 0.926095 0.937942 0.948154 0.9575164 0.9661453  
## PC18 PC19 PC20 PC21 PC22  
## Eigenvalue 0.0007691 0.0007224 0.0005273 0.0004884 0.0003792  
## Proportion Explained 0.0073197 0.0068752 0.0050178 0.0046484 0.0036088  
## Cumulative Proportion 0.9734650 0.9803401 0.9853579 0.9900063 0.9936150  
## PC23 PC24 PC25  
## Eigenvalue 0.0002861 0.0002248 0.0001601  
## Proportion Explained 0.0027225 0.0021389 0.0015236  
## Cumulative Proportion 0.9963375 0.9984764 1.0000000  
##   
## Accumulated constrained eigenvalues  
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.01262 0.007396 0.003728 0.002777 0.002058 0.001515  
## Proportion Explained 0.41939 0.245739 0.123876 0.092281 0.068390 0.050325  
## Cumulative Proportion 0.41939 0.665129 0.789005 0.881285 0.949675 1.000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.343445   
##   
##   
## Species scores  
##   
## RDA1 RDA2 RDA3 RDA4  
## Microcystis.spp. -0.164528 3.865e-02 -2.295e-02 1.894e-02  
## Nitzschia.spp. 0.059274 7.803e-02 -6.376e-02 -5.168e-02  
## Pseudoanabaena.spp. -0.056018 1.145e-01 6.849e-02 -1.495e-03  
## Glaucocystis.spp... 0.002633 5.853e-03 1.871e-02 8.318e-03  
## morphospecies.10 0.012014 -4.909e-03 2.010e-02 4.234e-03  
## Aulacoseria.spp. 0.105669 -1.743e-01 7.507e-02 -1.102e-02  
## Filamentous.Chlorophyte -0.135098 -1.412e-01 -2.092e-02 2.200e-02  
## Diatoma.spp... 0.005815 -2.753e-03 1.131e-01 1.327e-02  
## morphospecies.1 -0.014611 -1.243e-02 1.074e-02 -1.929e-02  
## pollen. -0.022233 6.464e-02 1.367e-03 -3.971e-02  
## Selenastraceae 0.064603 1.590e-02 -1.367e-02 -1.877e-02  
## morphospecies.2 0.007300 1.314e-05 1.635e-02 6.968e-03  
## morphospecies.3 -0.007162 3.026e-02 4.400e-03 2.586e-02  
## Cyclotella.spp. -0.011946 -1.868e-03 1.780e-02 -1.904e-02  
## morphospecies.4 0.014261 3.811e-02 -3.524e-02 8.353e-02  
## Dolichospermum.spp. 0.002633 5.853e-03 1.871e-02 8.318e-03  
## Aphanocapsa.spp.. 0.020006 3.224e-02 4.950e-02 2.713e-02  
## morphospecies.5 0.053118 -1.925e-02 -2.577e-02 -5.303e-02  
## Merismopedia.spp. 0.071843 6.953e-02 8.840e-02 -2.446e-02  
## Scenedesmus.spp. 0.030117 -4.164e-02 -2.355e-02 5.158e-02  
## morphospecies.6 0.005416 5.236e-04 6.991e-02 -4.698e-02  
## morphospecies.7 0.025421 9.536e-03 -2.699e-04 6.317e-03  
## morphospecies.8 0.023633 5.859e-02 6.603e-03 1.937e-03  
## clamydomonadaceae.1 -0.004507 -9.349e-03 2.500e-02 2.898e-02  
## morphospecies.11 -0.018753 5.111e-02 -3.505e-02 -8.137e-02  
## morphospecies.13 -0.007181 1.291e-02 2.321e-02 9.572e-06  
## Westella.spp.. 0.008244 1.886e-02 -3.886e-03 6.608e-03  
## Melosira.spp... 0.305566 -1.467e-02 -4.868e-02 1.236e-02  
## morphospecies.14 0.019957 -3.256e-02 -9.590e-03 -1.067e-02  
## morphospecies.15 0.050164 2.270e-02 3.775e-02 1.357e-02  
## morphospecies.16 0.006706 3.027e-02 4.049e-03 4.437e-02  
## Unidentified.13 -0.026455 7.651e-02 6.738e-03 2.007e-02  
## Spirulina.spp... 0.070045 -1.239e-02 3.522e-02 -1.434e-02  
## Tetraedron.spp. 0.001601 5.404e-03 -3.384e-03 1.673e-02  
## Cycyotella.spp..2.. -0.126567 -4.487e-02 3.965e-02 -5.194e-02  
## Thalassiosira.spp. 0.019194 -2.305e-03 3.771e-02 -1.865e-03  
## Micractinium.spp... 0.024037 6.733e-02 1.265e-02 3.634e-02  
## morphospecies.17 -0.004510 -1.499e-03 -8.625e-03 6.379e-03  
## morphospecies.18 -0.050124 6.032e-02 5.693e-03 -1.015e-03  
## morphospecies.19 0.020273 -1.905e-02 8.473e-03 -4.576e-03  
## morphospecies.20 0.050781 7.201e-02 -1.268e-02 1.463e-03  
## clamydomonadaceae.2 -0.004071 3.040e-02 1.186e-02 -1.386e-02  
## morphospecies.21 -0.007618 6.164e-02 1.361e-02 -7.605e-03  
## Dinobryon.spp. 0.004739 -9.433e-03 -5.663e-03 3.158e-02  
## morphospecies.22 0.015348 9.718e-03 -1.186e-02 9.053e-03  
## morphospecies.23 0.037895 1.379e-02 1.783e-03 -1.500e-02  
## morphospecies.24 -0.005139 9.695e-03 3.405e-03 -3.730e-03  
## morphospecies.25 0.053703 1.565e-02 4.577e-03 -3.184e-02  
## morphospecies.26 0.014885 8.766e-03 -9.166e-03 -5.015e-03  
## morphospecies.27 0.029784 -9.314e-04 8.449e-03 2.374e-02  
## morphospecies.28 0.007342 1.381e-02 -2.851e-05 8.190e-03  
## morphospecies.29 0.033808 3.263e-02 1.924e-02 1.862e-02  
## Tetraselmis.spp... 0.066480 -1.195e-02 3.946e-02 -1.017e-02  
## morphospecies.30 0.001231 6.904e-03 -5.269e-03 -2.162e-03  
## morphospecies.31 -0.018168 -2.268e-03 3.340e-02 2.080e-02  
## Kirchneriella.spp. 0.005640 5.410e-03 -1.319e-02 -1.257e-02  
## morphospecies.32 0.007852 1.667e-02 -2.211e-03 7.295e-03  
## Tetraedron.spp..2 0.001231 6.904e-03 -5.269e-03 -2.162e-03  
## Dinobryon.spp..1 -0.007962 -2.687e-02 1.193e-02 3.734e-03  
## Desmodesmus.spp... 0.005527 -2.347e-02 2.636e-03 8.333e-03  
## Selenastrum.spp. 0.004858 -1.354e-02 -7.709e-03 -5.250e-02  
## Unidentified.33 0.004575 8.047e-03 2.038e-02 1.161e-02  
## Euglena.spp. 0.020865 2.357e-02 1.789e-02 3.534e-02  
## Phacus.spp. 0.000000 0.000e+00 0.000e+00 0.000e+00  
## Unidentified.34 0.017285 1.952e-02 1.482e-02 2.928e-02  
## Treubaria.spp. 0.000000 0.000e+00 0.000e+00 0.000e+00  
## RDA5 RDA6  
## Microcystis.spp. -0.0184687 1.542e-02  
## Nitzschia.spp. 0.0099636 -1.828e-03  
## Pseudoanabaena.spp. -0.0190692 1.415e-02  
## Glaucocystis.spp... 0.0083643 -2.252e-03  
## morphospecies.10 0.0016058 3.825e-03  
## Aulacoseria.spp. -0.0260977 2.732e-02  
## Filamentous.Chlorophyte 0.0132955 -2.270e-02  
## Diatoma.spp... -0.0078238 -9.283e-03  
## morphospecies.1 0.0015668 1.298e-02  
## pollen. -0.0431482 -2.197e-02  
## Selenastraceae 0.0305600 2.905e-02  
## morphospecies.2 -0.0180765 1.000e-02  
## morphospecies.3 -0.0080610 1.326e-02  
## Cyclotella.spp. -0.0084925 -5.085e-02  
## morphospecies.4 0.0188316 2.049e-03  
## Dolichospermum.spp. 0.0083643 -2.252e-03  
## Aphanocapsa.spp.. -0.0089258 -1.898e-02  
## morphospecies.5 0.0130179 -2.729e-02  
## Merismopedia.spp. 0.0205632 -1.868e-02  
## Scenedesmus.spp. 0.0484793 1.573e-02  
## morphospecies.6 -0.0261350 -8.298e-04  
## morphospecies.7 0.0175278 1.573e-02  
## morphospecies.8 -0.0089466 1.251e-02  
## clamydomonadaceae.1 0.0167698 1.930e-02  
## morphospecies.11 0.0350486 -4.091e-03  
## morphospecies.13 -0.0107931 -8.073e-03  
## Westella.spp.. 0.0221800 8.187e-03  
## Melosira.spp... -0.0235218 1.577e-02  
## morphospecies.14 0.0043187 -2.452e-02  
## morphospecies.15 -0.0184685 1.474e-02  
## morphospecies.16 -0.0132026 -5.584e-03  
## Unidentified.13 -0.0249814 -1.663e-02  
## Spirulina.spp... -0.0029754 -3.912e-03  
## Tetraedron.spp. -0.0039913 2.842e-03  
## Cycyotella.spp..2.. 0.0383865 7.006e-02  
## Thalassiosira.spp. 0.0505225 -1.283e-02  
## Micractinium.spp... 0.0056225 3.037e-04  
## morphospecies.17 -0.0074120 8.231e-03  
## morphospecies.18 -0.0379321 4.538e-02  
## morphospecies.19 -0.0108256 1.084e-02  
## morphospecies.20 -0.0067853 3.464e-02  
## clamydomonadaceae.2 0.0315134 4.867e-02  
## morphospecies.21 0.0582226 -3.996e-02  
## Dinobryon.spp. -0.0087733 2.445e-03  
## morphospecies.22 0.0002341 -1.677e-02  
## morphospecies.23 -0.0123868 1.554e-04  
## morphospecies.24 -0.0100577 -3.647e-03  
## morphospecies.25 0.0317560 1.063e-02  
## morphospecies.26 0.0208059 2.277e-02  
## morphospecies.27 0.0160436 -3.889e-05  
## morphospecies.28 0.0142514 2.449e-03  
## morphospecies.29 0.0495329 2.388e-02  
## Tetraselmis.spp... 0.0160372 -7.525e-03  
## morphospecies.30 0.0108307 7.838e-03  
## morphospecies.31 0.0757298 -2.324e-02  
## Kirchneriella.spp. 0.0112952 -3.731e-04  
## morphospecies.32 0.0187376 5.696e-03  
## Tetraedron.spp..2 0.0108307 7.838e-03  
## Dinobryon.spp..1 0.0060982 -4.705e-03  
## Desmodesmus.spp... -0.0010932 -5.927e-03  
## Selenastrum.spp. 0.0088320 -2.070e-02  
## Unidentified.33 0.0094516 -3.965e-03  
## Euglena.spp. 0.0116790 -1.840e-02  
## Phacus.spp. 0.0000000 0.000e+00  
## Unidentified.34 0.0096752 -1.524e-02  
## Treubaria.spp. 0.0000000 0.000e+00  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.087224 -0.0618052 0.04983 0.858909 -0.75742 -0.302648  
## 3 -0.252870 -0.0006786 -0.38879 0.003149 -0.23005 0.267868  
## 4 -0.198487 0.0729706 -0.54396 -0.128466 -0.25043 0.504919  
## 5 -0.386900 0.0876425 -0.48988 0.178807 0.11234 0.415019  
## 6 -0.136351 0.2606880 0.33142 -0.292218 -0.18275 0.159157  
## 7 -0.151615 -0.0240401 0.33174 -0.409818 -0.32198 -0.110786  
## 8 -0.080798 0.5240052 -0.28778 0.235644 -0.74839 -0.514539  
## 9 -0.271654 0.3230821 0.24469 -0.064006 -0.14056 0.242073  
## 10 -0.084971 0.4089791 -0.02776 -0.063424 0.36572 0.379593  
## 11 0.102920 -0.0943539 -0.20280 -0.138316 0.02115 0.296510  
## 12 0.191027 0.2763077 -0.48314 0.096804 0.66733 0.294114  
## 13 0.069212 0.0904133 0.08284 -0.199244 0.56436 0.462004  
## 14 -0.422251 -0.0132791 -0.16952 0.117891 0.09429 -0.289488  
## 15 -0.388802 -0.2367485 -0.10509 0.338005 0.09829 -0.524930  
## 16 -0.165086 -0.7283156 0.14499 0.143266 0.08846 -0.087374  
## 17 -0.077551 -0.5900502 0.01475 0.228635 0.43449 0.044812  
## 18 -0.262889 -0.1339232 0.54658 -0.297653 -0.05304 0.184206  
## 19 -0.153494 -0.0548153 0.53915 -0.130811 0.31657 -0.017263  
## 20 -0.308602 -0.2983429 0.11980 -0.159327 0.04099 0.341038  
## 21 -0.242340 0.2376465 0.29533 -0.331364 0.14736 -0.035608  
## 22 0.461114 -0.3875843 -0.40836 -0.405791 0.10263 -0.225520  
## 23 0.363583 0.2265591 -0.48182 -0.323652 0.05527 -0.293207  
## 24 -0.003412 0.1120641 -0.08621 -0.106552 -0.33403 -0.666937  
## 25 -0.286203 0.1477410 -0.29446 -0.672676 0.18642 -0.300364  
## 26 0.355654 0.2143968 0.01184 0.514798 0.14426 0.061699  
## 27 0.085168 -0.0506933 0.08246 0.854425 -0.76732 -0.307431  
## 28 0.246873 0.6226938 -0.09985 -0.034318 0.48671 -0.355532  
## 29 0.092932 0.5233989 0.63230 0.150341 0.57294 -0.477743  
## 30 0.756130 -0.5328517 0.59660 -0.043787 -0.47261 0.009116  
## 31 0.614248 -0.2606321 0.20922 -0.192052 -0.26157 0.390280  
## 32 0.365218 -0.5203027 -0.08725 0.008358 -0.01525 0.264475  
## 33 0.082973 -0.1401721 -0.07687 0.264443 0.03583 0.192484  
##   
##   
## Site constraints (linear combinations of constraining variables)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.16259 -0.05405 -0.31095 0.229986 -0.26722 0.2968  
## 3 -0.16259 -0.05405 -0.31095 0.229986 -0.26722 0.2968  
## 4 -0.16259 -0.05405 -0.31095 0.229986 -0.26722 0.2968  
## 5 -0.16259 -0.05405 -0.31095 0.229986 -0.26722 0.2968  
## 6 -0.18527 0.34951 0.12276 -0.134486 -0.36260 -0.1315  
## 7 -0.18527 0.34951 0.12276 -0.134486 -0.36260 -0.1315  
## 8 -0.18527 0.34951 0.12276 -0.134486 -0.36260 -0.1315  
## 9 -0.18527 0.34951 0.12276 -0.134486 -0.36260 -0.1315  
## 10 0.04438 0.24892 -0.18997 -0.077932 0.39046 0.2826  
## 11 0.04438 0.24892 -0.18997 -0.077932 0.39046 0.2826  
## 12 0.04438 0.24892 -0.18997 -0.077932 0.39046 0.2826  
## 13 0.04438 0.24892 -0.18997 -0.077932 0.39046 0.2826  
## 14 -0.28859 -0.31352 -0.06097 0.205063 0.16471 -0.2897  
## 15 -0.28859 -0.31352 -0.06097 0.205063 0.16471 -0.2897  
## 16 -0.28859 -0.31352 -0.06097 0.205063 0.16471 -0.2897  
## 17 -0.28859 -0.31352 -0.06097 0.205063 0.16471 -0.2897  
## 18 -0.21667 -0.14094 0.40747 -0.227903 0.12714 0.1936  
## 19 -0.21667 -0.14094 0.40747 -0.227903 0.12714 0.1936  
## 20 -0.21667 -0.14094 0.40747 -0.227903 0.12714 0.1936  
## 21 -0.21667 -0.14094 0.40747 -0.227903 0.12714 0.1936  
## 22 0.15894 -0.05388 -0.28546 -0.375281 0.01675 -0.2960  
## 23 0.15894 -0.05388 -0.28546 -0.375281 0.01675 -0.2960  
## 24 0.15894 -0.05388 -0.28546 -0.375281 0.01675 -0.2960  
## 25 0.15894 -0.05388 -0.28546 -0.375281 0.01675 -0.2960  
## 26 0.22032 0.24887 0.18894 0.373198 0.12332 -0.1943  
## 27 0.22032 0.24887 0.18894 0.373198 0.12332 -0.1943  
## 28 0.22032 0.24887 0.18894 0.373198 0.12332 -0.1943  
## 29 0.22032 0.24887 0.18894 0.373198 0.12332 -0.1943  
## 30 0.42948 -0.28491 0.12818 0.007354 -0.19258 0.1386  
## 31 0.42948 -0.28491 0.12818 0.007354 -0.19258 0.1386  
## 32 0.42948 -0.28491 0.12818 0.007354 -0.19258 0.1386  
## 33 0.42948 -0.28491 0.12818 0.007354 -0.19258 0.1386  
##   
##   
## Biplot scores for constraining variables  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## N 0.26092 0.18162 0.89199 0.01912 -0.32076 0.006744  
## P 0.89806 0.16737 -0.16665 -0.07649 0.35576 -0.072755  
## T 0.08754 -0.83504 0.19918 -0.41135 0.12214 -0.266927  
## Int.NT 0.09958 -0.24315 0.03656 -0.07210 0.06086 0.959543  
## Int.PT 0.25322 -0.04561 -0.36367 -0.28678 -0.84808 0.008261  
## Int.NP 0.20908 -0.42487 -0.05769 0.85857 -0.18081 -0.051179

anova(rda.maum.rare.hel.all.xyz)

## Permutation test for rda under reduced model  
## Permutation: free  
## Number of permutations: 999  
##   
## Model: rda(X = maum.rare.hel.fact[, 12:77], Y = maum.rare.hel.fact[, 2:7])  
## Df Variance F Pr(>F)   
## Model 6 0.030098 1.6725 0.001 \*\*\*  
## Residual 25 0.074981   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

RsquareAdj(rda.maum.rare.hel.all.xyz)

## $r.squared  
## [1] 0.2864301  
##   
## $adj.r.squared  
## [1] 0.1151733

#slightly lower adj Rsquared  
   
### Another method of getting a marginal test provides similar results. The conditional statements don't work with interactions. The programs are enforcing that statistical philosophy that you should test for interactions before testing for main effects... so to get around that, we have to use the X,Y,Z coding   
   
# Let's try testing this using Y,X,Z format  
rda.maum.rare.hel.factor=rda(maum.rare.hel.fact[,12:77],maum.rare.hel.fact[,c(5:8)],maum.rare.hel.fact[2:4])  
 anova(rda.maum.rare.hel.factor)

## Permutation test for rda under reduced model  
## Permutation: free  
## Number of permutations: 999  
##   
## Model: rda(X = maum.rare.hel.fact[, 12:77], Y = maum.rare.hel.fact[, c(5:8)], Z = maum.rare.hel.fact[2:4])  
## Df Variance F Pr(>F)  
## Model 4 0.014019 1.2018 0.158  
## Residual 24 0.069991

#not significant   
  
   
###  
# Plots and getting some more species info  
# Better plots can be made if you extract scores as shown below  
rda.maum.rare.hel.all.spscores=scores(rda.maum.rare.hel.all.treats,display="sp",choices=c(1:17))  
head(rda.maum.rare.hel.all.spscores)

## RDA1 RDA2 RDA3 RDA4  
## Microcystis.spp. -0.1778939142 -3.984337e-02 -0.025506519 -0.00139329  
## Nitzschia.spp. 0.0513639606 -7.760848e-02 -0.028584354 0.06254275  
## Pseudoanabaena.spp. -0.0712923150 -1.030321e-01 0.080786016 -0.01434156  
## Glaucocystis.spp... -0.0008047167 -1.234838e-02 0.009834576 -0.01896002  
## morphospecies.10 0.0111409827 -3.101507e-05 0.011306578 -0.01798764  
## Aulacoseria.spp. 0.1455896571 2.013654e-01 0.059889161 -0.02559404  
## RDA5 RDA6 RDA7 PC1  
## Microcystis.spp. -0.019343407 0.017644606 -0.020502976 0.177242023  
## Nitzschia.spp. 0.054016074 -0.006632229 0.010437618 -0.019435191  
## Pseudoanabaena.spp. 0.001336889 0.019803115 -0.013055871 0.000947693  
## Glaucocystis.spp... -0.009051181 -0.009690744 -0.001840031 0.010479658  
## morphospecies.10 -0.004880324 -0.002430493 -0.006758746 0.020822098  
## Aulacoseria.spp. 0.010863935 0.028852390 -0.018174251 -0.414628120  
## PC2 PC3 PC4 PC5  
## Microcystis.spp. 0.1282640608 0.01705020 -0.081854675 -0.0459763967  
## Nitzschia.spp. -0.1191822501 0.01830274 0.029452169 -0.0318396635  
## Pseudoanabaena.spp. 0.0796579351 0.06873317 0.090166349 -0.0398675459  
## Glaucocystis.spp... 0.0002907574 0.01235703 0.012702336 0.0221414128  
## morphospecies.10 0.0030491575 -0.02203298 -0.005297136 0.0006539667  
## Aulacoseria.spp. -0.0651571094 0.09391864 -0.054995065 -0.0352367727  
## PC6 PC7 PC8 PC9  
## Microcystis.spp. -0.064845317 0.008195646 0.0067539426 -0.01821305  
## Nitzschia.spp. -0.055818283 -0.056509347 -0.0873702630 0.00386375  
## Pseudoanabaena.spp. 0.041308267 -0.029279300 0.0054726428 -0.01374451  
## Glaucocystis.spp... -0.012286618 -0.007852830 -0.0055461010 -0.01175962  
## morphospecies.10 0.011816590 -0.008034556 -0.0003723889 0.01258738  
## Aulacoseria.spp. -0.004574837 0.016251199 0.0179946147 -0.03191043  
## PC10  
## Microcystis.spp. 0.0128251381  
## Nitzschia.spp. -0.0002216501  
## Pseudoanabaena.spp. -0.0036491215  
## Glaucocystis.spp... 0.0013612887  
## morphospecies.10 -0.0032748323  
## Aulacoseria.spp. -0.0256941034

rda.maum.rare.hel.all.lcscores=scores(rda.maum.rare.hel.all.treats,display="lc",choices=c(1:17))  
head(rda.maum.rare.hel.all.lcscores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.2015561 -0.05069606 -0.3485735 0.06073011 -0.2301329 0.2731580  
## 3 -0.2015561 -0.05069606 -0.3485735 0.06073011 -0.2301329 0.2731580  
## 4 -0.2015561 -0.05069606 -0.3485735 0.06073011 -0.2301329 0.2731580  
## 5 -0.2015561 -0.05069606 -0.3485735 0.06073011 -0.2301329 0.2731580  
## 6 -0.1658560 -0.14942988 0.3151555 0.18405563 0.1432440 0.3781578  
## 7 -0.1658560 -0.14942988 0.3151555 0.18405563 0.1432440 0.3781578  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 -0.3143986 -0.46553165 0.56182137 -0.030334285 0.17380117 -0.031340212  
## 3 -0.3143986 0.14243841 -0.19221304 0.056172450 -0.13402874 0.010071821  
## 4 -0.3143986 0.14419205 -0.15208692 -0.021204722 0.10682517 0.008525136  
## 5 -0.3143986 0.17890119 -0.21752141 -0.004633443 -0.14659760 0.012743256  
## 6 0.2196597 0.06363281 -0.04474996 -0.105047902 0.02501729 0.681240205  
## 7 0.2196597 -0.22859976 -0.12164029 0.380161683 -0.17165885 -0.076199498  
## PC6 PC7 PC8 PC9 PC10  
## 2 0.135590640 -0.1062761 0.03257742 -0.160027338 -0.06817675  
## 3 -0.205963709 -0.4129946 0.08921491 0.004060172 0.56015806  
## 4 0.001055824 0.3626645 -0.23837753 0.207451726 -0.06338558  
## 5 0.069317245 0.1566062 0.11658520 -0.051484560 -0.42859573  
## 6 0.301520638 0.3230637 -0.19346872 0.137351022 0.34035777  
## 7 0.014423983 -0.1855877 -0.20799979 0.271403573 0.01736087

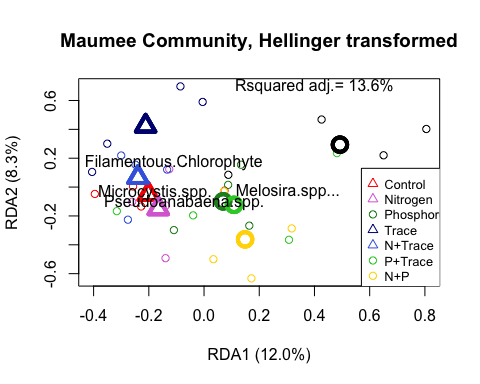
rda.maum.rare.hel.all.wascores=scores(rda.maum.rare.hel.all.treats,display="wa",choices=c(1:17))  
head(rda.maum.rare.hel.all.wascores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.07406828 -0.02468632 -0.1285856 -0.33627029 -0.8789326479 0.70452796  
## 3 -0.25703299 0.00399664 -0.3395240 0.17484822 0.0009097462 0.23828908  
## 4 -0.22777465 -0.13446727 -0.5612090 0.07204152 0.1250379407 0.24050087  
## 5 -0.39548524 -0.04762731 -0.3649752 0.33230099 -0.1675468308 -0.09068599  
## 6 -0.13770974 -0.12758085 0.4772695 0.12776502 0.3030540085 0.22211923  
## 7 -0.12603035 0.12406668 0.3903896 0.01432860 0.4151168309 0.34695212  
## RDA7 PC1 PC2 PC3 PC4  
## 2 0.183440943 -0.46553165 0.56182137 -0.030334285 0.17380117  
## 3 -0.300758504 0.14243841 -0.19221304 0.056172450 -0.13402874  
## 4 -0.689774829 0.14419205 -0.15208692 -0.021204722 0.10682517  
## 5 -0.450502206 0.17890119 -0.21752141 -0.004633443 -0.14659760  
## 6 -0.003982861 0.06363281 -0.04474996 -0.105047902 0.02501729  
## 7 0.285569453 -0.22859976 -0.12164029 0.380161683 -0.17165885  
## PC5 PC6 PC7 PC8 PC9  
## 2 -0.031340212 0.135590640 -0.1062761 0.03257742 -0.160027338  
## 3 0.010071821 -0.205963709 -0.4129946 0.08921491 0.004060172  
## 4 0.008525136 0.001055824 0.3626645 -0.23837753 0.207451726  
## 5 0.012743256 0.069317245 0.1566062 0.11658520 -0.051484560  
## 6 0.681240205 0.301520638 0.3230637 -0.19346872 0.137351022  
## 7 -0.076199498 0.014423983 -0.1855877 -0.20799979 0.271403573  
## PC10  
## 2 -0.06817675  
## 3 0.56015806  
## 4 -0.06338558  
## 5 -0.42859573  
## 6 0.34035777  
## 7 0.01736087

#weighted averages with P symbols  
#make P have a symbol diference  
symbols=ifelse(maum.rare.hel$phosphorus=="TRUE",1,ifelse(maum.rare.hel$phosphorus=="FALSE",2,0))  
plot(rda.maum.rare.hel.all.wascores[,1:2],col=colors,xlab="RDA1 (12.0%)",ylab="RDA2 (8.3%)",main="Maumee Community, Hellinger transformed")  
points(rda.maum.rare.hel.all.lcscores[,1:2],col=colors,pch=symbols,cex=2,lwd=4)  
text(0.4,0.7,"Rsquared adj.= 13.6%")  
# symbols N  
#symbols=ifelse(maum.rare.hel$nitrogen=="TRUE",1,ifelse(maum.rare.hel$nitrogen=="FALSE",2,0))  
#plot(rda.maum.rare.hel.all.wascores[,1:2],col=colors,xlab="RDA1 (12.4%)",ylab="RDA2 (8.3%)",main="Maumee Community, Hellinger transformed")  
#points(rda.maum.rare.hel.all.lcscores[,1:2],col=colors,pch=symbols,cex=2,lwd=4)  
  
# This command provides and R-squared for each taxon for each axis  
goodness(rda.maum.rare.hel.all.treats)

## RDA1 RDA2 RDA3 RDA4  
## Microcystis.spp. 3.229111e-01 0.339109578 0.34574798 0.34576778  
## Nitzschia.spp. 5.306160e-02 0.174199951 0.19063307 0.26930455  
## Pseudoanabaena.spp. 9.975173e-02 0.308095507 0.43618320 0.44021991  
## Glaucocystis.spp... 1.654927e-04 0.039133889 0.06385137 0.15572071  
## morphospecies.10 3.287685e-02 0.032877105 0.06673856 0.15244066  
## Aulacoseria.spp. 8.164984e-02 0.237843647 0.25165992 0.25418323  
## Filamentous.Chlorophyte 1.454264e-01 0.494003188 0.50502485 0.50535812  
## Diatoma.spp... 1.382769e-07 0.003710208 0.15063812 0.39049023  
## morphospecies.1 5.682620e-02 0.056843466 0.06404965 0.18739115  
## pollen. 2.732645e-02 0.101426679 0.20137295 0.32843246  
## Selenastraceae 1.541976e-01 0.177016310 0.17890346 0.18888960  
## morphospecies.2 6.181022e-03 0.006869285 0.02551252 0.04517995  
## morphospecies.3 1.032694e-02 0.076512986 0.07813916 0.07826947  
## Cyclotella.spp. 1.509068e-02 0.024027198 0.02556736 0.11522332  
## morphospecies.4 9.920124e-04 0.179881202 0.26687666 0.27600053  
## Dolichospermum.spp. 1.654927e-04 0.039133889 0.06385137 0.15572071  
## Aphanocapsa.spp.. 2.090096e-02 0.033280833 0.18619811 0.18701809  
## morphospecies.5 1.264873e-01 0.127792904 0.22442579 0.24197612  
## Merismopedia.spp. 9.622938e-02 0.123032867 0.34220469 0.34251120  
## Scenedesmus.spp. 3.748304e-02 0.113341186 0.11355027 0.16488663  
## morphospecies.6 1.237539e-03 0.025474845 0.04019124 0.23857092  
## morphospecies.7 1.218951e-01 0.124516840 0.14217777 0.18986677  
## morphospecies.8 1.595976e-02 0.124560313 0.15497322 0.17684201  
## clamydomonadaceae.1 1.004846e-03 0.002574303 0.01280558 0.02539294  
## morphospecies.11 3.572580e-02 0.201056798 0.26396471 0.27951314  
## morphospecies.13 3.858450e-04 0.003250123 0.11336199 0.12216400  
## Westella.spp.. 1.058101e-02 0.052437384 0.05962870 0.10691834  
## Melosira.spp... 5.529369e-01 0.558728063 0.57672236 0.57741119  
## morphospecies.14 3.469098e-02 0.065154260 0.11899986 0.14940248  
## morphospecies.15 6.713633e-02 0.093464112 0.12688911 0.13925658  
## morphospecies.16 2.126072e-04 0.126464801 0.12653643 0.13582323  
## Unidentified.13 4.022830e-02 0.175549198 0.22533168 0.26180891  
## Spirulina.spp... 1.692493e-01 0.169249437 0.18186983 0.22049794  
## Tetraedron.spp. 8.235452e-04 0.051226676 0.06926521 0.07564548  
## Cycyotella.spp..2.. 8.237275e-02 0.162589593 0.19851700 0.21013532  
## Thalassiosira.spp. 1.468974e-02 0.015637167 0.05200638 0.06071833  
## Micractinium.spp... 1.371282e-02 0.133923111 0.17865757 0.19936991  
## morphospecies.17 2.323490e-02 0.024704831 0.09419724 0.09630663  
## morphospecies.18 1.092610e-01 0.177962023 0.20884916 0.23779037  
## morphospecies.19 1.788560e-02 0.018369204 0.03534014 0.12722558  
## morphospecies.20 7.808353e-02 0.206409106 0.22238896 0.30882056  
## clamydomonadaceae.2 6.674958e-03 0.077122221 0.08933444 0.08940664  
## morphospecies.21 1.223011e-03 0.044515000 0.13842162 0.20102303  
## Dinobryon.spp. 1.808581e-03 0.003039016 0.01802030 0.02076275  
## morphospecies.22 6.111372e-03 0.080306440 0.13361417 0.15591638  
## morphospecies.23 1.060051e-01 0.107483155 0.12234606 0.14198025  
## morphospecies.24 1.573299e-02 0.028503947 0.08531052 0.10468575  
## morphospecies.25 1.180849e-01 0.136269003 0.13911271 0.13968445  
## morphospecies.26 6.613483e-02 0.066603499 0.07705052 0.23835361  
## morphospecies.27 1.322762e-01 0.134368974 0.15378163 0.15692065  
## morphospecies.28 1.400779e-02 0.076837354 0.08543346 0.10239596  
## morphospecies.29 5.875408e-02 0.114616964 0.16474293 0.17002706  
## Tetraselmis.spp... 1.961288e-01 0.210848074 0.21398778 0.39531003  
## morphospecies.30 2.719747e-03 0.008303210 0.01103054 0.12544087  
## morphospecies.31 1.505872e-02 0.015329644 0.02808757 0.05755045  
## Kirchneriella.spp. 9.297560e-03 0.023864295 0.05619376 0.09015767  
## morphospecies.32 1.192681e-02 0.061484040 0.06928324 0.10477349  
## Tetraedron.spp..2 2.719747e-03 0.008303210 0.01103054 0.12544087  
## Dinobryon.spp..1 1.567740e-03 0.146920522 0.15339075 0.16651237  
## Desmodesmus.spp... 2.327727e-02 0.175301405 0.17609044 0.17614600  
## Selenastrum.spp. 3.787059e-04 0.010997029 0.12567835 0.25870901  
## Unidentified.33 4.910698e-05 0.046232670 0.06824166 0.15088190  
## Euglena.spp. 3.931428e-02 0.272496319 0.29079871 0.36741103  
## Phacus.spp. NaN NaN NaN NaN  
## Unidentified.34 2.615884e-02 0.181312947 0.19349095 0.24446707  
## Treubaria.spp. NaN NaN NaN NaN  
## RDA5 RDA6 RDA7  
## Microcystis.spp. 0.34958570 0.35276247 0.35705185  
## Nitzschia.spp. 0.32798716 0.32887183 0.33106295  
## Pseudoanabaena.spp. 0.44025499 0.44795164 0.45129703  
## Glaucocystis.spp... 0.17665717 0.20065694 0.20152219  
## morphospecies.10 0.15874937 0.16031407 0.17241379  
## Aulacoseria.spp. 0.25463788 0.25784457 0.25911692  
## Filamentous.Chlorophyte 0.51115104 0.51341336 0.52121696  
## Diatoma.spp... 0.39813767 0.39832557 0.39870195  
## morphospecies.1 0.24141664 0.24296927 0.30702930  
## pollen. 0.44579751 0.59084057 0.68381654  
## Selenastraceae 0.20418481 0.23669389 0.27012941  
## morphospecies.2 0.05289984 0.09848622 0.11486089  
## morphospecies.3 0.11569776 0.11945245 0.13126093  
## Cyclotella.spp. 0.12798951 0.12842421 0.20772697  
## morphospecies.4 0.49104552 0.50605720 0.51340853  
## Dolichospermum.spp. 0.17665717 0.20065694 0.20152219  
## Aphanocapsa.spp.. 0.21863993 0.22228176 0.24691837  
## morphospecies.5 0.38309344 0.39681632 0.41838767  
## Merismopedia.spp. 0.35338149 0.35891244 0.37301989  
## Scenedesmus.spp. 0.20385729 0.23470647 0.23505684  
## morphospecies.6 0.28406788 0.29417419 0.29969638  
## morphospecies.7 0.19471164 0.23402362 0.25986401  
## morphospecies.8 0.17687214 0.18240031 0.18426365  
## clamydomonadaceae.1 0.06131834 0.07319329 0.09549704  
## morphospecies.11 0.40482943 0.43490113 0.43748578  
## morphospecies.13 0.12220077 0.13446728 0.15223630  
## Westella.spp.. 0.11347437 0.19594634 0.20355677  
## Melosira.spp... 0.57831430 0.58171319 0.58328463  
## morphospecies.14 0.15702362 0.16112808 0.19199475  
## morphospecies.15 0.14554828 0.15606637 0.16409067  
## morphospecies.16 0.28595855 0.29601276 0.29631774  
## Unidentified.13 0.27660863 0.30648793 0.33378526  
## Spirulina.spp... 0.22646357 0.22651119 0.22651584  
## Tetraedron.spp. 0.18649713 0.19114087 0.20000000  
## Cycyotella.spp..2.. 0.23289073 0.23989938 0.26397680  
## Thalassiosira.spp. 0.06079392 0.14632218 0.14969494  
## Micractinium.spp... 0.24510174 0.24559856 0.24666057  
## morphospecies.17 0.12659712 0.16927241 0.22580645  
## morphospecies.18 0.23800013 0.30276560 0.35425489  
## morphospecies.19 0.12791432 0.13335692 0.16113848  
## morphospecies.20 0.30884261 0.31375942 0.33446180  
## clamydomonadaceae.2 0.10142437 0.15293485 0.30967835  
## morphospecies.21 0.20478763 0.33538978 0.43539420  
## Dinobryon.spp. 0.13951872 0.14723385 0.14943584  
## morphospecies.22 0.16572144 0.16649298 0.17810927  
## morphospecies.23 0.15774094 0.17032548 0.17268762  
## morphospecies.24 0.11642125 0.19821025 0.22580645  
## morphospecies.25 0.18507611 0.22675115 0.23212888  
## morphospecies.26 0.24646168 0.30832891 0.36934331  
## morphospecies.27 0.22595186 0.25600269 0.25625293  
## morphospecies.28 0.12614390 0.19848403 0.20000000  
## morphospecies.29 0.18938621 0.32634910 0.36053613  
## Tetraselmis.spp... 0.39868013 0.42100346 0.42219731  
## morphospecies.30 0.13103051 0.19988834 0.22580645  
## morphospecies.31 0.07390552 0.28587475 0.29298958  
## Kirchneriella.spp. 0.15424649 0.19970845 0.20000000  
## morphospecies.32 0.11633997 0.19650106 0.20152219  
## Tetraedron.spp..2 0.13103051 0.19988834 0.22580645  
## Dinobryon.spp..1 0.16906378 0.17587001 0.17848618  
## Desmodesmus.spp... 0.18928695 0.18953658 0.20000000  
## Selenastrum.spp. 0.57228218 0.59150908 0.60666533  
## Unidentified.33 0.18038240 0.20348915 0.20355677  
## Euglena.spp. 0.62710699 0.66591274 0.70135614  
## Phacus.spp. NaN NaN NaN  
## Unidentified.34 0.41726294 0.44308342 0.46666667  
## Treubaria.spp. NaN NaN NaN

sp.rsqm=goodness(rda.maum.rare.hel.all.treats)  
sp.affm=rownames(sp.rsqm)[sp.rsqm[,2]>0.3]  
lm=length(na.omit(sp.affm))  
sp.aff.rowsm=match(na.omit(sp.affm)[1:lm],rownames(rda.maum.rare.hel.all.spscores))  
text(rda.maum.rare.hel.all.spscores[sp.aff.rowsm,1:2],labels=rownames(rda.maum.rare.hel.all.spscores[sp.aff.rowsm,]))  
legend(0.57,0.13,legend=c("Control","Nitrogen","Phosphorus","Trace","N+Trace","P+Trace","N+P","N+P+Trace"),pch=c(2,2,1,2,2,1,1,1), col=c("red","orchid","forestgreen","navy","royalblue","limegreen","gold","grey0"),pt.cex=1, cex=0.8)

 Interpretation: The regular RDA with all factors is significant, but even with using the XYZ format I was unable to parse out variation for each interaction/main effect. The ordination depicts a separation in communities based on treatments containing P (circles) or not (triangles). A filamentous chlorphyte (likely Mougeotia spp.) and Microcystis spp. are associated with N and trace treatments, while Melosira spp. is associated with the P treatments.

NE RDA

#add columns for treatments n,p,trace as y/n for analysis of interactive effects  
#modified csv to remove dinobryon (was coming out as Inf in RDA) and renamed important taxa.  
#after re-run, have to delete more columns that are coming out with infs....  
  
necounts<- read.csv("~/Desktop/USGS/NEspeciescountsFORrda.csv")  
necounts<-necounts[which(necounts1$Treatment!='Chelex'& necounts$Treatment!='Initial'),]  
  
necounts$trace<-grepl("Trace", necounts$Treatment)   
necounts$nitrogen<-grepl("N", necounts$Treatment)   
necounts$phosphorus<-grepl("P", necounts$Treatment)   
  
dim(necounts)

## [1] 32 146

names(necounts)

## [1] "Sample" "Treatment"   
## [3] "Counter" "Total"   
## [5] "Cyclotella.spp." "Peridinium.spp."   
## [7] "Cocconeis.spp." "Selenastrum."   
## [9] "Gomphenema." "pennate.1"   
## [11] "pennate.3" "pennate.4"   
## [13] "Unidentified.3.5" "Aphanizomenon"   
## [15] "Unidentified.4.5" "Synedra."   
## [17] "Unidentified.4" "Chlorophyte"   
## [19] "Unidentified.6" "Unidentified.6.5"   
## [21] "Unidentified.7" "Synedra..1"   
## [23] "Unidentified.8" "Unidentified.9"   
## [25] "Unidentified.10" "Unidentified.14"   
## [27] "Unidentified.15" "Tabellaria."   
## [29] "centric.1" "Unidentified.16"   
## [31] "pennate.4.5" "Glaucocystis.spp..."   
## [33] "Unidentified.19" "Unidentified.20"   
## [35] "Unidentified.21" "Unidentified.22"   
## [37] "Aulacoseria." "centric.2"   
## [39] "pennate.5" "Unidentified.23"   
## [41] "Unidentified.24" "Unidentified.25"   
## [43] "Unidentified.28" "Stephanodiscus."   
## [45] "Unidentified.29" "Unidentified.30"   
## [47] "Unidentified.31" "Unidentified.32"   
## [49] "Unidentified.33" "pennate.6"   
## [51] "Unidentified.35" "Naviculoid"   
## [53] "Unidentified.36" "Unidentified.36.5"   
## [55] "Unidentified.37" "Unidentified.39"   
## [57] "Unidentified.40" "Unidentified.41"   
## [59] "Unidentified.42" "pennate.8"   
## [61] "Unidentified.44" "Unidentified.45"   
## [63] "Unidentified.46" "Unidentified.47"   
## [65] "pennate.9" "Unidentified.48"   
## [67] "Unidentified.50" "Unidentified.51"   
## [69] "Unidentified.52" "Unidentified.53"   
## [71] "Unidentified.54" "Unidentified.55"   
## [73] "Unidentified.56" "Unidentified.57"   
## [75] "Unidentified.58" "Unidentified.59"   
## [77] "Unidentified.60" "Unidentified.61"   
## [79] "Unidentified.62" "Unidentified.63"   
## [81] "Unidentified.64" "Unidentified.65"   
## [83] "Unidentified.66" "Unidentified.67"   
## [85] "Unidentified.68" "centric.3"   
## [87] "Unidentified.69" "centric.4"   
## [89] "Unidentified.70" "Unidentified.71"   
## [91] "Unidentified.72" "Unidentified.73"   
## [93] "Unidentified.74" "Unidentified.75"   
## [95] "Unidentified.76" "Unidentified.77"   
## [97] "Unidentified.78" "Unidentified.79"   
## [99] "Dolichospermum." "Unidentified.80"   
## [101] "Unidentified.81" "Unidentified.82"   
## [103] "Unidentified.83" "pennate.11"   
## [105] "Unidentified.84" "Unidentified.86"   
## [107] "pennate.12" "Unidentified.88"   
## [109] "Actinastrum.spp." "Unidentified.90"   
## [111] "Unidentified.91" "Unidentified.92"   
## [113] "Unidentified.93" "Unidentified.94"   
## [115] "Unidentified.95" "Unidentified.96"   
## [117] "Unidentified.97" "Unidentified.98"   
## [119] "Unidentified.99" "Unidentified.100"   
## [121] "Unidentified.101" "Unidentified.102"   
## [123] "pennate.13" "Unidentified.103"   
## [125] "Nitzschia.spp." "unidentified.1"   
## [127] "Filamentous.Chlorophyte" "Unidentified.1.5"   
## [129] "Unidentified.2" "Fragillaria.spp."   
## [131] "Microcystis.aeurgenosa" "Merismopedia.spp."   
## [133] "Pediastrum.spp." "Scenedesmus.spp."   
## [135] "clamydomonadaceae.1" "Unidentified.13"   
## [137] "Chlamydomonas.spp." "centric.diatom"   
## [139] "Pseudoanabaena.spp." "Unidentified.26"   
## [141] "Unidentified.87" "Unidentified.43"   
## [143] "Micractinium.spp..." "trace"   
## [145] "nitrogen" "phosphorus"

ne.colsums=apply(necounts[,5:143],2,sum)  
ne.rowsums=apply(necounts[,5:143],1,sum)  
min(ne.rowsums)

## [1] 380

min=min(ne.rowsums)  
n=nrow(necounts)  
  
# Rarefaction and Hellinger distance transformation  
ne.rare=rrarefy(necounts[,5:143],sample=min)  
str(ne.rare)

## int [1:32, 1:139] 28 21 13 17 10 7 8 12 9 31 ...  
## - attr(\*, "dimnames")=List of 2  
## ..$ : chr [1:32] "2" "3" "4" "5" ...  
## ..$ : chr [1:139] "Cyclotella.spp." "Peridinium.spp." "Cocconeis.spp." "Selenastrum." ...

ne.rare.hel1=cbind(necounts[,1:4],decostand(ne.rare,method="hellinger"))  
#ne.stands.hel.dist=vegdist(ne.rare.hel[5:147],method="euclidean")  
ne.rare.hel=cbind(necounts[,144:146],ne.rare.hel1)  
str(ne.rare.hel)

## 'data.frame': 32 obs. of 146 variables:  
## $ trace : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ nitrogen : logi FALSE FALSE FALSE FALSE TRUE TRUE ...  
## $ phosphorus : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ Sample : Factor w/ 37 levels "1","10","11",..: 1 12 23 31 32 33 34 35 36 2 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Counter : Factor w/ 3 levels "Brian","Jordyn",..: 2 2 2 2 1 3 2 2 3 3 ...  
## $ Total : int 520 422 458 423 400 467 470 479 418 432 ...  
## $ Cyclotella.spp. : num 0.271 0.235 0.185 0.212 0.162 ...  
## $ Peridinium.spp. : num 0 0 0.0513 0 0 ...  
## $ Cocconeis.spp. : num 0 0.0513 0.0513 0 0 ...  
## $ Selenastrum. : num 0 0.0889 0 0.0889 0.0725 ...  
## $ Gomphenema. : num 0 0 0.0513 0 0 ...  
## $ pennate.1 : num 0 0 0.0513 0 0 ...  
## $ pennate.3 : num 0 0 0 0 0 ...  
## $ pennate.4 : num 0 0 0 0 0 ...  
## $ Unidentified.3.5 : num 0.0889 0.1026 0.0725 0.0725 0.0725 ...  
## $ Aphanizomenon : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.4.5 : num 0 0 0 0 0 ...  
## $ Synedra. : num 0 0.0725 0.0513 0 0.0513 ...  
## $ Unidentified.4 : num 0 0 0 0 0 ...  
## $ Chlorophyte : num 0 0.17 0 0 0.136 ...  
## $ Unidentified.6 : num 0 0.0725 0 0 0 ...  
## $ Unidentified.6.5 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.7 : num 0 0.185 0.126 0.246 0 ...  
## $ Synedra..1 : num 0 0 0.0513 0 0 ...  
## $ Unidentified.8 : num 0.0513 0 0 0 0.1026 ...  
## $ Unidentified.9 : num 0.0513 0 0 0 0 ...  
## $ Unidentified.10 : num 0 0 0.0889 0.0513 0.1147 ...  
## $ Unidentified.14 : num 0 0 0 0.0889 0 ...  
## $ Unidentified.15 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Tabellaria. : num 0 0.0513 0.0513 0 0 ...  
## $ centric.1 : num 0.0889 0.0889 0.1026 0 0.1026 ...  
## $ Unidentified.16 : num 0 0 0 0 0 ...  
## $ pennate.4.5 : num 0 0 0 0 0 ...  
## $ Glaucocystis.spp... : num 0.0513 0 0 0 0 ...  
## $ Unidentified.19 : num 0 0 0 0 0.0889 ...  
## $ Unidentified.20 : num 0 0 0 0 0.0513 ...  
## $ Unidentified.21 : num 0 0 0 0 0 ...  
## $ Unidentified.22 : num 0 0 0.103 0 0 ...  
## $ Aulacoseria. : num 0 0 0.0725 0 0 ...  
## $ centric.2 : num 0 0.0889 0 0 0 ...  
## $ pennate.5 : num 0.0513 0.0513 0 0 0 ...  
## $ Unidentified.23 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.24 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.25 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.28 : num 0 0 0 0 0 ...  
## $ Stephanodiscus. : num 0 0 0.0513 0 0 ...  
## $ Unidentified.29 : num 0 0 0.0513 0.0725 0.0725 ...  
## $ Unidentified.30 : num 0 0 0 0 0 ...  
## $ Unidentified.31 : num 0 0 0 0 0.0889 ...  
## $ Unidentified.32 : num 0 0 0 0 0 ...  
## $ Unidentified.33 : num 0 0.0513 0 0 0 ...  
## $ pennate.6 : num 0 0.0513 0.0513 0 0 ...  
## $ Unidentified.35 : num 0 0.0889 0.0513 0 0 ...  
## $ Naviculoid : num 0 0 0 0.0513 0 ...  
## $ Unidentified.36 : num 0 0 0 0 0 ...  
## $ Unidentified.36.5 : num 0 0 0 0 0 ...  
## $ Unidentified.37 : num 0 0 0 0 0 ...  
## $ Unidentified.39 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.40 : num 0 0 0 0 0.0889 ...  
## $ Unidentified.41 : num 0 0 0 0 0.0513 ...  
## $ Unidentified.42 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.8 : num 0 0 0 0 0.0513 ...  
## $ Unidentified.44 : num 0 0.126 0.192 0 0 ...  
## $ Unidentified.45 : num 0 0.1147 0 0 0.0513 ...  
## $ Unidentified.46 : num 0 0 0.154 0 0 ...  
## $ Unidentified.47 : num 0 0 0.0513 0 0 ...  
## $ pennate.9 : num 0 0 0.0513 0 0 ...  
## $ Unidentified.48 : num 0 0 0.0725 0.0725 0.0513 ...  
## $ Unidentified.50 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.51 : num 0 0 0 0.1147 0.0513 ...  
## $ Unidentified.52 : num 0 0 0 0.0889 0 ...  
## $ Unidentified.53 : num 0 0 0 0.145 0 ...  
## $ Unidentified.54 : num 0 0 0 0.0513 0.1257 ...  
## $ Unidentified.55 : num 0 0 0 0 0 ...  
## $ Unidentified.56 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.57 : num 0 0 0 0.0513 0.0725 ...  
## $ Unidentified.58 : num 0 0 0 0.0889 0 ...  
## $ Unidentified.59 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.60 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.61 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.62 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.63 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.64 : num 0 0 0 0.0725 0.0513 ...  
## $ Unidentified.65 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.66 : num 0 0 0 0.0513 0.0513 ...  
## $ Unidentified.67 : num 0 0 0 0.0889 0.1357 ...  
## $ Unidentified.68 : num 0 0 0 0.0513 0.0513 ...  
## $ centric.3 : num 0 0 0 0.0513 0 ...  
## $ Unidentified.69 : num 0 0 0 0.103 0 ...  
## $ centric.4 : num 0 0 0 0 0.0725 ...  
## $ Unidentified.70 : num 0 0 0 0 0.0889 ...  
## $ Unidentified.71 : num 0 0 0 0 0.0889 ...  
## $ Unidentified.72 : num 0 0 0 0 0.0725 ...  
## $ Unidentified.73 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Unidentified.74 : num 0 0 0 0 0.115 ...  
## $ Unidentified.75 : num 0 0 0 0 0 ...  
## $ Unidentified.76 : num 0 0 0 0 0 ...  
## $ Unidentified.77 : num 0 0 0 0 0 ...  
## [list output truncated]

# RDA - Redundancy Analysis -Treatments apart  
rda.ne.rare.hel.all.treats=rda(ne.rare.hel[,8:146]~ne.rare.hel$trace\*ne.rare.hel$nitrogen\*ne.rare.hel$phosphorus)  
 summary(rda.ne.rare.hel.all.treats)

##   
## Call:  
## rda(formula = ne.rare.hel[, 8:146] ~ ne.rare.hel$trace \* ne.rare.hel$nitrogen \* ne.rare.hel$phosphorus)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.21675 1.0000  
## Constrained 0.08255 0.3808  
## Unconstrained 0.13420 0.6192  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.03226 0.01619 0.01087 0.00907 0.005689 0.004605  
## Proportion Explained 0.14883 0.07472 0.05013 0.04184 0.026246 0.021248  
## Cumulative Proportion 0.14883 0.22355 0.27368 0.31552 0.341769 0.363017  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 0.003864 0.02752 0.01668 0.01268 0.01038 0.008619  
## Proportion Explained 0.017828 0.12695 0.07698 0.05850 0.04790 0.039764  
## Cumulative Proportion 0.380845 0.50779 0.58477 0.64326 0.69117 0.730929  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 0.007369 0.006681 0.005915 0.005031 0.004715  
## Proportion Explained 0.033997 0.030824 0.027290 0.023212 0.021753  
## Cumulative Proportion 0.764926 0.795751 0.823040 0.846252 0.868005  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 0.003933 0.003354 0.003235 0.002724 0.002408  
## Proportion Explained 0.018145 0.015473 0.014925 0.012569 0.011109  
## Cumulative Proportion 0.886150 0.901623 0.916548 0.929117 0.940227  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 0.002203 0.002128 0.001746 0.001700 0.001368  
## Proportion Explained 0.010165 0.009819 0.008054 0.007845 0.006314  
## Cumulative Proportion 0.950392 0.960212 0.968266 0.976111 0.982425  
## PC21 PC22 PC23 PC24  
## Eigenvalue 0.001261 0.0009759 0.0008353 0.0007377  
## Proportion Explained 0.005816 0.0045024 0.0038537 0.0034035  
## Cumulative Proportion 0.988240 0.9927428 0.9965965 1.0000000  
##   
## Accumulated constrained eigenvalues  
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.03226 0.01619 0.01087 0.00907 0.005689 0.004605  
## Proportion Explained 0.39079 0.19619 0.13163 0.10987 0.068916 0.055791  
## Cumulative Proportion 0.39079 0.58698 0.71861 0.82848 0.897397 0.953189  
## RDA7  
## Eigenvalue 0.003864  
## Proportion Explained 0.046811  
## Cumulative Proportion 1.000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.610015   
##   
##   
## Species scores  
##   
## RDA1 RDA2 RDA3 RDA4  
## Cyclotella.spp. 0.1046205 -0.0877252 -0.1215034 -0.0042361  
## Peridinium.spp. -0.0238801 -0.0029671 -0.0011930 -0.0118889  
## Cocconeis.spp. -0.0047986 0.0030477 -0.0068233 0.0204755  
## Selenastrum. 0.0253847 0.0894471 -0.0185624 0.0479033  
## Gomphenema. 0.0085531 -0.0046731 -0.0168768 -0.0014170  
## pennate.1 -0.0001531 -0.0111763 -0.0107269 -0.0067039  
## pennate.3 -0.0151416 0.0601371 0.0402085 0.0401387  
## pennate.4 0.0003875 0.0360472 0.0098881 -0.0118073  
## Unidentified.3.5 -0.0356573 -0.0438145 -0.0435184 -0.0012668  
## Aphanizomenon 0.0005312 0.0145978 0.0011645 -0.0012808  
## Unidentified.4.5 0.0004498 0.0700400 0.0153867 0.0221878  
## Synedra. 0.0156001 -0.0041414 -0.0031590 -0.0063310  
## Unidentified.4 0.0045597 -0.0023677 -0.0046192 0.0005201  
## Chlorophyte -0.0033303 0.2178546 -0.0262354 0.0065058  
## Unidentified.6 -0.0062397 0.0143826 -0.0112934 0.0099594  
## Unidentified.6.5 -0.0148986 0.0276016 0.0343180 -0.0569337  
## Unidentified.7 -0.0490609 -0.0425188 -0.1117409 -0.0220047  
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## Unidentified.9 -0.0067896 -0.0028747 -0.0057695 0.0081968  
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## Unidentified.14 -0.0437324 0.0067518 -0.0206964 0.0493178  
## Unidentified.15 -0.0121924 -0.0063125 0.0067262 -0.0203635  
## Tabellaria. -0.0132367 -0.0050618 -0.0231356 0.0121355  
## centric.1 0.0265459 -0.0242501 -0.0349591 0.0401380  
## Unidentified.16 -0.0103750 -0.0100748 0.0095658 0.0258870  
## pennate.4.5 0.0058332 -0.0041017 0.0025111 0.0037921  
## Glaucocystis.spp... 0.0508769 -0.0314995 0.0070324 0.0209240  
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## Unidentified.21 0.0019876 0.0545617 0.0172590 -0.0188403  
## Unidentified.22 -0.0046224 -0.0590894 0.0398348 -0.0137558  
## Aulacoseria. 0.0283890 -0.0481946 0.0335206 0.0732244  
## centric.2 0.0148657 -0.0173595 -0.0050560 0.0177068  
## pennate.5 -0.0074915 0.0594485 -0.0102832 0.0057222  
## Unidentified.23 0.0060115 -0.0021241 0.0029311 -0.0005805  
## Unidentified.24 0.0082131 0.0125071 0.0023099 0.0151333  
## Unidentified.25 -0.0418364 -0.0171261 0.0611546 0.0751714  
## Unidentified.28 0.0082494 -0.0058007 0.0035513 0.0053629  
## Stephanodiscus. -0.0132689 -0.0351658 0.0142463 -0.0156518  
## Unidentified.29 0.0051922 -0.0258363 0.0134369 0.0344676  
## Unidentified.30 0.0260237 0.0156938 0.0068557 -0.0010061  
## Unidentified.31 0.0158838 -0.0124099 0.0039184 0.0092705  
## Unidentified.32 0.0058332 -0.0041017 0.0025111 0.0037921  
## Unidentified.33 0.0190051 0.0118996 -0.0033689 -0.0200716  
## pennate.6 0.0090558 -0.0122327 -0.0105825 0.0106150  
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## Unidentified.42 -0.0058584 0.0133004 0.0077959 0.0072844  
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## Unidentified.46 0.0422243 0.0213860 -0.0231625 -0.0052343  
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## Unidentified.79 -0.0060471 -0.0006098 -0.0049652 0.0043072  
## Dolichospermum. -0.0060471 -0.0006098 -0.0049652 0.0043072  
## Unidentified.80 -0.0055097 0.0153232 -0.0057725 0.0105951  
## Unidentified.81 -0.0063896 -0.0012974 0.0066313 0.0085652  
## Unidentified.82 0.0058332 -0.0041017 0.0025111 0.0037921  
## Unidentified.83 0.0058332 -0.0041017 0.0025111 0.0037921  
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## Unidentified.84 0.0058332 -0.0041017 0.0025111 0.0037921  
## Unidentified.86 -0.0127791 -0.0025949 0.0132627 0.0171305  
## pennate.12 0.0000000 0.0000000 0.0000000 0.0000000  
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## Actinastrum.spp. -0.0762806 0.0331559 0.0934754 -0.1506871  
## Unidentified.90 0.0021119 -0.0043013 0.0107765 0.0077443  
## Unidentified.91 -0.0070393 -0.0036445 0.0038834 -0.0117569  
## Unidentified.92 0.0004608 -0.0048876 0.0041280 -0.0144347  
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## Unidentified.96 -0.0298190 -0.0154385 0.0164503 -0.0498029  
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## Unidentified.98 0.0294389 -0.0096902 0.0050734 -0.0247812  
## Unidentified.99 0.0004608 -0.0048876 0.0041280 -0.0144347  
## Unidentified.100 -0.0121924 -0.0063125 0.0067262 -0.0203635  
## Unidentified.101 0.0000000 0.0000000 0.0000000 0.0000000  
## Unidentified.102 0.0060115 -0.0021241 0.0029311 -0.0005805  
## pennate.13 0.0060115 -0.0021241 0.0029311 -0.0005805  
## Unidentified.103 0.0085015 -0.0030039 0.0041452 -0.0008209  
## Nitzschia.spp. 0.0736333 -0.0339930 0.0551014 0.0238836  
## unidentified.1 0.0815740 0.1025355 -0.1700383 -0.0363022  
## Filamentous.Chlorophyte 0.2848734 0.0575062 0.0733206 0.0113135  
## Unidentified.1.5 0.0926958 -0.1211152 0.0324749 -0.0145931  
## Unidentified.2 -0.1000584 0.0585162 -0.0298309 -0.1053279  
## Fragillaria.spp. -0.1103295 0.0290299 -0.0234370 0.0283781  
## Microcystis.aeurgenosa -0.2266392 -0.0789765 0.0432537 -0.0020848  
## Merismopedia.spp. -0.0596589 -0.0247881 0.0235418 0.0244741  
## Pediastrum.spp. 0.0875931 0.0098776 -0.0379296 -0.1200640  
## Scenedesmus.spp. 0.0040609 0.0318682 0.0979276 0.0264764  
## clamydomonadaceae.1 -0.0345468 -0.0158756 0.0221649 -0.0384622  
## Unidentified.13 0.1150180 -0.1271370 -0.0435776 -0.0142026  
## Chlamydomonas.spp. 0.0002038 -0.0099839 -0.0170570 0.0133485  
## centric.diatom 0.2910623 -0.0214760 0.0345803 0.0067056  
## Pseudoanabaena.spp. -0.1216909 -0.0025245 -0.0069292 0.0397989  
## Unidentified.26 0.0245371 -0.0019489 -0.0265473 0.0286928  
## Unidentified.87 -0.0165514 0.0151337 0.0222505 -0.0081294  
## Unidentified.43 -0.0208418 -0.0109369 -0.0367897 -0.0001425  
## Micractinium.spp... 0.0073680 -0.0293520 0.0160889 -0.0392795  
## RDA5 RDA6  
## Cyclotella.spp. -9.707e-02 -0.0021666  
## Peridinium.spp. -3.128e-03 -0.0145504  
## Cocconeis.spp. -2.988e-03 0.0296574  
## Selenastrum. -3.022e-02 -0.0492473  
## Gomphenema. -1.820e-02 -0.0079990  
## pennate.1 -1.100e-02 -0.0051390  
## pennate.3 1.648e-02 0.0175596  
## pennate.4 -1.746e-03 0.0029230  
## Unidentified.3.5 2.646e-02 0.0019155  
## Aphanizomenon 2.635e-04 0.0006960  
## Unidentified.4.5 -2.000e-02 -0.0094957  
## Synedra. 2.594e-02 -0.0041651  
## Unidentified.4 -1.393e-02 -0.0147759  
## Chlorophyte 3.419e-02 -0.0086384  
## Unidentified.6 1.298e-02 0.0047762  
## Unidentified.6.5 2.948e-02 0.0157288  
## Unidentified.7 2.088e-02 0.0710085  
## Synedra..1 -4.984e-04 0.0044771  
## Unidentified.8 -2.043e-03 -0.0151287  
## Unidentified.9 -6.125e-05 0.0142859  
## Unidentified.10 3.153e-02 -0.0302025  
## Unidentified.14 -4.851e-03 -0.0232091  
## Unidentified.15 -5.618e-04 0.0009694  
## Tabellaria. 1.215e-03 0.0103364  
## centric.1 -3.181e-02 -0.0056344  
## Unidentified.16 3.121e-02 -0.0214304  
## pennate.4.5 -2.212e-03 0.0002755  
## Glaucocystis.spp... -1.039e-02 0.0058419  
## Unidentified.19 -6.426e-03 0.0034560  
## Unidentified.20 -1.610e-04 -0.0119125  
## Unidentified.21 -3.740e-03 0.0048136  
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## Aulacoseria. -1.993e-02 0.0053200  
## centric.2 7.178e-03 0.0189880  
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## Unidentified.23 1.223e-02 -0.0018798  
## Unidentified.24 -4.946e-03 0.0161564  
## Unidentified.25 -2.570e-03 0.0515168  
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## Stephanodiscus. 2.262e-03 -0.0012973  
## Unidentified.29 3.828e-04 0.0102825  
## Unidentified.30 -2.285e-02 -0.0023669  
## Unidentified.31 3.927e-02 -0.0267757  
## Unidentified.32 -2.212e-03 0.0002755  
## Unidentified.33 -1.784e-02 -0.0094446  
## pennate.6 2.035e-02 0.0192685  
## Unidentified.35 -2.506e-03 0.0162890  
## Naviculoid 4.240e-02 -0.0177045  
## Unidentified.36 -2.212e-03 0.0002755  
## Unidentified.36.5 -2.212e-03 0.0002755  
## Unidentified.37 -5.419e-03 0.0006748  
## Unidentified.39 0.000e+00 0.0000000  
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## Unidentified.41 -1.610e-04 -0.0119125  
## Unidentified.42 -1.235e-03 0.0070189  
## pennate.8 1.025e-04 -0.0112165  
## Unidentified.44 4.660e-03 0.0671841  
## Unidentified.45 3.053e-03 0.0058933  
## Unidentified.46 -3.941e-03 0.0177956  
## Unidentified.47 1.437e-03 0.0079630  
## pennate.9 1.437e-03 0.0079630  
## Unidentified.48 -7.156e-03 0.0163564  
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## Unidentified.60 -6.125e-05 0.0142859  
## Unidentified.61 1.437e-03 0.0079630  
## Unidentified.62 1.437e-03 0.0079630  
## Unidentified.63 1.437e-03 0.0079630  
## Unidentified.64 1.711e-03 -0.0125636  
## Unidentified.65 0.000e+00 0.0000000  
## Unidentified.66 1.276e-03 -0.0039495  
## Unidentified.67 5.649e-04 -0.0114022  
## Unidentified.68 -8.724e-03 0.0104135  
## centric.3 -1.546e-02 0.0054892  
## Unidentified.69 2.874e-03 0.0159260  
## centric.4 -1.726e-03 -0.0105239  
## Unidentified.70 -4.398e-04 -0.0325455  
## Unidentified.71 -5.577e-04 -0.0412661  
## Unidentified.72 -2.277e-04 -0.0168468  
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## Unidentified.78 -1.610e-04 -0.0119125  
## Unidentified.79 -1.610e-04 -0.0119125  
## Dolichospermum. -1.610e-04 -0.0119125  
## Unidentified.80 -2.162e-03 -0.0225653  
## Unidentified.81 -1.499e-03 0.0063229  
## Unidentified.82 -2.212e-03 0.0002755  
## Unidentified.83 -2.212e-03 0.0002755  
## pennate.11 -2.212e-03 0.0002755  
## Unidentified.84 -2.212e-03 0.0002755  
## Unidentified.86 -2.997e-03 0.0126458  
## pennate.12 0.000e+00 0.0000000  
## Unidentified.88 -2.997e-03 0.0126458  
## Actinastrum.spp. -3.671e-02 0.0256397  
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## Unidentified.91 -3.244e-04 0.0005597  
## Unidentified.92 -1.006e-02 -0.0014650  
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## Unidentified.94 -1.298e-03 0.0022388  
## Unidentified.95 -3.244e-04 0.0005597  
## Unidentified.96 -1.374e-03 0.0023709  
## Unidentified.97 -1.170e-03 0.0020180  
## Unidentified.98 -4.768e-02 -0.0092880  
## Unidentified.99 -1.006e-02 -0.0014650  
## Unidentified.100 -5.618e-04 0.0009694  
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## pennate.13 1.223e-02 -0.0018798  
## Unidentified.103 1.730e-02 -0.0026585  
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## unidentified.1 3.641e-02 0.0299761  
## Filamentous.Chlorophyte -5.207e-02 0.0033039  
## Unidentified.1.5 7.448e-02 -0.0677212  
## Unidentified.2 5.220e-02 -0.0101792  
## Fragillaria.spp. -4.434e-02 -0.0005262  
## Microcystis.aeurgenosa -3.845e-02 -0.0249040  
## Merismopedia.spp. -5.832e-03 -0.0198597  
## Pediastrum.spp. -8.728e-02 -0.0332395  
## Scenedesmus.spp. -6.248e-02 0.0613028  
## clamydomonadaceae.1 -2.796e-03 0.0085617  
## Unidentified.13 6.912e-03 -0.0313585  
## Chlamydomonas.spp. -1.112e-02 0.0064535  
## centric.diatom 4.185e-02 0.0213266  
## Pseudoanabaena.spp. 1.922e-02 0.0254159  
## Unidentified.26 -2.746e-02 -0.0089298  
## Unidentified.87 -1.284e-02 0.0127959  
## Unidentified.43 2.923e-03 0.0221575  
## Micractinium.spp... -1.477e-02 -0.0276934  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.127282 -0.1490664 -0.72367 -0.54376 -0.30695 -0.2869690  
## 3 0.024527 0.1047083 -0.76351 0.01364 0.33409 0.4733442  
## 4 -0.001151 -0.2160842 -0.31871 0.16260 0.19127 0.7374108  
## 5 -0.231515 -0.0583572 -0.70059 0.29304 0.07209 0.6857062  
## 6 -0.325793 -0.0479742 -0.31048 0.29021 -0.47311 -1.0550489  
## 7 -0.492086 0.1657973 -0.14742 0.35924 0.19704 -0.7296779  
## 8 -0.241831 -0.0973261 -0.24157 0.05872 0.20153 -0.2491397  
## 9 -0.162528 -0.1437495 -0.30411 0.16240 0.04200 -0.3738987  
## 10 0.291337 -0.1198703 0.21802 0.20022 0.40480 0.2595460  
## 11 0.438935 0.0178077 -0.06802 0.23658 -0.01774 0.3986975  
## 12 0.089767 -0.4165346 0.26799 0.29963 -0.40401 -0.1970666  
## 13 0.358979 -0.3104438 0.08956 0.03004 -0.43021 -0.4054986  
## 14 -0.330823 -0.1616441 0.43799 0.51607 -0.10204 0.2732082  
## 15 -0.401514 0.0540298 0.55461 0.86801 -0.12941 0.2071847  
## 16 -0.218713 -0.0685211 0.12768 0.43148 0.07101 0.3079864  
## 17 -0.340413 -0.0861048 0.22006 -0.08434 -0.14244 0.4896130  
## 18 -0.261823 -0.1631517 0.19409 -0.60063 -0.12970 -0.2317069  
## 19 -0.527708 -0.1911585 0.40197 -0.59358 -0.02307 0.2306517  
## 20 -0.285764 -0.1532158 -0.01112 -0.77262 -0.09546 -0.1054079  
## 21 -0.347496 -0.2291123 0.19997 -0.40947 0.18267 0.2195902  
## 22 0.364853 -0.1833518 0.12007 0.25083 -0.30026 0.0309706  
## 23 0.342838 -0.0002802 -0.06159 -0.23146 -0.47145 -0.2593272  
## 24 0.401684 0.0615732 -0.09344 -0.43396 -0.62595 -0.1078956  
## 25 0.406550 -0.1291817 0.08441 -0.12666 -0.57018 -0.0729892  
## 26 0.213636 -0.1432775 0.06851 -0.04331 0.25795 -0.1040418  
## 27 0.425936 -0.0211750 0.11545 0.08804 0.39723 0.0177609  
## 28 0.205794 -0.1755050 0.09570 -0.15479 0.72049 -0.2928691  
## 29 0.369679 -0.0893583 0.31277 -0.00726 1.09657 -0.0007996  
## 30 -0.031026 0.7834287 -0.04857 -0.19605 0.22582 0.2291813  
## 31 0.080154 0.8388222 0.03637 0.30616 0.08996 -0.0943970  
## 32 -0.043118 0.9284753 0.09480 0.05261 0.17099 0.0806738  
## 33 0.101352 0.3998015 0.15277 -0.42160 -0.43353 -0.0747918  
##   
##   
## Site constraints (linear combinations of constraining variables)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.02021 -0.07970 -0.62662 -0.01862 0.072625 0.40237  
## 3 -0.02021 -0.07970 -0.62662 -0.01862 0.072625 0.40237  
## 4 -0.02021 -0.07970 -0.62662 -0.01862 0.072625 0.40237  
## 5 -0.02021 -0.07970 -0.62662 -0.01862 0.072625 0.40237  
## 6 -0.30556 -0.03081 -0.25089 0.21764 -0.008135 -0.60194  
## 7 -0.30556 -0.03081 -0.25089 0.21764 -0.008135 -0.60194  
## 8 -0.30556 -0.03081 -0.25089 0.21764 -0.008135 -0.60194  
## 9 -0.30556 -0.03081 -0.25089 0.21764 -0.008135 -0.60194  
## 10 0.29475 -0.20726 0.12689 0.19162 -0.111791 0.01392  
## 11 0.29475 -0.20726 0.12689 0.19162 -0.111791 0.01392  
## 12 0.29475 -0.20726 0.12689 0.19162 -0.111791 0.01392  
## 13 0.29475 -0.20726 0.12689 0.19162 -0.111791 0.01392  
## 14 -0.32287 -0.06556 0.33508 0.43280 -0.075720 0.31950  
## 15 -0.32287 -0.06556 0.33508 0.43280 -0.075720 0.31950  
## 16 -0.32287 -0.06556 0.33508 0.43280 -0.075720 0.31950  
## 17 -0.32287 -0.06556 0.33508 0.43280 -0.075720 0.31950  
## 18 -0.35570 -0.18416 0.19623 -0.59408 -0.016391 0.02828  
## 19 -0.35570 -0.18416 0.19623 -0.59408 -0.016391 0.02828  
## 20 -0.35570 -0.18416 0.19623 -0.59408 -0.016391 0.02828  
## 21 -0.35570 -0.18416 0.19623 -0.59408 -0.016391 0.02828  
## 22 0.37898 -0.06281 0.01236 -0.13531 -0.491959 -0.10231  
## 23 0.37898 -0.06281 0.01236 -0.13531 -0.491959 -0.10231  
## 24 0.37898 -0.06281 0.01236 -0.13531 -0.491959 -0.10231  
## 25 0.37898 -0.06281 0.01236 -0.13531 -0.491959 -0.10231  
## 26 0.30376 -0.10733 0.14811 -0.02933 0.618058 -0.09499  
## 27 0.30376 -0.10733 0.14811 -0.02933 0.618058 -0.09499  
## 28 0.30376 -0.10733 0.14811 -0.02933 0.618058 -0.09499  
## 29 0.30376 -0.10733 0.14811 -0.02933 0.618058 -0.09499  
## 30 0.02684 0.73763 0.05884 -0.06472 0.013313 0.03517  
## 31 0.02684 0.73763 0.05884 -0.06472 0.013313 0.03517  
## 32 0.02684 0.73763 0.05884 -0.06472 0.013313 0.03517  
## 33 0.02684 0.73763 0.05884 -0.06472 0.013313 0.03517  
##   
##   
## Biplot scores for constraining variables  
##   
## RDA1  
## ne.rare.hel$traceTRUE -0.23957  
## ne.rare.hel$nitrogenTRUE -0.29044  
## ne.rare.hel$phosphorusTRUE 0.88220  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE -0.33355  
## ne.rare.hel$traceTRUE:ne.rare.hel$phosphorusTRUE 0.41161  
## ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.33532  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.03564  
## RDA2  
## ne.rare.hel$traceTRUE 0.3734  
## ne.rare.hel$nitrogenTRUE 0.3648  
## ne.rare.hel$phosphorusTRUE 0.3164  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE 0.5614  
## ne.rare.hel$traceTRUE:ne.rare.hel$phosphorusTRUE 0.6845  
## ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.6393  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.9796  
## RDA3  
## ne.rare.hel$traceTRUE 0.52924  
## ne.rare.hel$nitrogenTRUE 0.13376  
## ne.rare.hel$phosphorusTRUE 0.30410  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE 0.25871  
## ne.rare.hel$traceTRUE:ne.rare.hel$phosphorusTRUE 0.07222  
## ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.20990  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.07814  
## RDA4  
## ne.rare.hel$traceTRUE -0.31737  
## ne.rare.hel$nitrogenTRUE -0.41327  
## ne.rare.hel$phosphorusTRUE -0.03316  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE -0.66820  
## ne.rare.hel$traceTRUE:ne.rare.hel$phosphorusTRUE -0.20289  
## ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE -0.09540  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE -0.08595  
## RDA5  
## ne.rare.hel$traceTRUE -0.501344  
## ne.rare.hel$nitrogenTRUE 0.533044  
## ne.rare.hel$phosphorusTRUE 0.024262  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE -0.003121  
## ne.rare.hel$traceTRUE:ne.rare.hel$phosphorusTRUE -0.485477  
## ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.640382  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.017680  
## RDA6  
## ne.rare.hel$traceTRUE 0.24651  
## ne.rare.hel$nitrogenTRUE -0.55644  
## ne.rare.hel$phosphorusTRUE -0.13019  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE 0.06435  
## ne.rare.hel$traceTRUE:ne.rare.hel$phosphorusTRUE -0.06810  
## ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE -0.06067  
## ne.rare.hel$traceTRUE:ne.rare.hel$nitrogenTRUE:ne.rare.hel$phosphorusTRUE 0.04670

anova(rda.ne.rare.hel.all.treats)

## Permutation test for rda under reduced model  
## Permutation: free  
## Number of permutations: 999  
##   
## Model: rda(formula = ne.rare.hel[, 8:146] ~ ne.rare.hel$trace \* ne.rare.hel$nitrogen \* ne.rare.hel$phosphorus)  
## Df Variance F Pr(>F)   
## Model 7 0.082548 2.1089 0.001 \*\*\*  
## Residual 24 0.134201   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

RsquareAdj(rda.ne.rare.hel.all.treats)

## $r.squared  
## [1] 0.3808447  
##   
## $adj.r.squared  
## [1] 0.2002578

#adj. Rsquared is 0.1963  
#anova is significant  
   
### Another method of getting a marginal test provides similar results.  
#rda.ne.rare.hel.int=rda(ne.rare.hel[,8:146] ~ ne.rare.hel$trace:ne.rare.hel$nitrogen:ne.rare.hel$phosphorus + Condition(ne.rare.hel$trace + ne.rare.hel$nitrogen +ne.rare.hel$phosphorus))  
# anova(rda.ne.rare.hel.int)  
# summary(rda.ne.rare.hel.int)  
  
###  
# Plots and getting some more species info  
# Better plots can be made if you extract scores as shown below  
rda.ne.rare.hel.all.spscores=scores(rda.ne.rare.hel.all.treats,display="sp",choices=c(1:17))  
head(rda.ne.rare.hel.all.spscores)

## RDA1 RDA2 RDA3 RDA4  
## Cyclotella.spp. 0.1046204620 -0.087725163 -0.121503380 -0.004236091  
## Peridinium.spp. -0.0238801467 -0.002967129 -0.001192975 -0.011888946  
## Cocconeis.spp. -0.0047985893 0.003047717 -0.006823256 0.020475547  
## Selenastrum. 0.0253847410 0.089447093 -0.018562361 0.047903310  
## Gomphenema. 0.0085530747 -0.004673108 -0.016876769 -0.001417011  
## pennate.1 -0.0001530924 -0.011176335 -0.010726925 -0.006703898  
## RDA5 RDA6 RDA7 PC1  
## Cyclotella.spp. -0.097074201 -0.002166626 0.020940557 0.019467740  
## Peridinium.spp. -0.003127514 -0.014550386 -0.013741563 0.013349362  
## Cocconeis.spp. -0.002987776 0.029657368 0.009998867 -0.021521360  
## Selenastrum. -0.030218689 -0.049247347 -0.037653726 -0.025731139  
## Gomphenema. -0.018195619 -0.007998953 -0.015437684 0.007854613  
## pennate.1 -0.010996418 -0.005139046 0.006603530 -0.003785331  
## PC2 PC3 PC4 PC5  
## Cyclotella.spp. -0.011263398 -0.02333765 -0.056300764 0.0113444537  
## Peridinium.spp. -0.023956402 -0.02856621 0.028249053 -0.0198202156  
## Cocconeis.spp. 0.009358574 -0.02156279 -0.019279657 0.0139827455  
## Selenastrum. 0.008388204 -0.02408649 -0.008959868 0.0260222943  
## Gomphenema. -0.013237573 -0.01219607 0.003719391 0.0002332524  
## pennate.1 -0.020115258 -0.01544102 0.003990249 0.0105636307  
## PC6 PC7 PC8 PC9  
## Cyclotella.spp. 0.070908716 -0.0168545691 -0.066992284 0.01460282  
## Peridinium.spp. 0.016009234 -0.0192183743 0.008303776 -0.03201295  
## Cocconeis.spp. -0.010363498 -0.0145456027 -0.019134251 -0.01676045  
## Selenastrum. 0.049428353 -0.0199099089 0.015179575 0.02343100  
## Gomphenema. -0.005695022 -0.0028428745 0.003557100 -0.01042515  
## pennate.1 -0.002591140 0.0005222744 -0.016171577 -0.02121146  
## PC10  
## Cyclotella.spp. 0.000868352  
## Peridinium.spp. -0.014389868  
## Cocconeis.spp. 0.013434376  
## Selenastrum. -0.005630156  
## Gomphenema. 0.001480957  
## pennate.1 -0.006158081

rda.ne.rare.hel.all.lcscores=scores(rda.ne.rare.hel.all.treats,display="lc",choices=c(1:17))  
head(rda.ne.rare.hel.all.lcscores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.02021427 -0.07969986 -0.6266183 -0.01861859 0.072624590 0.4023730  
## 3 -0.02021427 -0.07969986 -0.6266183 -0.01861859 0.072624590 0.4023730  
## 4 -0.02021427 -0.07969986 -0.6266183 -0.01861859 0.072624590 0.4023730  
## 5 -0.02021427 -0.07969986 -0.6266183 -0.01861859 0.072624590 0.4023730  
## 6 -0.30555951 -0.03081313 -0.2508948 0.21764223 -0.008134858 -0.6019413  
## 7 -0.30555951 -0.03081313 -0.2508948 0.21764223 -0.008134858 -0.6019413  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 -0.0097909427 0.5795044 -0.09288962 0.127478193 -0.5442903 0.21347207  
## 3 -0.0097909427 -0.1591926 -0.24705980 -0.016384705 -0.3998921 0.02880662  
## 4 -0.0097909427 -0.1538839 -0.15365371 -0.009674619 0.2324118 -0.06132065  
## 5 -0.0097909427 -0.2664279 0.49360313 -0.101418870 0.7117706 -0.18095804  
## 6 0.0004512416 0.3791274 0.42116585 0.387010059 0.4092928 0.42286980  
## 7 0.0004512416 -0.3104016 0.39127703 -0.074603597 -0.1767196 0.20726708  
## PC6 PC7 PC8 PC9 PC10  
## 2 -0.164634602 0.02251889 -0.1321917 0.28610111 -0.41751126  
## 3 -0.006890011 -0.30851873 0.1037747 0.05478313 0.69046614  
## 4 -0.168773376 -0.24304860 0.1822101 -0.97887144 -0.03876606  
## 5 0.340297990 0.52904844 -0.1537931 0.63798721 -0.23418883  
## 6 0.056374770 -0.32811452 -0.2838621 0.08669258 0.74512855  
## 7 0.317223479 -0.10892027 0.6476117 -0.19688152 -0.59346033

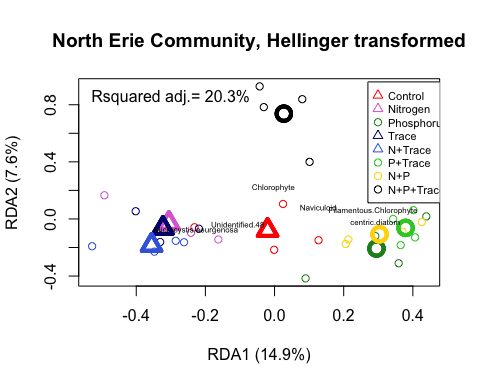
rda.ne.rare.hel.all.wascores=scores(rda.ne.rare.hel.all.treats,display="wa",choices=c(1:17))  
head(rda.ne.rare.hel.all.wascores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.127281856 -0.14906640 -0.7236687 -0.54375853 -0.3069478 -0.2869690  
## 3 0.024527270 0.10470833 -0.7635063 0.01364425 0.3340861 0.4733442  
## 4 -0.001151038 -0.21608417 -0.3187101 0.16259599 0.1912679 0.7374108  
## 5 -0.231515161 -0.05835720 -0.7005883 0.29304393 0.0720922 0.6857062  
## 6 -0.325792965 -0.04797423 -0.3104769 0.29020901 -0.4731057 -1.0550489  
## 7 -0.492086243 0.16579729 -0.1474242 0.35923900 0.1970392 -0.7296779  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 -0.13819222 0.5795044 -0.09288962 0.127478193 -0.5442903 0.21347207  
## 3 0.25746699 -0.1591926 -0.24705980 -0.016384705 -0.3998921 0.02880662  
## 4 -0.01807698 -0.1538839 -0.15365371 -0.009674619 0.2324118 -0.06132065  
## 5 -0.14036156 -0.2664279 0.49360313 -0.101418870 0.7117706 -0.18095804  
## 6 0.09743096 0.3791274 0.42116585 0.387010059 0.4092928 0.42286980  
## 7 0.14540854 -0.3104016 0.39127703 -0.074603597 -0.1767196 0.20726708  
## PC6 PC7 PC8 PC9 PC10  
## 2 -0.164634602 0.02251889 -0.1321917 0.28610111 -0.41751126  
## 3 -0.006890011 -0.30851873 0.1037747 0.05478313 0.69046614  
## 4 -0.168773376 -0.24304860 0.1822101 -0.97887144 -0.03876606  
## 5 0.340297990 0.52904844 -0.1537931 0.63798721 -0.23418883  
## 6 0.056374770 -0.32811452 -0.2838621 0.08669258 0.74512855  
## 7 0.317223479 -0.10892027 0.6476117 -0.19688152 -0.59346033

#weighted averages with P symbols  
#make P have a symbol diference  
symbols=ifelse(ne.rare.hel$phosphorus=="TRUE",1,ifelse(ne.rare.hel$phosphorus=="FALSE",2,0))  
plot(rda.ne.rare.hel.all.wascores[,1:2],col=colors,xlab="RDA1 (14.9%)",ylab="RDA2 (7.6%)",main="North Erie Community, Hellinger transformed")  
points(rda.ne.rare.hel.all.lcscores[,1:2],col=colors,pch=symbols,cex=2,lwd=4)  
text(-0.3,0.85,"Rsquared adj.= 20.3%")  
# This command provides and R-squared for each taxon for each axis  
goodness(rda.ne.rare.hel.all.treats)

## RDA1 RDA2 RDA3 RDA4  
## Cyclotella.spp. 1.822866e-01 0.310451745 0.55631761 0.55661646  
## Peridinium.spp. 5.943472e-02 0.060352287 0.06050062 0.07523232  
## Cocconeis.spp. 3.969234e-03 0.005570372 0.01359570 0.08586446  
## Selenastrum. 2.369953e-02 0.317956441 0.33062889 0.41502555  
## Gomphenema. 2.058826e-02 0.026734180 0.10689345 0.10745855  
## pennate.1 5.472258e-06 0.029170222 0.05603665 0.06653000  
## pennate.3 1.606704e-02 0.269508483 0.38280799 0.49571438  
## pennate.4 3.505245e-05 0.303426641 0.32625535 0.35880602  
## Unidentified.3.5 8.436425e-02 0.211742691 0.33740550 0.33751198  
## Aphanizomenon 2.868896e-04 0.216961551 0.21834042 0.22000854  
## Unidentified.4.5 7.494492e-06 0.181724104 0.19049400 0.20873003  
## Synedra. 2.166042e-02 0.023186955 0.02407515 0.02764255  
## Unidentified.4 7.267579e-03 0.009227209 0.01668591 0.01678047  
## Chlorophyte 1.307364e-04 0.559578868 0.56769227 0.56819119  
## Unidentified.6 6.458012e-03 0.040769913 0.06192540 0.07837827  
## Unidentified.6.5 1.444164e-02 0.064009216 0.14063449 0.35152994  
## Unidentified.7 5.555922e-02 0.097289048 0.38549862 0.39667536  
## Synedra..1 1.180022e-01 0.134797566 0.13509843 0.16343425  
## Unidentified.8 1.405476e-01 0.145708161 0.17392626 0.30016733  
## Unidentified.9 2.421755e-02 0.028558959 0.04604621 0.08134233  
## Unidentified.10 7.413472e-02 0.081514504 0.08713362 0.10596750  
## Unidentified.14 1.025606e-01 0.105005204 0.12797533 0.25840675  
## Unidentified.15 5.038381e-02 0.063889519 0.07922338 0.21976802  
## Tabellaria. 4.930999e-02 0.056520752 0.20715974 0.24860628  
## centric.1 3.326948e-02 0.061033063 0.11873220 0.19479289  
## Unidentified.16 7.935773e-03 0.015418921 0.02216512 0.07157077  
## pennate.4.5 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Glaucocystis.spp... 1.574357e-01 0.217784689 0.22079260 0.24742151  
## Unidentified.19 3.556037e-03 0.382718272 0.39959952 0.41913836  
## Unidentified.20 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.21 3.049336e-04 0.230092940 0.25308528 0.28048374  
## Unidentified.22 4.465581e-04 0.073420614 0.10658531 0.11054006  
## Aulacoseria. 1.376224e-02 0.053425138 0.07261233 0.16417094  
## centric.2 2.829100e-02 0.066870030 0.07014260 0.11028085  
## pennate.5 6.085091e-03 0.389268819 0.40073393 0.40428411  
## Unidentified.23 3.674453e-02 0.041331886 0.05006733 0.05040995  
## Unidentified.24 9.743271e-03 0.032337804 0.03310848 0.06618778  
## Unidentified.25 4.980080e-02 0.058146108 0.16455686 0.32533716  
## Unidentified.28 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Stephanodiscus. 1.648701e-02 0.132288056 0.15129330 0.17423365  
## Unidentified.29 1.759406e-03 0.045323540 0.05710692 0.13464065  
## Unidentified.30 7.357272e-02 0.100329587 0.10543567 0.10554563  
## Unidentified.31 2.817809e-02 0.045378351 0.04709316 0.05669163  
## Unidentified.32 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.33 4.674742e-02 0.065073983 0.06654292 0.11868416  
## pennate.6 1.352330e-02 0.038199322 0.05666684 0.07524800  
## Unidentified.35 6.744985e-02 0.090350758 0.09738841 0.16161022  
## Naviculoid 3.994331e-01 0.561301133 0.58643023 0.60462810  
## Unidentified.36 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.36.5 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.37 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.39 NaN NaN NaN NaN  
## Unidentified.40 1.132644e-01 0.115159463 0.12553448 0.21474456  
## Unidentified.41 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.42 1.803003e-02 0.110963172 0.14289098 0.17076678  
## pennate.8 1.598350e-02 0.118774557 0.12636338 0.13117478  
## Unidentified.44 1.938411e-02 0.027669712 0.18219663 0.20430350  
## Unidentified.45 8.366950e-03 0.011338299 0.19694627 0.19905305  
## Unidentified.46 6.666315e-02 0.083764087 0.10382412 0.10484854  
## Unidentified.47 1.627214e-04 0.002692275 0.15905559 0.15919364  
## pennate.9 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.48 4.895566e-01 0.551904146 0.55532019 0.56286066  
## Unidentified.50 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.51 8.366950e-03 0.011338299 0.19694627 0.19905305  
## Unidentified.52 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.53 4.568998e-03 0.021569873 0.09635489 0.10821228  
## Unidentified.54 1.072668e-01 0.110944475 0.12928940 0.22536545  
## Unidentified.55 7.952687e-02 0.081615973 0.08842317 0.18267334  
## Unidentified.56 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.57 2.801251e-02 0.030093065 0.16196299 0.17341124  
## Unidentified.58 7.397197e-03 0.013563546 0.10352646 0.10391484  
## Unidentified.59 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.60 2.421755e-02 0.028558959 0.04604621 0.08134233  
## Unidentified.61 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.62 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.63 1.627214e-04 0.002692275 0.15905559 0.15919364  
## Unidentified.64 4.342210e-02 0.046647165 0.25105832 0.26880422  
## Unidentified.65 NaN NaN NaN NaN  
## Unidentified.66 2.183591e-02 0.024348760 0.18278203 0.19093186  
## Unidentified.67 5.197699e-02 0.055083423 0.13148726 0.16791405  
## Unidentified.68 2.701953e-01 0.335517856 0.37179894 0.38528057  
## centric.3 7.387189e-02 0.091972664 0.10765469 0.10797081  
## Unidentified.69 1.627214e-04 0.002692275 0.15905559 0.15919364  
## centric.4 7.803793e-02 0.079668574 0.07972190 0.15481209  
## Unidentified.70 7.137451e-02 0.072100318 0.12022135 0.15643212  
## Unidentified.71 7.684060e-02 0.077621993 0.12942828 0.16841220  
## Unidentified.72 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.73 NaN NaN NaN NaN  
## Unidentified.74 6.398240e-02 0.191438613 0.19358973 0.23514821  
## Unidentified.75 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.76 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.77 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.78 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.79 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Dolichospermum. 3.718093e-02 0.037559029 0.06262659 0.08148977  
## Unidentified.80 4.678683e-03 0.040866702 0.04600233 0.06330349  
## Unidentified.81 4.151193e-02 0.043223547 0.08793652 0.16253149  
## Unidentified.82 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.83 3.459787e-02 0.051704348 0.05811598 0.07273759  
## pennate.11 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.84 3.459787e-02 0.051704348 0.05811598 0.07273759  
## Unidentified.86 8.579132e-02 0.089328663 0.18173547 0.33589841  
## pennate.12 NaN NaN NaN NaN  
## Unidentified.88 4.151193e-02 0.043223547 0.08793652 0.16253149  
## Actinastrum.spp. 8.726192e-02 0.103748006 0.23478418 0.57530889  
## Unidentified.90 1.559152e-03 0.008026474 0.04862207 0.06958675  
## Unidentified.91 5.038381e-02 0.063889519 0.07922338 0.21976802  
## Unidentified.92 1.115420e-04 0.012661045 0.02161327 0.13107406  
## Unidentified.93 5.038381e-02 0.063889519 0.07922338 0.21976802  
## Unidentified.94 2.231283e-01 0.282939299 0.35084638 0.97325838  
## Unidentified.95 5.038381e-02 0.063889519 0.07922338 0.21976802  
## Unidentified.96 1.360172e-01 0.172477506 0.21387312 0.59329043  
## Unidentified.97 5.038381e-02 0.063889519 0.07922338 0.21976802  
## Unidentified.98 9.564285e-02 0.106005642 0.10884617 0.17661853  
## Unidentified.99 1.115420e-04 0.012661045 0.02161327 0.13107406  
## Unidentified.100 5.038381e-02 0.063889519 0.07922338 0.21976802  
## Unidentified.101 NaN NaN NaN NaN  
## Unidentified.102 3.674453e-02 0.041331886 0.05006733 0.05040995  
## pennate.13 3.674453e-02 0.041331886 0.05006733 0.05040995  
## Unidentified.103 3.674453e-02 0.041331886 0.05006733 0.05040995  
## Nitzschia.spp. 1.619339e-01 0.196445800 0.28712650 0.30416327  
## unidentified.1 5.832232e-02 0.150468935 0.40387943 0.41542986  
## Filamentous.Chlorophyte 5.465857e-01 0.568858997 0.60506719 0.60592928  
## Unidentified.1.5 1.722782e-01 0.466386718 0.48753161 0.49180139  
## Unidentified.2 9.735754e-02 0.130655252 0.13930885 0.24719097  
## Fragillaria.spp. 1.135541e-01 0.121415710 0.12653989 0.13405244  
## Microcystis.aeurgenosa 4.861254e-01 0.545155523 0.56286167 0.56290280  
## Merismopedia.spp. 2.259313e-01 0.264935529 0.30011631 0.33813850  
## Pediastrum.spp. 2.727810e-02 0.027624980 0.03273981 0.08399046  
## Scenedesmus.spp. 3.015096e-04 0.018870142 0.19420741 0.20702429  
## clamydomonadaceae.1 2.786599e-01 0.337506316 0.45221317 0.79761769  
## Unidentified.13 1.476771e-01 0.328113762 0.34931240 0.35156412  
## Chlamydomonas.spp. 6.849522e-06 0.016444204 0.06442198 0.09380495  
## centric.diatom 6.045799e-01 0.607871373 0.61640513 0.61672602  
## Pseudoanabaena.spp. 1.892098e-01 0.189291271 0.18990475 0.21014282  
## Unidentified.26 2.424720e-02 0.024400175 0.05278295 0.08593886  
## Unidentified.87 2.783561e-02 0.051107027 0.10141205 0.10812702  
## Unidentified.43 5.546446e-02 0.070737871 0.24355972 0.24356232  
## Micractinium.spp... 3.251905e-03 0.054859339 0.07036490 0.16278542  
## RDA5 RDA6 RDA7  
## Cyclotella.spp. 0.71355484 0.71363301 0.72093596  
## Peridinium.spp. 0.07625177 0.09831734 0.11799795  
## Cocconeis.spp. 0.08740323 0.23901913 0.25625293  
## Selenastrum. 0.44861056 0.53780954 0.58995423  
## Gomphenema. 0.20063556 0.21864257 0.28571429  
## pennate.1 0.09476332 0.10092961 0.11111111  
## pennate.3 0.51475612 0.53636438 0.53874445  
## pennate.4 0.35951806 0.36151297 0.46666667  
## Unidentified.3.5 0.38397694 0.38422041 0.39776652  
## Aphanizomenon 0.22007912 0.22057160 0.22580645  
## Unidentified.4.5 0.22354655 0.22688665 0.23816031  
## Synedra. 0.08751348 0.08905754 0.09254515  
## Unidentified.4 0.08460804 0.16092686 0.20152219  
## Chlorophyte 0.58197266 0.58285226 0.59573607  
## Unidentified.6 0.10631209 0.11009601 0.11592645  
## Unidentified.6.5 0.40806730 0.42416329 0.48342353  
## Unidentified.7 0.40674251 0.52312956 0.52406935  
## Synedra..1 0.16347706 0.16693219 0.16875328  
## Unidentified.8 0.30076518 0.33355743 0.34545455  
## Unidentified.9 0.08134430 0.18856001 0.20000000  
## Unidentified.10 0.15864812 0.20698918 0.27018849  
## Unidentified.14 0.25966866 0.28855484 0.28859922  
## Unidentified.15 0.21987501 0.22019353 0.22580645  
## Tabellaria. 0.24902175 0.27909062 0.28571429  
## centric.1 0.24256799 0.24406681 0.24933914  
## Unidentified.16 0.14338360 0.17724251 0.21090587  
## pennate.4.5 0.07771430 0.07779146 0.22580645  
## Glaucocystis.spp... 0.25398797 0.25606371 0.52014484  
## Unidentified.19 0.42025201 0.42057409 0.44879085  
## Unidentified.20 0.08151613 0.22580637 0.22580645  
## Unidentified.21 0.28156330 0.28335184 0.40037670  
## Unidentified.22 0.24234961 0.24265176 0.24408509  
## Aulacoseria. 0.17095526 0.17143855 0.17274460  
## centric.2 0.11687701 0.16303408 0.23527450  
## pennate.5 0.40468311 0.48932374 0.49050659  
## Unidentified.23 0.20253018 0.20612321 0.22580645  
## Unidentified.24 0.06972125 0.10742464 0.22385704  
## Unidentified.25 0.32552515 0.40103882 0.42649603  
## Unidentified.28 0.07771430 0.07779146 0.22580645  
## Stephanodiscus. 0.17471281 0.17487040 0.37220649  
## Unidentified.29 0.13465021 0.14155053 0.14653315  
## Unidentified.30 0.16225509 0.16286371 0.17282337  
## Unidentified.31 0.22892299 0.30899494 0.30996104  
## Unidentified.32 0.07771430 0.07779146 0.22580645  
## Unidentified.33 0.15989513 0.17143981 0.17879368  
## pennate.6 0.14353293 0.20475783 0.20478632  
## Unidentified.35 0.16202557 0.17956965 0.32500080  
## Naviculoid 0.64933382 0.65712859 0.71980385  
## Unidentified.36 0.07771430 0.07779146 0.22580645  
## Unidentified.36.5 0.07771430 0.07779146 0.22580645  
## Unidentified.37 0.07771430 0.07779146 0.22580645  
## Unidentified.39 NaN NaN NaN  
## Unidentified.40 0.21555531 0.36393671 0.36820667  
## Unidentified.41 0.08151613 0.22580637 0.22580645  
## Unidentified.42 0.17156807 0.19744871 0.20000000  
## pennate.8 0.13118030 0.19727400 0.20000000  
## Unidentified.44 0.20530028 0.41250141 0.42130758  
## Unidentified.45 0.20067131 0.20670209 0.20673335  
## Unidentified.46 0.10542932 0.11727021 0.11744606  
## Unidentified.47 0.16129401 0.22576828 0.22580645  
## pennate.9 0.16129401 0.22576828 0.22580645  
## Unidentified.48 0.56506648 0.57659024 0.58125059  
## Unidentified.50 0.16129401 0.22576828 0.22580645  
## Unidentified.51 0.20067131 0.20670209 0.20673335  
## Unidentified.52 0.16129401 0.22576828 0.22580645  
## Unidentified.53 0.10846703 0.11708841 0.18312648  
## Unidentified.54 0.22588287 0.25649829 0.26526871  
## Unidentified.55 0.18449081 0.18757540 0.20152219  
## Unidentified.56 0.16129401 0.22576828 0.22580645  
## Unidentified.57 0.17392267 0.20151072 0.20152219  
## Unidentified.58 0.16058333 0.19769281 0.20355677  
## Unidentified.59 0.16129401 0.22576828 0.22580645  
## Unidentified.60 0.08134430 0.18856001 0.20000000  
## Unidentified.61 0.16129401 0.22576828 0.22580645  
## Unidentified.62 0.16129401 0.22576828 0.22580645  
## Unidentified.63 0.16129401 0.22576828 0.22580645  
## Unidentified.64 0.26959699 0.31236114 0.31237892  
## Unidentified.65 NaN NaN NaN  
## Unidentified.66 0.19178756 0.19998205 0.20000000  
## Unidentified.67 0.16794519 0.18062945 0.18286301  
## Unidentified.68 0.39356329 0.40536602 0.41041651  
## centric.3 0.15980647 0.16634099 0.17436767  
## Unidentified.69 0.16129401 0.22576828 0.22580645  
## centric.4 0.15585367 0.19456850 0.20152219  
## Unidentified.70 0.15648271 0.43346997 0.43347013  
## Unidentified.71 0.16846666 0.46666650 0.46666667  
## Unidentified.72 0.08151613 0.22580637 0.22580645  
## Unidentified.73 NaN NaN NaN  
## Unidentified.74 0.23540096 0.31492451 0.31498517  
## Unidentified.75 0.08151613 0.22580637 0.22580645  
## Unidentified.76 0.08151613 0.22580637 0.22580645  
## Unidentified.77 0.08151613 0.22580637 0.22580645  
## Unidentified.78 0.08151613 0.22580637 0.22580645  
## Unidentified.79 0.08151613 0.22580637 0.22580645  
## Dolichospermum. 0.08151613 0.22580637 0.22580645  
## Unidentified.80 0.06402372 0.14250222 0.17854323  
## Unidentified.81 0.16481470 0.20546513 0.22580645  
## Unidentified.82 0.07771430 0.07779146 0.22580645  
## Unidentified.83 0.07771430 0.07779146 0.22580645  
## pennate.11 0.07771430 0.07779146 0.22580645  
## Unidentified.84 0.07771430 0.07779146 0.22580645  
## Unidentified.86 0.34061704 0.42462793 0.46666667  
## pennate.12 NaN NaN NaN  
## Unidentified.88 0.16481470 0.20546513 0.22580645  
## Actinastrum.spp. 0.59551651 0.60537526 0.60746302  
## Unidentified.90 0.15684435 0.16153833 0.20152219  
## Unidentified.91 0.21987501 0.22019353 0.22580645  
## Unidentified.92 0.18424390 0.18537146 0.20000000  
## Unidentified.93 0.21987501 0.22019353 0.22580645  
## Unidentified.94 0.97373218 0.97514279 1.00000000  
## Unidentified.95 0.21987501 0.22019353 0.22580645  
## Unidentified.96 0.59357926 0.59443915 0.60959190  
## Unidentified.97 0.21987501 0.22019353 0.22580645  
## Unidentified.98 0.42747702 0.43699741 0.57021071  
## Unidentified.99 0.18424390 0.18537146 0.20000000  
## Unidentified.100 0.21987501 0.22019353 0.22580645  
## Unidentified.101 NaN NaN NaN  
## Unidentified.102 0.20253018 0.20612321 0.22580645  
## pennate.13 0.20253018 0.20612321 0.22580645  
## Unidentified.103 0.20253018 0.20612321 0.22580645  
## Nitzschia.spp. 0.34498203 0.36199467 0.38562054  
## unidentified.1 0.42705123 0.43492681 0.44583111  
## Filamentous.Chlorophyte 0.62419057 0.62426409 0.64580388  
## Unidentified.1.5 0.60303595 0.69498767 0.69515219  
## Unidentified.2 0.27368412 0.27469173 0.27533614  
## Fragillaria.spp. 0.15239140 0.15239398 0.17100675  
## Microcystis.aeurgenosa 0.57689403 0.58276374 0.58567210  
## Merismopedia.spp. 0.34029740 0.36533384 0.36605738  
## Pediastrum.spp. 0.11107351 0.11500161 0.11530732  
## Scenedesmus.spp. 0.27840853 0.34711930 0.37208615  
## clamydomonadaceae.1 0.79944301 0.81655814 0.82222222  
## Unidentified.13 0.35209742 0.36307463 0.36509262  
## Chlamydomonas.spp. 0.11419030 0.12105818 0.12107962  
## centric.diatom 0.62922347 0.63246928 0.64979993  
## Pseudoanabaena.spp. 0.21486348 0.22311701 0.26853454  
## Unidentified.26 0.11631020 0.11952163 0.14429501  
## Unidentified.87 0.12487466 0.14151161 0.14897839  
## Unidentified.43 0.24465342 0.30734213 0.30832600  
## Micractinium.spp... 0.17584902 0.22178871 0.22201271

sp.rsqne=goodness(rda.ne.rare.hel.all.treats)  
sp.affne=rownames(sp.rsqne)[sp.rsqne[,2]>0.50]  
lne=length(na.omit(sp.affne))  
sp.aff.rowsne=match(na.omit(sp.affne)[1:lne],rownames(rda.ne.rare.hel.all.spscores))  
text(rda.ne.rare.hel.all.spscores[sp.aff.rowsne,1:2],labels=rownames(rda.ne.rare.hel.all.spscores[sp.aff.rowsne,]),cex=0.5)  
legend(0.27,0.96,legend=c("Control","Nitrogen","Phosphorus","Trace","N+Trace","P+Trace","N+P","N+P+Trace"),pch=c(2,2,1,2,2,1,1,1), col=c("red","orchid","forestgreen","navy","royalblue","limegreen","gold","grey0"),pt.cex=1, cex=0.7)

 Interpreation: I didn’t bother with the XYZ format for sites other than Maumee because I still wasn’t able to get the variation explained that I was looking for. This ordination is super neat!! It demonstrates a clear community shift from the control with N, Trace, and N+trace treatments clustering and Microcystis being associated. It also shows N+P, P+trace and P treatments clustering with filamentous chlorophytes and centric diatom associations. It also shows N+P+trace being different from everything else! Neat! The adj. Rsquared is higher for this RDA as well.

GREEN BAY RDA

#add columns for treatments n,p,trace as y/n for analysis of interactive effects  
  
gbcounts$trace<-grepl("Trace", gbcounts$Treatment)   
gbcounts$nitrogen<-grepl("N", gbcounts$Treatment)   
gbcounts$phosphorus<-grepl("P", gbcounts$Treatment)   
  
dim(gbcounts)

## [1] 32 55

names(gbcounts)

## [1] "Sample.ID" "Counter"   
## [3] "Treatment" "Total.Counted"   
## [5] "Chlamydonaceae" "Aulacoseira.spp."   
## [7] "morphospecies.1" "Meloseira.spp..."   
## [9] "centric.1" "pennate.3"   
## [11] "Actinastrum.spp." "morphospecies.2"   
## [13] "morphospecies.3" "morphospecies.4"   
## [15] "morphospecies.5" "morphospecies.7"   
## [17] "Selenastrum.spp." "morphospecies.8"   
## [19] "Closterium.spp." "pennate.4"   
## [21] "Pediastrum.spp..1" "Staurastrum.spp."   
## [23] "Pediastrum.spp..2" "Cosmarium.spp."   
## [25] "Merismopedia.spp." "Gomphoneis.spp..."   
## [27] "Atractomorpha.spp..." "morphospecies.9"   
## [29] "morphospecies.10" "morphospecies.11"   
## [31] "Pediastrum.spp..3" "Treubaria.spp."   
## [33] "morphospecies.12" "mophospecies.13"   
## [35] "Staurastrum.spp..3" "Dinobryon.spp.."   
## [37] "Cyclotella.spp." "Scenedesmum.spp."   
## [39] "Microcystis.spp." "Navicula.spp..."   
## [41] "Stephanodiscus.spp." "Pseudoanabaena.spp."   
## [43] "Fragillaria.spp..." "Micractinium.spp."   
## [45] "Staurastrum.spp..2" "Pediastrum.spp."   
## [47] "filamentous.cyanobacteria" "Coconeis.spp."   
## [49] "Dolichospermum.spp." "Planktothrix.spp.."   
## [51] "Diatoma.spp." "Selenastrum.spp..."   
## [53] "trace" "nitrogen"   
## [55] "phosphorus"

gb.colsums=apply(gbcounts[,5:52],2,sum)  
gb.rowsums=apply(gbcounts[,5:52],1,sum)  
min(gb.rowsums)

## [1] 299

min=min(gb.rowsums)  
n=nrow(gbcounts)  
  
# Rarefaction and Hellinger distance transformation  
gb.rare=rrarefy(gbcounts[,5:52],sample=min)  
str(gb.rare)

## int [1:32, 1:48] 2 0 0 0 2 1 0 0 0 0 ...  
## - attr(\*, "dimnames")=List of 2  
## ..$ : chr [1:32] "2" "3" "4" "5" ...  
## ..$ : chr [1:48] "Chlamydonaceae" "Aulacoseira.spp." "morphospecies.1" "Meloseira.spp..." ...

gb.rare.hel1=cbind(gbcounts[,1:4],decostand(gb.rare,method="hellinger"))  
#ne.stands.hel.dist=vegdist(ne.rare.hel[5:147],method="euclidean")  
gb.rare.hel=cbind(gbcounts[,53:55],gb.rare.hel1)  
str(gb.rare.hel)

## 'data.frame': 32 obs. of 55 variables:  
## $ trace : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ nitrogen : logi FALSE FALSE FALSE FALSE TRUE TRUE ...  
## $ phosphorus : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ Sample.ID : Factor w/ 37 levels "1","10","11",..: 1 12 23 31 32 33 34 35 36 2 ...  
## $ Counter : Factor w/ 4 levels "Alyssa","Brian",..: 4 1 1 4 4 4 2 2 2 2 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Total.Counted : int 401 480 546 436 559 634 299 400 400 412 ...  
## $ Chlamydonaceae : num 0.0818 0 0 0 0.0818 ...  
## $ Aulacoseira.spp. : num 0.561 0.421 0.507 0.1 0.543 ...  
## $ morphospecies.1 : num 0 0 0 0 0 ...  
## $ Meloseira.spp... : num 0.259 0.173 0 0 0.238 ...  
## $ centric.1 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.3 : num 0.116 0.129 0.129 0.173 0.142 ...  
## $ Actinastrum.spp. : num 0 0 0 0.0578 0 ...  
## $ morphospecies.2 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.3 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.4 : num 0.0818 0.0578 0.0578 0 0 ...  
## $ morphospecies.5 : num 0 0 0 0.0578 0 ...  
## $ morphospecies.7 : num 0 0 0 0 0 ...  
## $ Selenastrum.spp. : num 0 0 0 0 0.0578 ...  
## $ morphospecies.8 : num 0 0 0 0 0.0578 ...  
## $ Closterium.spp. : num 0 0 0 0 0.0578 ...  
## $ pennate.4 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pediastrum.spp..1 : num 0 0 0 0 0 ...  
## $ Staurastrum.spp. : num 0 0 0 0 0 ...  
## $ Pediastrum.spp..2 : num 0 0 0 0 0 ...  
## $ Cosmarium.spp. : num 0 0 0 0 0 ...  
## $ Merismopedia.spp. : num 0 0 0 0 0 ...  
## $ Gomphoneis.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Atractomorpha.spp... : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.9 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.10 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.11 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pediastrum.spp..3 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Treubaria.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.12 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ mophospecies.13 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Staurastrum.spp..3 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Dinobryon.spp.. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Cyclotella.spp. : num 0.129 0.183 0.129 0.116 0.283 ...  
## $ Scenedesmum.spp. : num 0.1157 0.1417 0.1293 0.0818 0.1293 ...  
## $ Microcystis.spp. : num 0.745 0.657 0.687 0.933 0.584 ...  
## $ Navicula.spp... : num 0.0578 0.0818 0.0578 0.0578 0.0578 ...  
## $ Stephanodiscus.spp. : num 0 0.0578 0.0818 0.0578 0.1002 ...  
## $ Pseudoanabaena.spp. : num 0 0.1829 0.0818 0.1417 0.1002 ...  
## $ Fragillaria.spp... : num 0 0.259 0 0 0 ...  
## $ Micractinium.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Staurastrum.spp..2 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pediastrum.spp. : num 0 0.116 0.252 0.183 0 ...  
## $ filamentous.cyanobacteria: num 0 0.361 0.352 0 0.379 ...  
## $ Coconeis.spp. : num 0.0578 0.0578 0 0 0 ...  
## $ Dolichospermum.spp. : num 0 0.1735 0.1157 0 0.0818 ...  
## $ Planktothrix.spp.. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Diatoma.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Selenastrum.spp... : num 0 0 0 0.0578 0 ...

# RDA - Redundancy Analysis -Treatments apart  
rda.gb.rare.hel.all.treats=rda(gb.rare.hel[,8:55]~gb.rare.hel$trace\*gb.rare.hel$nitrogen\*gb.rare.hel$phosphorus)  
 summary(rda.gb.rare.hel.all.treats)

##   
## Call:  
## rda(formula = gb.rare.hel[, 8:55] ~ gb.rare.hel$trace \* gb.rare.hel$nitrogen \* gb.rare.hel$phosphorus)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.15949 1.0000  
## Constrained 0.04511 0.2828  
## Unconstrained 0.11438 0.7172  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.01597 0.01195 0.005746 0.004382 0.003111 0.002525  
## Proportion Explained 0.10015 0.07490 0.036030 0.027472 0.019504 0.015831  
## Cumulative Proportion 0.10015 0.17505 0.211080 0.238552 0.258056 0.273887  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 0.001424 0.02441 0.02026 0.01804 0.01121 0.009378  
## Proportion Explained 0.008926 0.15306 0.12702 0.11311 0.07029 0.058798  
## Cumulative Proportion 0.282813 0.43587 0.56289 0.67600 0.74629 0.805089  
## PC6 PC7 PC8 PC9 PC10 PC11  
## Eigenvalue 0.00564 0.005421 0.003959 0.003214 0.002755 0.002105  
## Proportion Explained 0.03536 0.033987 0.024826 0.020154 0.017274 0.013199  
## Cumulative Proportion 0.84045 0.874437 0.899263 0.919417 0.936690 0.949890  
## PC12 PC13 PC14 PC15 PC16  
## Eigenvalue 0.001432 0.001289 0.001083 0.001032 0.0007083  
## Proportion Explained 0.008978 0.008082 0.006792 0.006468 0.0044408  
## Cumulative Proportion 0.958867 0.966949 0.973741 0.980210 0.9846505  
## PC17 PC18 PC19 PC20 PC21  
## Eigenvalue 0.0006361 0.0004727 0.0004003 0.0003049 0.0002046  
## Proportion Explained 0.0039883 0.0029638 0.0025099 0.0019118 0.0012829  
## Cumulative Proportion 0.9886388 0.9916027 0.9941125 0.9960243 0.9973072  
## PC22 PC23 PC24  
## Eigenvalue 0.0001721 0.0001391 0.0001183  
## Proportion Explained 0.0010789 0.0008723 0.0007416  
## Cumulative Proportion 0.9983861 0.9992584 1.0000000  
##   
## Accumulated constrained eigenvalues  
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.01597 0.01195 0.005746 0.004382 0.003111 0.002525  
## Proportion Explained 0.35412 0.26484 0.127398 0.097140 0.068963 0.055977  
## Cumulative Proportion 0.35412 0.61896 0.746357 0.843497 0.912461 0.968438  
## RDA7  
## Eigenvalue 0.001424  
## Proportion Explained 0.031562  
## Cumulative Proportion 1.000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.491153   
##   
##   
## Species scores  
##   
## RDA1 RDA2 RDA3 RDA4  
## Chlamydonaceae 1.856e-02 0.030829 0.0122136 0.0358204  
## Aulacoseira.spp. 2.093e-01 -0.137230 0.0665346 -0.0100401  
## morphospecies.1 2.173e-02 -0.015827 0.0368506 0.0533683  
## Meloseira.spp... -2.958e-01 -0.104892 0.0866347 -0.1163804  
## centric.1 -2.962e-02 0.045068 0.0171949 0.0011952  
## pennate.3 -6.541e-05 -0.002219 -0.0421825 -0.0257176  
## Actinastrum.spp. -3.193e-04 0.028128 -0.0020627 -0.0002823  
## morphospecies.2 -2.043e-02 0.014889 -0.0063444 0.0242104  
## morphospecies.3 -5.074e-03 0.025665 -0.0052860 0.0091254  
## morphospecies.4 1.347e-02 0.001422 0.0293828 -0.0296012  
## morphospecies.5 -1.777e-02 0.004645 -0.0235571 0.0167953  
## morphospecies.7 6.553e-03 0.028543 -0.0188789 -0.0030803  
## Selenastrum.spp. -2.535e-02 0.031310 0.0086112 0.0110865  
## morphospecies.8 -2.878e-04 0.020532 0.0624549 0.0214865  
## Closterium.spp. -1.154e-02 -0.017496 0.0110812 0.0083146  
## pennate.4 -5.210e-03 0.007927 0.0030243 0.0002102  
## Pediastrum.spp..1 -2.299e-01 -0.082346 -0.0830482 0.0902938  
## Staurastrum.spp. 5.074e-03 -0.001894 0.0151121 0.0060208  
## Pediastrum.spp..2 1.342e-02 -0.005010 0.0399830 0.0159296  
## Cosmarium.spp. 8.742e-03 0.016206 0.0021730 0.0181642  
## Merismopedia.spp. 3.852e-02 -0.028869 0.1166742 0.0575688  
## Gomphoneis.spp... -1.021e-03 0.005655 -0.0014124 0.0008244  
## Atractomorpha.spp... 4.611e-03 0.008606 -0.0088190 -0.0061733  
## morphospecies.9 -4.970e-03 -0.027127 -0.0109474 0.0178080  
## morphospecies.10 -5.210e-03 0.007927 0.0030243 0.0002102  
## morphospecies.11 -5.210e-03 0.007927 0.0030243 0.0002102  
## Pediastrum.spp..3 -7.783e-02 -0.017196 -0.0001863 0.0085238  
## Treubaria.spp. 0.000e+00 0.000000 0.0000000 0.0000000  
## morphospecies.12 3.316e-03 0.008799 -0.0081506 0.0080037  
## mophospecies.13 3.316e-03 0.008799 -0.0081506 0.0080037  
## Staurastrum.spp..3 0.000e+00 0.000000 0.0000000 0.0000000  
## Dinobryon.spp.. 0.000e+00 0.000000 0.0000000 0.0000000  
## Cyclotella.spp. -3.457e-02 0.008499 0.0428155 0.1148124  
## Scenedesmum.spp. -3.659e-02 -0.002026 0.1130970 0.0543960  
## Microcystis.spp. 3.391e-02 -0.021474 -0.0863913 -0.0120358  
## Navicula.spp... 5.353e-02 -0.015658 0.0140440 -0.0285557  
## Stephanodiscus.spp. -6.411e-03 -0.003512 -0.0023598 -0.0424399  
## Pseudoanabaena.spp. -5.398e-02 0.084347 0.0127150 0.0136617  
## Fragillaria.spp... 6.170e-02 0.111724 -0.0764908 -0.0063284  
## Micractinium.spp. -4.413e-02 0.021495 -0.0277201 0.0362320  
## Staurastrum.spp..2 8.308e-04 -0.004764 -0.0136243 0.0169077  
## Pediastrum.spp. 7.582e-02 -0.003395 0.0327894 -0.0711862  
## filamentous.cyanobacteria -6.181e-02 0.313332 0.0654420 -0.0272122  
## Coconeis.spp. -9.929e-03 -0.015115 -0.0056221 -0.0141690  
## Dolichospermum.spp. 4.530e-02 0.007326 0.0010887 0.0033218  
## Planktothrix.spp.. 8.308e-04 -0.004764 -0.0136243 0.0169077  
## Diatoma.spp. -7.679e-03 0.017632 -0.0133801 -0.0212969  
## Selenastrum.spp... -3.874e-03 -0.013643 0.0306694 0.0050148  
## RDA5 RDA6  
## Chlamydonaceae 0.0023239 -0.0083071  
## Aulacoseira.spp. 0.0539091 0.0056673  
## morphospecies.1 0.0007419 -0.0208152  
## Meloseira.spp... 0.0121841 0.0183698  
## centric.1 0.0676519 0.0488710  
## pennate.3 0.0663072 0.0307372  
## Actinastrum.spp. 0.0110929 0.0101985  
## morphospecies.2 0.0488108 0.0271048  
## morphospecies.3 0.0035934 0.0102069  
## morphospecies.4 -0.0049028 -0.0110349  
## morphospecies.5 -0.0138014 -0.0052519  
## morphospecies.7 0.0162209 0.0214116  
## Selenastrum.spp. 0.0266498 -0.0153916  
## morphospecies.8 0.0365351 0.0221753  
## Closterium.spp. -0.0017167 -0.0068162  
## pennate.4 0.0118989 0.0085956  
## Pediastrum.spp..1 0.0182749 -0.0840144  
## Staurastrum.spp. -0.0011858 -0.0020792  
## Pediastrum.spp..2 -0.0031373 -0.0055009  
## Cosmarium.spp. -0.0138081 -0.0082856  
## Merismopedia.spp. -0.0078950 -0.0137434  
## Gomphoneis.spp... -0.0147116 0.0083288  
## Atractomorpha.spp... -0.0269005 0.0218711  
## morphospecies.9 0.0033788 0.0061238  
## morphospecies.10 0.0118989 0.0085956  
## morphospecies.11 0.0118989 0.0085956  
## Pediastrum.spp..3 0.0501054 0.0217565  
## Treubaria.spp. 0.0000000 0.0000000  
## morphospecies.12 0.0014774 -0.0102780  
## mophospecies.13 0.0014774 -0.0102780  
## Staurastrum.spp..3 0.0000000 0.0000000  
## Dinobryon.spp.. 0.0000000 0.0000000  
## Cyclotella.spp. 0.0019336 0.0341424  
## Scenedesmum.spp. -0.0245453 0.0021251  
## Microcystis.spp. -0.0856978 0.0455998  
## Navicula.spp... 0.0200759 -0.0146158  
## Stephanodiscus.spp. 0.0138329 0.0002284  
## Pseudoanabaena.spp. -0.0300813 -0.0039617  
## Fragillaria.spp... 0.0883850 -0.0262574  
## Micractinium.spp. 0.0242814 0.0027953  
## Staurastrum.spp..2 0.0031668 -0.0072161  
## Pediastrum.spp. 0.0044932 -0.1168352  
## filamentous.cyanobacteria -0.0120854 -0.0176859  
## Coconeis.spp. -0.0291154 -0.0001288  
## Dolichospermum.spp. -0.0431875 -0.0078296  
## Planktothrix.spp.. 0.0031668 -0.0072161  
## Diatoma.spp. -0.0309670 0.0386589  
## Selenastrum.spp... 0.0095257 -0.0053434  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.2557146 -0.733743 0.23057 -0.42387 0.25918 0.46920  
## 3 0.2090538 0.380647 0.28386 -0.46311 0.41128 -0.44683  
## 4 0.5219495 0.171568 0.36721 -0.41012 0.06831 -0.75805  
## 5 0.2139140 -0.153746 -0.65837 -0.16869 -0.65737 -0.04001  
## 6 0.0869357 0.104236 0.81237 -0.17996 0.49339 0.22647  
## 7 0.2804673 -0.162470 0.13369 0.28186 0.07402 -0.65697  
## 8 0.3170953 0.247179 0.64028 0.52308 -0.40033 -0.06254  
## 9 0.0957999 -0.480174 0.73782 0.30099 -0.34945 0.17328  
## 10 -0.0002954 -0.193786 0.11727 -0.39087 -0.46026 0.48835  
## 11 -0.2366674 -0.002254 -0.21206 -0.12940 -0.53285 0.43962  
## 12 0.0472902 0.318981 -0.18584 0.46142 -0.47318 0.01433  
## 13 0.0326465 0.746826 0.06340 0.18564 -0.79628 0.33863  
## 14 -0.3002524 0.158878 0.20852 -0.90936 0.57818 -0.42856  
## 15 0.4609039 -0.369743 -0.47864 -0.08752 0.04034 0.15931  
## 16 0.5295536 -0.451908 -0.41910 -0.02370 -0.06594 0.73770  
## 17 0.3329348 0.246740 -0.23265 -0.18241 -0.16461 0.33334  
## 18 0.3766630 0.097207 0.23631 0.30858 0.44741 0.59818  
## 19 -0.1852952 0.730219 -0.45879 0.59880 0.57393 -0.13087  
## 20 -0.6634128 0.147230 0.27167 -0.03297 0.49848 0.45042  
## 21 -0.3292797 0.244430 0.41593 -0.84208 0.31017 0.40422  
## 22 -0.2513040 0.652533 -0.11928 0.70274 -0.48644 -0.24506  
## 23 0.3609210 0.285179 -0.03960 -0.22203 -0.29767 -0.64654  
## 24 0.4162395 0.334270 -0.69551 0.17492 0.87970 -0.13074  
## 25 -0.0159126 0.081308 -0.39914 0.57529 0.13163 -0.55835  
## 26 -0.4789765 0.404559 -0.05124 -0.18312 -0.43739 0.05690  
## 27 -0.4177796 -0.167383 0.50346 -0.62321 0.11385 -0.06362  
## 28 -0.4625968 -0.741832 -0.26276 0.30470 0.36043 -0.32181  
## 29 -0.8141422 0.191061 0.03243 -0.51499 -0.37835 -0.87091  
## 30 -0.3354759 -0.218137 0.19392 -0.20909 0.08257 0.69987  
## 31 -0.4164137 -0.688867 -0.34733 0.16366 -0.03295 -0.05718  
## 32 0.2369859 -0.635046 -0.18497 0.69469 0.32793 -0.13569  
## 33 0.1327356 -0.543962 -0.50344 0.72013 -0.11774 -0.03609  
##   
##   
## Site constraints (linear combinations of constraining variables)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.30016 -0.08382 0.05582 -0.366447 0.02035 -0.19392  
## 3 0.30016 -0.08382 0.05582 -0.366447 0.02035 -0.19392  
## 4 0.30016 -0.08382 0.05582 -0.366447 0.02035 -0.19392  
## 5 0.30016 -0.08382 0.05582 -0.366447 0.02035 -0.19392  
## 6 0.19507 -0.07281 0.58104 0.231492 -0.04559 -0.07994  
## 7 0.19507 -0.07281 0.58104 0.231492 -0.04559 -0.07994  
## 8 0.19507 -0.07281 0.58104 0.231492 -0.04559 -0.07994  
## 9 0.19507 -0.07281 0.58104 0.231492 -0.04559 -0.07994  
## 10 -0.03926 0.21744 -0.05431 0.031697 -0.56564 0.32023  
## 11 -0.03926 0.21744 -0.05431 0.031697 -0.56564 0.32023  
## 12 -0.03926 0.21744 -0.05431 0.031697 -0.56564 0.32023  
## 13 -0.03926 0.21744 -0.05431 0.031697 -0.56564 0.32023  
## 14 0.25578 -0.10401 -0.23047 -0.300748 0.09699 0.20045  
## 15 0.25578 -0.10401 -0.23047 -0.300748 0.09699 0.20045  
## 16 0.25578 -0.10401 -0.23047 -0.300748 0.09699 0.20045  
## 17 0.25578 -0.10401 -0.23047 -0.300748 0.09699 0.20045  
## 18 -0.20033 0.30477 0.11628 0.008083 0.45750 0.33049  
## 19 -0.20033 0.30477 0.11628 0.008083 0.45750 0.33049  
## 20 -0.20033 0.30477 0.11628 0.008083 0.45750 0.33049  
## 21 -0.20033 0.30477 0.11628 0.008083 0.45750 0.33049  
## 22 0.12749 0.33832 -0.31338 0.307732 0.05680 -0.39517  
## 23 0.12749 0.33832 -0.31338 0.307732 0.05680 -0.39517  
## 24 0.12749 0.33832 -0.31338 0.307732 0.05680 -0.39517  
## 25 0.12749 0.33832 -0.31338 0.307732 0.05680 -0.39517  
## 26 -0.54337 -0.07840 0.05547 -0.254154 -0.08537 -0.29986  
## 27 -0.54337 -0.07840 0.05547 -0.254154 -0.08537 -0.29986  
## 28 -0.54337 -0.07840 0.05547 -0.254154 -0.08537 -0.29986  
## 29 -0.54337 -0.07840 0.05547 -0.254154 -0.08537 -0.29986  
## 30 -0.09554 -0.52150 -0.21046 0.342346 0.06495 0.11773  
## 31 -0.09554 -0.52150 -0.21046 0.342346 0.06495 0.11773  
## 32 -0.09554 -0.52150 -0.21046 0.342346 0.06495 0.11773  
## 33 -0.09554 -0.52150 -0.21046 0.342346 0.06495 0.11773  
##   
##   
## Biplot scores for constraining variables  
##   
## RDA1  
## gb.rare.hel$traceTRUE 0.08289  
## gb.rare.hel$nitrogenTRUE -0.61093  
## gb.rare.hel$phosphorusTRUE -0.52227  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE -0.32402  
## gb.rare.hel$traceTRUE:gb.rare.hel$phosphorusTRUE 0.03498  
## gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.69969  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.13699  
## RDA2  
## gb.rare.hel$traceTRUE 0.01668  
## gb.rare.hel$nitrogenTRUE -0.34895  
## gb.rare.hel$phosphorusTRUE -0.04186  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE -0.23735  
## gb.rare.hel$traceTRUE:gb.rare.hel$phosphorusTRUE -0.20060  
## gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.65696  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.74776  
## RDA3  
## gb.rare.hel$traceTRUE -0.6051  
## gb.rare.hel$nitrogenTRUE 0.5144  
## gb.rare.hel$phosphorusTRUE -0.4957  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE -0.1031  
## gb.rare.hel$traceTRUE:gb.rare.hel$phosphorusTRUE -0.5737  
## gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.1697  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.3018  
## RDA4  
## gb.rare.hel$traceTRUE 0.33897  
## gb.rare.hel$nitrogenTRUE 0.31085  
## gb.rare.hel$phosphorusTRUE 0.40556  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE 0.38376  
## gb.rare.hel$traceTRUE:gb.rare.hel$phosphorusTRUE 0.71191  
## gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE 0.09658  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE 0.49087  
## RDA5  
## gb.rare.hel$traceTRUE 0.64136  
## gb.rare.hel$nitrogenTRUE 0.37129  
## gb.rare.hel$phosphorusTRUE -0.50194  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE 0.57215  
## gb.rare.hel$traceTRUE:gb.rare.hel$phosphorusTRUE 0.13334  
## gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.02235  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE 0.09314  
## RDA6  
## gb.rare.hel$traceTRUE 0.24041  
## gb.rare.hel$nitrogenTRUE 0.06489  
## gb.rare.hel$phosphorusTRUE -0.24381  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE 0.49085  
## gb.rare.hel$traceTRUE:gb.rare.hel$phosphorusTRUE -0.30384  
## gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE -0.19946  
## gb.rare.hel$traceTRUE:gb.rare.hel$nitrogenTRUE:gb.rare.hel$phosphorusTRUE 0.16880

anova(rda.gb.rare.hel.all.treats)

## Permutation test for rda under reduced model  
## Permutation: free  
## Number of permutations: 999  
##   
## Model: rda(formula = gb.rare.hel[, 8:55] ~ gb.rare.hel$trace \* gb.rare.hel$nitrogen \* gb.rare.hel$phosphorus)  
## Df Variance F Pr(>F)   
## Model 7 0.045105 1.352 0.045 \*  
## Residual 24 0.114383   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

RsquareAdj(rda.gb.rare.hel.all.treats)

## $r.squared  
## [1] 0.2828133  
##   
## $adj.r.squared  
## [1] 0.07363385

#anova significant, adj. rsquared 0.103  
   
   
### Another method of getting a marginal test provides similar results.  
#rda.gb.rare.hel.int=rda(gb.rare.hel[,8:55] ~ gb.rare.hel$trace:gb.rare.hel$nitrogen:gb.rare.hel$phosphorus + Condition(gb.rare.hel$trace + gb.rare.hel$nitrogen +gb.rare.hel$phosphorus))  
# anova(rda.gb.rare.hel.int)  
# summary(rda.gb.rare.hel.int)  
  
###  
# Plots and getting some more species info  
# Better plots can be made if you extract scores as shown below  
rda.gb.rare.hel.all.spscores=scores(rda.gb.rare.hel.all.treats,display="sp",choices=c(1:17))  
head(rda.gb.rare.hel.all.spscores)

## RDA1 RDA2 RDA3 RDA4  
## Chlamydonaceae 1.856242e-02 0.030828665 0.01221363 0.03582040  
## Aulacoseira.spp. 2.093499e-01 -0.137229520 0.06653456 -0.01004014  
## morphospecies.1 2.173363e-02 -0.015826512 0.03685057 0.05336829  
## Meloseira.spp... -2.958196e-01 -0.104892447 0.08663467 -0.11638039  
## centric.1 -2.962385e-02 0.045067909 0.01719494 0.00119520  
## pennate.3 -6.540887e-05 -0.002218635 -0.04218246 -0.02571757  
## RDA5 RDA6 RDA7 PC1  
## Chlamydonaceae 0.0023238981 -0.008307104 -0.015899492 -0.001224671  
## Aulacoseira.spp. 0.0539090706 0.005667332 0.024160845 -0.096376120  
## morphospecies.1 0.0007418672 -0.020815236 0.017063970 0.016922756  
## Meloseira.spp... 0.0121841049 0.018369790 -0.002175160 0.271910376  
## centric.1 0.0676519360 0.048871021 -0.021565218 -0.021796825  
## pennate.3 0.0663071989 0.030737245 0.001054039 -0.018230176  
## PC2 PC3 PC4 PC5  
## Chlamydonaceae 0.02328829 -0.0001171376 0.039931951 -0.008028719  
## Aulacoseira.spp. 0.26485426 -0.3731908392 -0.006172989 0.025496193  
## morphospecies.1 -0.02426790 0.0050293826 -0.011126877 0.025407881  
## Meloseira.spp... 0.36563049 0.2057196838 -0.058013446 -0.015063209  
## centric.1 -0.03026910 -0.0112880079 0.022569477 -0.012432305  
## pennate.3 -0.06090099 0.0024535124 -0.000824294 0.025510206  
## PC6 PC7 PC8 PC9  
## Chlamydonaceae 0.012840014 -0.04942850 0.024712941 -0.054156923  
## Aulacoseira.spp. 0.004691462 -0.03126096 0.002741368 0.020338035  
## morphospecies.1 -0.012398550 0.05169084 0.031680337 0.062244479  
## Meloseira.spp... -0.027282004 -0.01101815 -0.007211090 0.009214962  
## centric.1 0.013874522 -0.00787352 -0.002311236 0.018183163  
## pennate.3 -0.010809355 -0.02330075 -0.014321086 -0.047602375  
## PC10  
## Chlamydonaceae -0.023825275  
## Aulacoseira.spp. -0.004704562  
## morphospecies.1 -0.080797157  
## Meloseira.spp... 0.026136681  
## centric.1 0.018089023  
## pennate.3 0.039402967

rda.gb.rare.hel.all.lcscores=scores(rda.gb.rare.hel.all.treats,display="lc",choices=c(1:17))  
head(rda.gb.rare.hel.all.lcscores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.3001580 -0.08381841 0.0558150 -0.3664467 0.02035020 -0.19392103  
## 3 0.3001580 -0.08381841 0.0558150 -0.3664467 0.02035020 -0.19392103  
## 4 0.3001580 -0.08381841 0.0558150 -0.3664467 0.02035020 -0.19392103  
## 5 0.3001580 -0.08381841 0.0558150 -0.3664467 0.02035020 -0.19392103  
## 6 0.1950746 -0.07280716 0.5810403 0.2314919 -0.04559178 -0.07994045  
## 7 0.1950746 -0.07280716 0.5810403 0.2314919 -0.04559178 -0.07994045  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 -0.4624507 -0.1726217 0.55148492 -0.0492517 -0.146290545 -0.17562950  
## 3 -0.4624507 0.3745215 0.01252686 -0.1409330 0.453167377 -0.01389735  
## 4 -0.4624507 0.1506881 -0.17968420 -0.4008623 -0.150583010 0.14923463  
## 5 -0.4624507 -0.3525880 -0.38432758 0.5910470 -0.156293822 0.04029222  
## 6 0.2082752 0.3401587 0.23162927 -0.2924678 0.006917173 0.11073858  
## 7 0.2082752 -0.2227609 -0.16983073 -0.0916051 -0.091502756 -0.32256365  
## PC6 PC7 PC8 PC9 PC10  
## 2 0.13451242 0.29374236 0.37976205 -0.14993067 0.12965402  
## 3 0.13477029 -0.12355848 -0.46998037 0.02892854 0.01497324  
## 4 -0.10822529 -0.24715030 -0.06187730 0.30828299 -0.22135554  
## 5 -0.16105742 0.07696641 0.15209562 -0.18728086 0.07672828  
## 6 -0.03325004 -0.17431423 -0.09867932 -0.64783394 0.43905233  
## 7 -0.51422500 -0.58075627 0.34856644 -0.20772747 -0.07805304

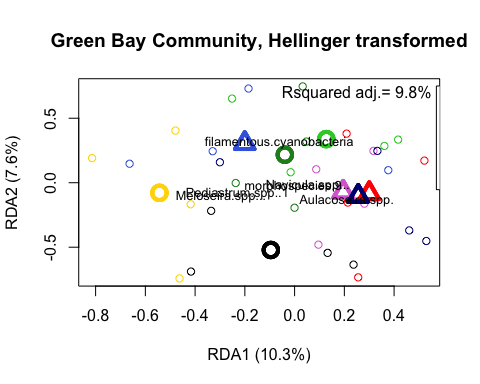
rda.gb.rare.hel.all.wascores=scores(rda.gb.rare.hel.all.treats,display="wa",choices=c(1:17))  
head(rda.gb.rare.hel.all.wascores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 0.25571462 -0.7337428 0.2305653 -0.4238745 0.25918147 0.46919830  
## 3 0.20905377 0.3806474 0.2838616 -0.4631101 0.41127990 -0.44682539  
## 4 0.52194947 0.1715679 0.3672070 -0.4101167 0.06830705 -0.75804848  
## 5 0.21391402 -0.1537462 -0.6583738 -0.1686855 -0.65736762 -0.04000856  
## 6 0.08693567 0.1042364 0.8123728 -0.1799625 0.49339180 0.22646511  
## 7 0.28046731 -0.1624702 0.1336876 0.2818622 0.07402318 -0.65696869  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 -0.14216605 -0.1726217 0.55148492 -0.0492517 -0.146290545 -0.17562950  
## 3 -0.52739935 0.3745215 0.01252686 -0.1409330 0.453167377 -0.01389735  
## 4 -0.03688954 0.1506881 -0.17968420 -0.4008623 -0.150583010 0.14923463  
## 5 -1.14334778 -0.3525880 -0.38432758 0.5910470 -0.156293822 0.04029222  
## 6 0.43293397 0.3401587 0.23162927 -0.2924678 0.006917173 0.11073858  
## 7 0.26437164 -0.2227609 -0.16983073 -0.0916051 -0.091502756 -0.32256365  
## PC6 PC7 PC8 PC9 PC10  
## 2 0.13451242 0.29374236 0.37976205 -0.14993067 0.12965402  
## 3 0.13477029 -0.12355848 -0.46998037 0.02892854 0.01497324  
## 4 -0.10822529 -0.24715030 -0.06187730 0.30828299 -0.22135554  
## 5 -0.16105742 0.07696641 0.15209562 -0.18728086 0.07672828  
## 6 -0.03325004 -0.17431423 -0.09867932 -0.64783394 0.43905233  
## 7 -0.51422500 -0.58075627 0.34856644 -0.20772747 -0.07805304

#weighted averages with P symbols  
#make P have a symbol diference  
symbols=ifelse(gb.rare.hel$phosphorus=="TRUE",1,ifelse(gb.rare.hel$phosphorus=="FALSE",2,0))  
plot(rda.gb.rare.hel.all.wascores[,1:2],col=colors,xlab="RDA1 (10.3%)",ylab="RDA2 (7.6%)",main="Green Bay Community, Hellinger transformed")  
points(rda.gb.rare.hel.all.lcscores[,1:2],col=colors,pch=symbols,cex=2,lwd=4)  
text(0.25,0.69,"Rsquared adj.= 9.8%",cex=1)  
# This command provides and R-squared for each taxon for each axis  
goodness(rda.gb.rare.hel.all.treats)

## RDA1 RDA2 RDA3 RDA4  
## Chlamydonaceae 1.937470e-02 0.0728157883 0.081203725 0.15335213  
## Aulacoseira.spp. 1.499814e-01 0.2144261472 0.229575247 0.22992021  
## morphospecies.1 1.550111e-02 0.0237210478 0.068285317 0.16175374  
## Meloseira.spp... 2.329662e-01 0.2622567709 0.282238013 0.31829577  
## centric.1 5.308941e-02 0.1759633372 0.193849880 0.19393630  
## pennate.3 1.881861e-07 0.0002167022 0.078483603 0.10757564  
## Actinastrum.spp. 1.606235e-05 0.1247014650 0.125371988 0.12538455  
## morphospecies.2 2.863475e-02 0.0438386978 0.046599191 0.08679745  
## morphospecies.3 4.707575e-03 0.1251561859 0.130265712 0.14549325  
## morphospecies.4 1.701422e-02 0.0172039808 0.098220016 0.18044472  
## morphospecies.5 2.903663e-02 0.0310207560 0.082047375 0.10798498  
## morphospecies.7 2.938663e-03 0.0586952170 0.083087682 0.08373707  
## Selenastrum.spp. 5.771215e-02 0.1457389372 0.152397373 0.16343388  
## morphospecies.8 4.777181e-06 0.0243162808 0.249274493 0.27590012  
## Closterium.spp. 3.258678e-02 0.1074451633 0.137472861 0.15437827  
## pennate.4 1.863120e-02 0.0617525856 0.068029690 0.06806002  
## Pediastrum.spp..1 2.717084e-01 0.3065563645 0.342001451 0.38390115  
## Staurastrum.spp. 1.766627e-02 0.0201271625 0.176858655 0.20173664  
## Pediastrum.spp..2 1.766627e-02 0.0201271625 0.176858655 0.20173664  
## Cosmarium.spp. 1.397425e-02 0.0619998147 0.062863283 0.12319655  
## Merismopedia.spp. 2.502903e-02 0.0390847126 0.268660915 0.32455326  
## Gomphoneis.spp... 7.154300e-04 0.0226651136 0.024034200 0.02450062  
## Atractomorpha.spp... 5.198358e-03 0.0233081308 0.042327107 0.05164629  
## morphospecies.9 8.757959e-03 0.2696902798 0.312185035 0.42463102  
## morphospecies.10 1.863120e-02 0.0617525856 0.068029690 0.06806002  
## morphospecies.11 1.863120e-02 0.0617525856 0.068029690 0.06806002  
## Pediastrum.spp..3 1.081761e-01 0.1134577963 0.113458416 0.11475607  
## Treubaria.spp. NaN NaN NaN NaN  
## morphospecies.12 7.545162e-03 0.0606831911 0.106274877 0.15023791  
## mophospecies.13 7.545162e-03 0.0606831911 0.106274877 0.15023791  
## Staurastrum.spp..3 NaN NaN NaN NaN  
## Dinobryon.spp.. NaN NaN NaN NaN  
## Cyclotella.spp. 2.869408e-02 0.0304280739 0.074430536 0.39084250  
## Scenedesmum.spp. 1.903156e-02 0.0190899286 0.200911644 0.24297244  
## Microcystis.spp. 1.648892e-02 0.0231020375 0.130132698 0.13221009  
## Navicula.spp... 2.403104e-01 0.2608691533 0.277407690 0.34578369  
## Stephanodiscus.spp. 1.534158e-03 0.0019945051 0.002202368 0.06943328  
## Pseudoanabaena.spp. 4.853579e-02 0.1670477676 0.169740866 0.17284993  
## Fragillaria.spp... 2.225080e-02 0.0952005594 0.129394382 0.12962843  
## Micractinium.spp. 7.553544e-02 0.0934605867 0.123270676 0.17419876  
## Staurastrum.spp..2 2.447552e-04 0.0082932193 0.074111100 0.17547518  
## Pediastrum.spp. 6.126412e-02 0.0613869487 0.072844949 0.12684988  
## filamentous.cyanobacteria 9.877857e-03 0.2637133671 0.274786142 0.27670071  
## Coconeis.spp. 1.001769e-02 0.0332317819 0.036443496 0.05684325  
## Dolichospermum.spp. 6.010961e-02 0.0616817502 0.061716475 0.06203974  
## Planktothrix.spp.. 2.447552e-04 0.0082932193 0.074111100 0.17547518  
## Diatoma.spp. 3.807752e-03 0.0238811217 0.035440400 0.06472526  
## Selenastrum.spp... 2.046458e-03 0.0274313798 0.155708979 0.15913858  
## RDA5 RDA6 RDA7  
## Chlamydonaceae 0.15365580 0.15753610 0.1717506  
## Aulacoseira.spp. 0.23986546 0.23997538 0.2419730  
## morphospecies.1 0.16177180 0.17599053 0.1855461  
## Meloseira.spp... 0.31869098 0.31958933 0.3196019  
## centric.1 0.47081235 0.61529901 0.6434331  
## pennate.3 0.30096635 0.34252335 0.3425722  
## Actinastrum.spp. 0.14477648 0.16116743 0.2296296  
## morphospecies.2 0.25019096 0.30057506 0.3276466  
## morphospecies.3 0.14785444 0.16690534 0.1748547  
## morphospecies.4 0.18270040 0.19412718 0.3174485  
## morphospecies.5 0.12549956 0.12803577 0.1701696  
## morphospecies.7 0.10174466 0.13312097 0.1507373  
## Selenastrum.spp. 0.22720633 0.24847858 0.2513742  
## morphospecies.8 0.35288209 0.38124234 0.3831397  
## Closterium.spp. 0.15509891 0.16646036 0.1724138  
## pennate.4 0.16522692 0.21593308 0.2258065  
## Pediastrum.spp..1 0.38561749 0.42189214 0.4267061  
## Staurastrum.spp. 0.20270162 0.20566834 0.2258065  
## Pediastrum.spp..2 0.20270162 0.20566834 0.2258065  
## Cosmarium.spp. 0.15806156 0.17061522 0.1748547  
## Merismopedia.spp. 0.32560446 0.32878987 0.3552522  
## Gomphoneis.spp... 0.17303376 0.22064111 0.2258065  
## Atractomorpha.spp... 0.22860295 0.34557612 0.3563218  
## morphospecies.9 0.42867900 0.44197613 0.4666667  
## morphospecies.10 0.16522692 0.21593308 0.2258065  
## morphospecies.11 0.16522692 0.21593308 0.2258065  
## Pediastrum.spp..3 0.15959551 0.16804961 0.1739233  
## Treubaria.spp. NaN NaN NaN  
## morphospecies.12 0.15173582 0.22423288 0.2258065  
## mophospecies.13 0.15173582 0.22423288 0.2258065  
## Staurastrum.spp..3 NaN NaN NaN  
## Dinobryon.spp.. NaN NaN NaN  
## Cyclotella.spp. 0.39093224 0.41891330 0.4530263  
## Scenedesmum.spp. 0.25153649 0.25160068 0.2675469  
## Microcystis.spp. 0.23752921 0.26734832 0.2674351  
## Navicula.spp... 0.37957981 0.39749250 0.4477372  
## Stephanodiscus.spp. 0.07657576 0.07657771 0.1005689  
## Pseudoanabaena.spp. 0.18792341 0.18818485 0.2283439  
## Fragillaria.spp... 0.17528328 0.17931260 0.1798826  
## Micractinium.spp. 0.19707154 0.19737466 0.2072406  
## Staurastrum.spp..2 0.17903107 0.19749472 0.2000000  
## Pediastrum.spp. 0.12706503 0.27254018 0.2946018  
## filamentous.cyanobacteria 0.27707834 0.27788706 0.2824063  
## Coconeis.spp. 0.14298057 0.14298226 0.2358121  
## Dolichospermum.spp. 0.11668082 0.11847671 0.1281333  
## Planktothrix.spp.. 0.17903107 0.19749472 0.2000000  
## Diatoma.spp. 0.12664192 0.22313743 0.2448944  
## Selenastrum.spp... 0.17151339 0.17540718 0.1794872

sp.rsqgb=goodness(rda.gb.rare.hel.all.treats)  
sp.affgb=rownames(sp.rsqgb)[sp.rsqgb[,2]>0.2]  
lgb=length(na.omit(sp.affgb))  
sp.aff.rowsgb=match(na.omit(sp.affgb)[1:lgb],rownames(rda.gb.rare.hel.all.spscores))  
text(rda.gb.rare.hel.all.spscores[sp.aff.rowsgb,1:2],labels=rownames(rda.gb.rare.hel.all.spscores[sp.aff.rowsgb,]),cex=0.8)  
legend(0.57,0.75,legend=c("Control","Nitrogen","Phosphorus","Trace","N+Trace","P+Trace","N+P","N+P+Trace"),pch=c(2,2,1,2,2,1,1,1), col=c("red","orchid","forestgreen","navy","royalblue","limegreen","gold","grey0"),pt.cex=1, cex=0.6)

 Interpretation: Even though Microsystis is important in the community, it does not explain variation in the RDA. Perhaps this is due to microcystis being conistent throughout all of the treatments. This RDA isn’t as good as the last two. It has a lower variation explained with an adjusted rsquared of only 9.8%. The treatments seperate, but not as clearly as other sites did. I won’t give this RDA very much cadence, even though the anova is significant.

FORD RDA

#add columns for treatments n,p,trace as y/n for analysis of interactive effects  
#removed morphospecies 8 (inf) and renames morphospecies 41- chlorophyte  
fordcounts<- read.csv("~/Desktop/USGS/Ford Compilation\_species\_RDA.csv")  
fordcounts<-fordcounts[which(fordcounts1$Treatment!='Chelex'& fordcounts$Treatment!='Initial'),]  
  
  
fordcounts$trace<-grepl("Trace", fordcounts$Treatment)   
fordcounts$nitrogen<-grepl("N", fordcounts$Treatment)   
fordcounts$phosphorus<-grepl("P", fordcounts$Treatment)   
  
dim(fordcounts)

## [1] 32 82

names(fordcounts)

## [1] "Sample.ID" "Treatment" "Total.counted"   
## [4] "pennate.1" "morphospecies.2" "Cymbella.spp.."   
## [7] "Cymbella.spp.2." "Scenedesmus.spp..3" "morphospecies.3"   
## [10] "morphospecies.4" "morphospecies.6" "Dolichospermum.spp.."  
## [13] "Tabellaria.spp.." "morphospecies.10" "morphospecies.11"   
## [16] "morphospecies.12" "morphospecies.13" "pennate.3"   
## [19] "morphospecies.14" "morphospecies.15" "morphospecies.16"   
## [22] "Coconeis.spp." "Staurastrum.spp." "morphospecies.17"   
## [25] "Selenastrum.spp..." "morphospecies.18" "Staurastrum.spp..2"   
## [28] "morphospecies.44" "morphospecies.45" "morphospecies.20"   
## [31] "morphospecies.21" "morphospecies.22" "morphospecies.23"   
## [34] "pennate.4" "morphospecies.24" "morphospecies.25"   
## [37] "morphospecies.26" "morphospecies.27" "Asterionella.spp.."   
## [40] "morphospecies.28" "morphospecies.29" "pennate.5"   
## [43] "morphospecies.30" "Cosmarium.spp." "morphospecies.31"   
## [46] "pennate.6" "morphospecies.31.1" "morphospecies.32"   
## [49] "Scenedesmus.spp..3.1" "morphospecies.33" "morphospecies.34"   
## [52] "Selenastrum.spp.." "morphospecies.35" "morphospecies.36"   
## [55] "morphospecies.37" "morphospecies.38" "pennate.7"   
## [58] "morphospecies.38.1" "morphospecies.39" "pennate.8"   
## [61] "pennate.9" "Scenedesmus.spp..2." "morphospecies.40"   
## [64] "Scenedesmus.spp.1." "Cyclotella.spp..." "pennate.2"   
## [67] "Fragillaria.spp." "morphospecies.7" "Chlorophyte"   
## [70] "Peridinium.spp..." "morphospecies.1" "Nitzschia.spp."   
## [73] "morphospecies.43" "Pinnularia.spp..." "Microcystis.spp."   
## [76] "Synedra.spp.." "morphospecies.19" "morphospecies.9"   
## [79] "Pediastrum.spp." "trace" "nitrogen"   
## [82] "phosphorus"

ford.colsums=apply(fordcounts[,4:79],2,sum)  
ford.rowsums=apply(fordcounts[,4:79],1,sum)  
min(ford.rowsums)

## [1] 401

min=min(ford.rowsums)  
n=nrow(fordcounts)  
  
# Rarefaction and Hellinger distance transformation  
ford.rare=rrarefy(fordcounts[,4:79],sample=min)  
str(ford.rare)

## int [1:32, 1:76] 24 6 6 10 1 0 1 3 5 30 ...  
## - attr(\*, "dimnames")=List of 2  
## ..$ : chr [1:32] "2" "3" "4" "5" ...  
## ..$ : chr [1:76] "pennate.1" "morphospecies.2" "Cymbella.spp.." "Cymbella.spp.2." ...

ford.rare.hel1=cbind(fordcounts[,1:3],decostand(ford.rare,method="hellinger"))  
#ne.stands.hel.dist=vegdist(ne.rare.hel[5:147],method="euclidean")  
ford.rare.hel=cbind(fordcounts[,80:82],ford.rare.hel1)  
str(ford.rare.hel)

## 'data.frame': 32 obs. of 82 variables:  
## $ trace : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ nitrogen : logi FALSE FALSE FALSE FALSE TRUE TRUE ...  
## $ phosphorus : logi FALSE FALSE FALSE FALSE FALSE FALSE ...  
## $ Sample.ID : Factor w/ 37 levels "37","38","39",..: 1 2 3 4 5 6 7 8 9 10 ...  
## $ Treatment : Factor w/ 10 levels "Chelex","Control",..: 2 2 2 2 7 7 7 7 9 9 ...  
## $ Total.counted : int 420 411 411 519 467 420 657 466 404 403 ...  
## $ pennate.1 : num 0.2446 0.1223 0.1223 0.1579 0.0499 ...  
## $ morphospecies.2 : num 0 0 0 0.0706 0.0499 ...  
## $ Cymbella.spp.. : num 0 0.0499 0 0 0 ...  
## $ Cymbella.spp.2. : num 0.0499 0.0706 0.0706 0.1321 0.0706 ...  
## $ Scenedesmus.spp..3 : num 0 0.2 0.193 0 0 ...  
## $ morphospecies.3 : num 0.0706 0 0 0.0706 0.0865 ...  
## $ morphospecies.4 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.6 : num 0.0865 0.0865 0.0865 0.0499 0 ...  
## $ Dolichospermum.spp..: num 0 0 0 0 0.0499 ...  
## $ Tabellaria.spp.. : num 0.0706 0 0 0.1223 0.0706 ...  
## $ morphospecies.10 : num 0 0.166 0.166 0.122 0 ...  
## $ morphospecies.11 : num 0 0 0 0 0 ...  
## $ morphospecies.12 : num 0 0.141 0.141 0 0 ...  
## $ morphospecies.13 : num 0 0.0999 0.0999 0.0499 0.0499 ...  
## $ pennate.3 : num 0 0.2233 0.2233 0.0706 0.1117 ...  
## $ morphospecies.14 : num 0 0.0499 0.0499 0 0 ...  
## $ morphospecies.15 : num 0 0.0865 0.0999 0 0.0865 ...  
## $ morphospecies.16 : num 0 0.0999 0.0999 0 0 ...  
## $ Coconeis.spp. : num 0 0.0706 0.0706 0 0.0706 ...  
## $ Staurastrum.spp. : num 0 0.0499 0.0499 0 0 ...  
## $ morphospecies.17 : num 0.234 0.187 0.173 0.193 0 ...  
## $ Selenastrum.spp... : num 0 0.0499 0.0499 0.0499 0 ...  
## $ morphospecies.18 : num 0 0 0 0 0 ...  
## $ Staurastrum.spp..2 : num 0 0 0 0.0499 0 ...  
## $ morphospecies.44 : num 0 0 0 0.0499 0 ...  
## $ morphospecies.45 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.20 : num 0.0865 0 0 0 0.0999 ...  
## $ morphospecies.21 : num 0.1579 0 0 0 0.0706 ...  
## $ morphospecies.22 : num 0.0865 0 0 0 0.0999 ...  
## $ morphospecies.23 : num 0.0499 0 0 0 0.0499 ...  
## $ pennate.4 : num 0 0 0 0 0 ...  
## $ morphospecies.24 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.25 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.26 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.27 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Asterionella.spp.. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.28 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.29 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.5 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.30 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Cosmarium.spp. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.31 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.6 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.31.1 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.32 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Scenedesmus.spp..3.1: num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.33 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.34 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Selenastrum.spp.. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.35 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.36 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.37 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.38 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.7 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.38.1 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.39 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.8 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ pennate.9 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Scenedesmus.spp..2. : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ morphospecies.40 : num 0.141 0.132 0.132 0.264 0.166 ...  
## $ Scenedesmus.spp.1. : num 0.166 0.35 0.346 0.3 0.218 ...  
## $ Cyclotella.spp... : num 0.234 0.206 0.212 0.255 0.25 ...  
## $ pennate.2 : num 0 0.0499 0.0499 0.1801 0.1117 ...  
## $ Fragillaria.spp. : num 0.599 0.387 0.377 0.653 0.502 ...  
## $ morphospecies.7 : num 0.25 0.132 0.132 0 0.158 ...  
## $ Chlorophyte : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Peridinium.spp... : num 0.0499 0 0 0 0 ...  
## $ morphospecies.1 : num 0.0865 0.0706 0.0865 0.0999 0 ...  
## $ Nitzschia.spp. : num 0 0.0499 0.0499 0.1321 0.0999 ...  
## $ morphospecies.43 : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pinnularia.spp... : num 0.0999 0.0499 0.0499 0 0 ...  
## $ Microcystis.spp. : num 0.468 0.614 0.624 0.335 0.641 ...  
## $ Synedra.spp.. : num 0.229 0.122 0.122 0.18 0.255 ...  
## $ morphospecies.19 : num 0.0499 0 0 0 0.0706 ...  
## $ morphospecies.9 : num 0.0706 0.0706 0.0706 0.0865 0.0499 ...  
## $ Pediastrum.spp. : num 0 0 0 0 0 ...

# RDA - Redundancy Analysis -Treatments apart  
rda.ford.rare.hel.all.treats=rda(ford.rare.hel[,7:82]~ford.rare.hel$trace\*ford.rare.hel$nitrogen\*ford.rare.hel$phosphorus)  
 summary(rda.ford.rare.hel.all.treats)

##   
## Call:  
## rda(formula = ford.rare.hel[, 7:82] ~ ford.rare.hel$trace \* ford.rare.hel$nitrogen \* ford.rare.hel$phosphorus)   
##   
## Partitioning of variance:  
## Inertia Proportion  
## Total 0.2153 1.0000  
## Constrained 0.1013 0.4707  
## Unconstrained 0.1139 0.5293  
##   
## Eigenvalues, and their contribution to the variance   
##   
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.04013 0.02611 0.01331 0.009691 0.006515 0.003483  
## Proportion Explained 0.18640 0.12130 0.06180 0.045015 0.030263 0.016176  
## Cumulative Proportion 0.18640 0.30770 0.36950 0.414514 0.444776 0.460952  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## Eigenvalue 0.002109 0.03614 0.01323 0.009281 0.008449 0.006328  
## Proportion Explained 0.009796 0.16785 0.06144 0.043110 0.039245 0.029395  
## Cumulative Proportion 0.470748 0.63860 0.70004 0.743153 0.782398 0.811792  
## PC6 PC7 PC8 PC9 PC10  
## Eigenvalue 0.005513 0.005032 0.004355 0.003688 0.003345  
## Proportion Explained 0.025609 0.023373 0.020227 0.017129 0.015535  
## Cumulative Proportion 0.837401 0.860774 0.881002 0.898131 0.913666  
## PC11 PC12 PC13 PC14 PC15  
## Eigenvalue 0.003005 0.002934 0.002229 0.002039 0.001612  
## Proportion Explained 0.013958 0.013627 0.010352 0.009469 0.007488  
## Cumulative Proportion 0.927624 0.941251 0.951603 0.961071 0.968559  
## PC16 PC17 PC18 PC19 PC20  
## Eigenvalue 0.001514 0.001310 0.001079 0.0008053 0.000676  
## Proportion Explained 0.007031 0.006083 0.005010 0.0037404 0.003140  
## Cumulative Proportion 0.975590 0.981672 0.986683 0.9904231 0.993563  
## PC21 PC22 PC23 PC24  
## Eigenvalue 0.0005515 0.0004741 0.0003138 4.645e-05  
## Proportion Explained 0.0025616 0.0022021 0.0014574 2.158e-04  
## Cumulative Proportion 0.9961247 0.9983269 0.9997842 1.000e+00  
##   
## Accumulated constrained eigenvalues  
## Importance of components:  
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## Eigenvalue 0.04013 0.02611 0.01331 0.009691 0.006515 0.003483  
## Proportion Explained 0.39597 0.25767 0.13128 0.095624 0.064286 0.034362  
## Cumulative Proportion 0.39597 0.65364 0.78492 0.880542 0.944829 0.979191  
## RDA7  
## Eigenvalue 0.002109  
## Proportion Explained 0.020809  
## Cumulative Proportion 1.000000  
##   
## Scaling 2 for species and site scores  
## \* Species are scaled proportional to eigenvalues  
## \* Sites are unscaled: weighted dispersion equal on all dimensions  
## \* General scaling constant of scores: 1.607307   
##   
##   
## Species scores  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5  
## pennate.1 -0.1834953 0.061051 0.1073320 -5.806e-02 0.103284  
## morphospecies.2 0.0901510 -0.047918 0.0235326 -1.074e-01 -0.111578  
## Cymbella.spp.. 0.0038078 0.003358 -0.0064213 -1.111e-02 0.012137  
## Cymbella.spp.2. 0.0713770 -0.020987 -0.0260454 6.923e-02 0.043506  
## Scenedesmus.spp..3 0.0094286 -0.165922 -0.0095810 3.613e-05 0.057651  
## morphospecies.3 -0.0094340 -0.003296 -0.0270077 4.323e-02 -0.008197  
## morphospecies.4 -0.0034889 0.023967 0.0232888 1.743e-02 0.008560  
## morphospecies.6 -0.0535191 -0.079230 0.0115125 4.843e-03 0.054148  
## Dolichospermum.spp.. 0.0192805 0.011074 -0.0180755 1.408e-02 -0.030548  
## Tabellaria.spp.. 0.0356603 0.021863 -0.0126571 -1.820e-02 0.016783  
## morphospecies.10 0.0308120 -0.029537 -0.0578151 -5.281e-02 0.080868  
## morphospecies.11 0.0025089 0.001273 -0.0078568 -1.296e-03 -0.010396  
## morphospecies.12 -0.0014701 -0.044996 -0.0325163 -4.452e-02 0.038749  
## morphospecies.13 -0.0394339 -0.010793 -0.0011597 -3.813e-02 0.020694  
## pennate.3 0.0121381 0.005214 -0.1101052 -4.053e-02 0.005744  
## morphospecies.14 -0.0054923 -0.007238 -0.0041347 5.054e-03 0.017275  
## morphospecies.15 0.0713728 -0.008041 0.0433489 -5.595e-02 0.049577  
## morphospecies.16 -0.0301860 0.006727 -0.0217860 -1.425e-02 0.036080  
## Coconeis.spp. 0.0506413 -0.038182 -0.0207930 5.143e-02 0.007199  
## Staurastrum.spp. -0.0271538 0.008038 -0.0104372 2.969e-03 0.012201  
## morphospecies.17 -0.0828282 -0.030983 -0.1592925 -4.940e-02 0.101135  
## Selenastrum.spp... -0.2457355 0.062337 0.0509888 5.120e-02 -0.016167  
## morphospecies.18 0.0043456 0.002205 -0.0136083 -2.244e-03 -0.018006  
## Staurastrum.spp..2 0.0038078 0.003358 -0.0064213 -1.111e-02 0.012137  
## morphospecies.44 0.0048061 -0.023566 -0.0004315 9.465e-03 0.014124  
## morphospecies.45 0.0028068 -0.004689 0.0014073 9.292e-03 0.004891  
## morphospecies.20 0.0583111 0.046586 -0.0473238 -2.586e-02 -0.038359  
## morphospecies.21 -0.0278575 0.013730 -0.0698388 -3.332e-03 -0.045753  
## morphospecies.22 -0.0579822 0.028750 -0.0316422 2.946e-02 -0.041918  
## morphospecies.23 0.0022281 0.007587 -0.0350996 3.885e-03 -0.032547  
## pennate.4 0.0283084 -0.021064 0.0111170 3.077e-02 0.004459  
## morphospecies.24 -0.0278774 0.009485 0.0069494 3.336e-03 -0.002578  
## morphospecies.25 0.0055311 0.006854 0.0034510 -7.454e-03 0.003938  
## morphospecies.26 0.0009158 -0.010692 0.0066263 -5.462e-03 -0.003857  
## morphospecies.27 0.0199996 -0.003321 0.0042898 3.964e-02 0.006357  
## Asterionella.spp.. -0.0009871 0.001973 0.0175575 2.505e-02 0.018196  
## morphospecies.28 0.0096821 -0.016176 0.0048543 3.205e-02 0.016871  
## morphospecies.29 -0.0081449 -0.022611 0.0444661 -2.348e-02 -0.009657  
## pennate.5 0.0149498 -0.034139 0.0136626 4.100e-02 0.020598  
## morphospecies.30 0.0028068 -0.004689 0.0014073 9.292e-03 0.004891  
## Cosmarium.spp. 0.0037226 -0.015381 0.0080335 3.830e-03 0.001034  
## morphospecies.31 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## pennate.6 -0.0343350 -0.025929 0.0231026 -1.073e-02 -0.017752  
## morphospecies.31.1 -0.0685629 0.016228 0.0104864 9.543e-03 -0.009360  
## morphospecies.32 -0.0649597 0.015631 0.0101731 8.993e-03 -0.008760  
## Scenedesmus.spp..3.1 -0.0178268 0.011379 0.0093889 1.130e-03 0.000611  
## morphospecies.33 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## morphospecies.34 -0.0044630 0.007618 0.0067886 -6.168e-04 0.002181  
## Selenastrum.spp.. -0.0123608 0.002049 0.0010746 1.886e-03 -0.002060  
## morphospecies.35 -0.0174808 0.002897 0.0015197 2.667e-03 -0.002914  
## morphospecies.36 -0.0654071 0.010841 0.0056861 9.979e-03 -0.010902  
## morphospecies.37 -0.0123608 0.002049 0.0010746 1.886e-03 -0.002060  
## morphospecies.38 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## pennate.7 -0.0123608 0.002049 0.0010746 1.886e-03 -0.002060  
## morphospecies.38.1 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## morphospecies.39 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## pennate.8 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## pennate.9 0.0000000 0.000000 0.0000000 0.000e+00 0.000000  
## Scenedesmus.spp..2. -0.0124140 0.000779 0.0368144 -1.421e-02 -0.001557  
## morphospecies.40 -0.0300399 0.013347 -0.0587435 -7.542e-02 0.033201  
## Scenedesmus.spp.1. 0.1337434 -0.161247 0.1197249 -9.487e-02 -0.017299  
## Cyclotella.spp... -0.3226707 0.009508 -0.0165338 -7.914e-03 -0.031719  
## pennate.2 0.2038956 -0.025287 0.0761175 3.465e-02 0.020182  
## Fragillaria.spp. -0.0841210 -0.280918 -0.1062021 2.926e-02 -0.017928  
## morphospecies.7 -0.1318281 0.066991 0.1645762 3.321e-02 0.044562  
## Chlorophyte -0.1597371 0.058274 0.0434740 1.837e-02 -0.013105  
## Peridinium.spp... 0.0529020 -0.075332 0.0447660 4.651e-02 0.008708  
## morphospecies.1 0.1153817 -0.092219 0.0473639 1.051e-01 0.016563  
## Nitzschia.spp. 0.0679270 -0.174018 0.1005956 -3.327e-02 0.008428  
## morphospecies.43 -0.0445674 0.007387 0.0038744 6.800e-03 -0.007429  
## Pinnularia.spp... 0.0332825 -0.043150 -0.0391783 3.577e-02 0.009744  
## Microcystis.spp. 0.2819737 0.291153 -0.0394190 3.958e-02 0.045064  
## Synedra.spp.. -0.0632468 -0.084200 -0.0290411 1.591e-01 0.006327  
## morphospecies.19 0.0423078 -0.025307 -0.0127322 6.830e-02 -0.001364  
## morphospecies.9 -0.0345366 0.006413 0.0023066 -1.526e-02 0.054631  
## Pediastrum.spp. -0.0168527 0.038048 -0.0126951 -7.109e-03 -0.046620  
## RDA6  
## pennate.1 0.0033506  
## morphospecies.2 -0.0457758  
## Cymbella.spp.. -0.0047285  
## Cymbella.spp.2. -0.0412568  
## Scenedesmus.spp..3 0.0104833  
## morphospecies.3 0.0012136  
## morphospecies.4 0.0437874  
## morphospecies.6 -0.0011286  
## Dolichospermum.spp.. -0.0052323  
## Tabellaria.spp.. -0.0140985  
## morphospecies.10 -0.0075467  
## morphospecies.11 0.0038895  
## morphospecies.12 -0.0089181  
## morphospecies.13 0.0498696  
## pennate.3 -0.0024122  
## morphospecies.14 0.0281550  
## morphospecies.15 -0.0065026  
## morphospecies.16 0.0312238  
## Coconeis.spp. -0.0070051  
## Staurastrum.spp. -0.0031504  
## morphospecies.17 -0.0438612  
## Selenastrum.spp... -0.0455933  
## morphospecies.18 0.0067367  
## Staurastrum.spp..2 -0.0047285  
## morphospecies.44 0.0042973  
## morphospecies.45 0.0027586  
## morphospecies.20 -0.0190725  
## morphospecies.21 0.0042835  
## morphospecies.22 0.0153697  
## morphospecies.23 -0.0017144  
## pennate.4 0.0006764  
## morphospecies.24 -0.0010712  
## morphospecies.25 -0.0044088  
## morphospecies.26 -0.0009003  
## morphospecies.27 -0.0079623  
## Asterionella.spp.. 0.0393284  
## morphospecies.28 0.0095159  
## morphospecies.29 0.0381036  
## pennate.5 0.0128929  
## morphospecies.30 0.0027586  
## Cosmarium.spp. 0.0018583  
## morphospecies.31 0.0000000  
## pennate.6 -0.0210267  
## morphospecies.31.1 -0.0211777  
## morphospecies.32 -0.0193970  
## Scenedesmus.spp..3.1 0.0131969  
## morphospecies.33 0.0000000  
## morphospecies.34 0.0157629  
## Selenastrum.spp.. -0.0061086  
## morphospecies.35 -0.0086389  
## morphospecies.36 -0.0323237  
## morphospecies.37 -0.0061086  
## morphospecies.38 0.0000000  
## pennate.7 -0.0061086  
## morphospecies.38.1 0.0000000  
## morphospecies.39 0.0000000  
## pennate.8 0.0000000  
## pennate.9 0.0000000  
## Scenedesmus.spp..2. 0.0490646  
## morphospecies.40 -0.0376775  
## Scenedesmus.spp.1. -0.0227148  
## Cyclotella.spp... 0.0028623  
## pennate.2 -0.0592808  
## Fragillaria.spp. 0.0347450  
## morphospecies.7 -0.0204257  
## Chlorophyte 0.0041198  
## Peridinium.spp... 0.0001903  
## morphospecies.1 -0.0117485  
## Nitzschia.spp. 0.0443247  
## morphospecies.43 -0.0220249  
## Pinnularia.spp... 0.0004177  
## Microcystis.spp. 0.0327360  
## Synedra.spp.. -0.0171220  
## morphospecies.19 0.0007949  
## morphospecies.9 0.0338773  
## Pediastrum.spp. 0.0747733  
##   
##   
## Site scores (weighted sums of species scores)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.283248 -0.10654 -0.547076 0.202700 0.15608 0.0339916  
## 3 0.026615 -0.07089 -0.489788 -0.364553 0.72180 0.1136484  
## 4 0.036882 -0.05154 -0.464508 -0.342509 0.70972 0.1278191  
## 5 -0.136857 -0.49442 -0.541533 -0.252256 0.10911 -0.3416108  
## 6 0.053161 0.06270 -0.436086 0.186037 -0.37202 0.1972386  
## 7 0.273584 0.34423 -0.433900 -0.142128 -0.37466 0.0002494  
## 8 -0.017862 -0.54180 -0.643949 -0.292405 -1.10026 0.5449738  
## 9 0.210301 0.39836 -0.111889 -0.019599 -0.30423 0.0623957  
## 10 0.353902 0.15826 -0.205922 -0.407105 -0.08811 -0.1702695  
## 11 0.164739 0.38421 0.220220 -0.594797 0.26401 -0.1759943  
## 12 0.270611 0.26727 0.129657 -0.007312 0.51698 0.0371014  
## 13 0.355307 0.60858 0.570173 -0.533268 0.12205 -0.6031711  
## 14 0.273563 0.58765 0.009434 0.009001 0.10243 -0.3726515  
## 15 0.312279 0.11509 0.079157 0.024067 -0.31264 -0.3322226  
## 16 0.348108 0.28070 0.186973 0.614640 -0.02038 -0.5185042  
## 17 0.199484 -0.29772 -0.199069 0.826994 -0.23661 -0.0299634  
## 18 0.226504 -0.05387 0.025704 0.633868 0.25672 0.1315858  
## 19 0.114396 -0.43047 -0.069422 0.356419 0.18027 0.1378608  
## 20 0.116923 -0.31093 0.075804 0.492938 0.22370 0.2758624  
## 21 0.122999 -0.17511 0.259122 0.439611 0.35139 0.0255448  
## 22 0.232545 -0.28181 0.524581 -0.260440 -0.08684 -0.3682637  
## 23 0.001120 -0.57647 0.355323 -0.436410 -0.29231 -0.1699166  
## 24 -0.004405 -0.63282 0.264226 -0.244651 -0.21378 -0.0036739  
## 25 -0.039757 -0.72139 0.227069 -0.188839 -0.20520 0.3555540  
## 26 0.149394 -0.16487 0.375700 -0.533533 0.18619 0.8125021  
## 27 -0.179373 0.34782 0.045794 0.087848 0.19060 0.6102853  
## 28 -0.315077 0.48933 0.327831 0.110368 0.05403 0.4472993  
## 29 -0.307985 0.44248 0.244010 0.245066 -0.11166 0.4364023  
## 30 -0.643315 0.10785 0.119614 0.365646 -0.26474 -0.3406911  
## 31 -0.652707 0.10946 0.162181 0.035676 -0.20789 -0.3567790  
## 32 -0.705665 0.10216 0.100068 0.144285 -0.28196 -0.2402946  
## 33 -0.556165 0.10451 -0.159498 -0.155359 0.32823 -0.3263085  
##   
##   
## Site constraints (linear combinations of constraining variables)  
##   
## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.08915 -0.18085 -0.51073 -0.18915 0.42418 -0.01654  
## 3 -0.08915 -0.18085 -0.51073 -0.18915 0.42418 -0.01654  
## 4 -0.08915 -0.18085 -0.51073 -0.18915 0.42418 -0.01654  
## 5 -0.08915 -0.18085 -0.51073 -0.18915 0.42418 -0.01654  
## 6 0.12980 0.06587 -0.40646 -0.06702 -0.53779 0.20121  
## 7 0.12980 0.06587 -0.40646 -0.06702 -0.53779 0.20121  
## 8 0.12980 0.06587 -0.40646 -0.06702 -0.53779 0.20121  
## 9 0.12980 0.06587 -0.40646 -0.06702 -0.53779 0.20121  
## 10 0.28614 0.35458 0.17853 -0.38562 0.20373 -0.22808  
## 11 0.28614 0.35458 0.17853 -0.38562 0.20373 -0.22808  
## 12 0.28614 0.35458 0.17853 -0.38562 0.20373 -0.22808  
## 13 0.28614 0.35458 0.17853 -0.38562 0.20373 -0.22808  
## 14 0.28336 0.17143 0.01912 0.36868 -0.11680 -0.31334  
## 15 0.28336 0.17143 0.01912 0.36868 -0.11680 -0.31334  
## 16 0.28336 0.17143 0.01912 0.36868 -0.11680 -0.31334  
## 17 0.28336 0.17143 0.01912 0.36868 -0.11680 -0.31334  
## 18 0.14521 -0.24260 0.07280 0.48071 0.25302 0.14271  
## 19 0.14521 -0.24260 0.07280 0.48071 0.25302 0.14271  
## 20 0.14521 -0.24260 0.07280 0.48071 0.25302 0.14271  
## 21 0.14521 -0.24260 0.07280 0.48071 0.25302 0.14271  
## 22 0.04738 -0.55312 0.34280 -0.28258 -0.19953 -0.04658  
## 23 0.04738 -0.55312 0.34280 -0.28258 -0.19953 -0.04658  
## 24 0.04738 -0.55312 0.34280 -0.28258 -0.19953 -0.04658  
## 25 0.04738 -0.55312 0.34280 -0.28258 -0.19953 -0.04658  
## 26 -0.16326 0.27869 0.24833 -0.02256 0.07979 0.57662  
## 27 -0.16326 0.27869 0.24833 -0.02256 0.07979 0.57662  
## 28 -0.16326 0.27869 0.24833 -0.02256 0.07979 0.57662  
## 29 -0.16326 0.27869 0.24833 -0.02256 0.07979 0.57662  
## 30 -0.63946 0.10599 0.05559 0.09756 -0.10659 -0.31602  
## 31 -0.63946 0.10599 0.05559 0.09756 -0.10659 -0.31602  
## 32 -0.63946 0.10599 0.05559 0.09756 -0.10659 -0.31602  
## 33 -0.63946 0.10599 0.05559 0.09756 -0.10659 -0.31602  
##   
##   
## Biplot scores for constraining variables  
##   
## RDA1  
## ford.rare.hel$traceTRUE -0.1439  
## ford.rare.hel$nitrogenTRUE -0.4643  
## ford.rare.hel$phosphorusTRUE -0.4128  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE -0.5022  
## ford.rare.hel$traceTRUE:ford.rare.hel$phosphorusTRUE -0.6015  
## ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE -0.8156  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE -0.8506  
## RDA2  
## ford.rare.hel$traceTRUE -0.4560  
## ford.rare.hel$nitrogenTRUE 0.1830  
## ford.rare.hel$phosphorusTRUE 0.1638  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE -0.1388  
## ford.rare.hel$traceTRUE:ford.rare.hel$phosphorusTRUE -0.4543  
## ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.3908  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.1410  
## RDA3  
## ford.rare.hel$traceTRUE 0.43141  
## ford.rare.hel$nitrogenTRUE -0.02616  
## ford.rare.hel$phosphorusTRUE 0.72611  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE 0.13044  
## ford.rare.hel$traceTRUE:ford.rare.hel$phosphorusTRUE 0.40476  
## ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.30878  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.07395  
## RDA4  
## ford.rare.hel$traceTRUE 0.5845  
## ford.rare.hel$nitrogenTRUE 0.4300  
## ford.rare.hel$phosphorusTRUE -0.5219  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE 0.5875  
## ford.rare.hel$traceTRUE:ford.rare.hel$phosphorusTRUE -0.1880  
## ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.0762  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.1298  
## RDA5  
## ford.rare.hel$traceTRUE -0.14949  
## ford.rare.hel$nitrogenTRUE -0.27414  
## ford.rare.hel$phosphorusTRUE -0.01989  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE 0.14877  
## ford.rare.hel$traceTRUE:ford.rare.hel$phosphorusTRUE -0.31102  
## ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE -0.02723  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE -0.14179  
## RDA6  
## ford.rare.hel$traceTRUE -0.46916  
## ford.rare.hel$nitrogenTRUE 0.53191  
## ford.rare.hel$phosphorusTRUE -0.01237  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE -0.17607  
## ford.rare.hel$traceTRUE:ford.rare.hel$phosphorusTRUE -0.36839  
## ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE 0.26477  
## ford.rare.hel$traceTRUE:ford.rare.hel$nitrogenTRUE:ford.rare.hel$phosphorusTRUE -0.42038

anova(rda.ford.rare.hel.all.treats)

## Permutation test for rda under reduced model  
## Permutation: free  
## Number of permutations: 999  
##   
## Model: rda(formula = ford.rare.hel[, 7:82] ~ ford.rare.hel$trace \* ford.rare.hel$nitrogen \* ford.rare.hel$phosphorus)  
## Df Variance F Pr(>F)   
## Model 7 0.10135 3.0496 0.001 \*\*\*  
## Residual 24 0.11395   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

RsquareAdj(rda.ford.rare.hel.all.treats)

## $r.squared  
## [1] 0.470748  
##   
## $adj.r.squared  
## [1] 0.3163829

#anova is significant, Rsquared is very high at 32.7%  
   
   
### Another method of getting a marginal test provides similar results.  
#rda.ford.rare.hel.int=rda(ford.rare.hel[,7:83] ~ ford.rare.hel$trace:ford.rare.hel$nitrogen:ford.rare.hel$phosphorus + Condition(ford.rare.hel$trace + ford.rare.hel$nitrogen +ford.rare.hel$phosphorus))  
# anova(rda.ford.rare.hel.int)  
# summary(rda.ford.rare.hel.int)  
   
   
#rerun with more powerful test that separates out interactions and individual treatment effects--- different syntax  
###  
# Plots and getting some more species info  
# Better plots can be made if you extract scores as shown below  
rda.ford.rare.hel.all.spscores=scores(rda.ford.rare.hel.all.treats,display="sp",choices=c(1:17))  
head(rda.ford.rare.hel.all.spscores)

## RDA1 RDA2 RDA3 RDA4  
## pennate.1 -0.183495317 0.061051154 0.107331990 -5.806162e-02  
## morphospecies.2 0.090151048 -0.047917651 0.023532613 -1.074180e-01  
## Cymbella.spp.. 0.003807760 0.003358223 -0.006421285 -1.111035e-02  
## Cymbella.spp.2. 0.071377018 -0.020986547 -0.026045367 6.922525e-02  
## Scenedesmus.spp..3 0.009428625 -0.165921596 -0.009580978 3.613298e-05  
## morphospecies.3 -0.009433993 -0.003296018 -0.027007723 4.322654e-02  
## RDA5 RDA6 RDA7 PC1  
## pennate.1 0.103283639 0.003350567 0.010319871 0.020563223  
## morphospecies.2 -0.111578225 -0.045775818 0.007493411 -0.011788481  
## Cymbella.spp.. 0.012137420 -0.004728511 0.001363273 0.003853200  
## Cymbella.spp.2. 0.043506113 -0.041256806 0.020798173 -0.002797819  
## Scenedesmus.spp..3 0.057650553 0.010483330 0.016856700 0.035518665  
## morphospecies.3 -0.008196996 0.001213579 -0.008771834 -0.019954856  
## PC2 PC3 PC4 PC5  
## pennate.1 0.022029267 0.041741304 0.0418709507 -0.07839589  
## morphospecies.2 -0.012054797 0.087869823 -0.0623964177 -0.08721178  
## Cymbella.spp.. -0.005701797 -0.013934765 -0.0006471928 0.01317182  
## Cymbella.spp.2. 0.013119057 -0.030555943 -0.0200943133 -0.01968742  
## Scenedesmus.spp..3 -0.074891905 -0.009539136 -0.0228725429 0.07521969  
## morphospecies.3 0.037162997 -0.045316040 0.0285580744 -0.01885365  
## PC6 PC7 PC8 PC9  
## pennate.1 0.038223305 -0.038011720 0.0458420394 -0.005652803  
## morphospecies.2 0.006586321 0.018696847 -0.0058859296 0.014593098  
## Cymbella.spp.. -0.012464858 -0.001163903 0.0002355104 -0.004926705  
## Cymbella.spp.2. -0.042572465 0.024133983 -0.0464615631 -0.010036556  
## Scenedesmus.spp..3 -0.039839160 0.013629774 0.0484421003 -0.003471394  
## morphospecies.3 -0.006036282 0.040948839 0.0012699784 0.018456826  
## PC10  
## pennate.1 0.0072931562  
## morphospecies.2 0.0507928022  
## Cymbella.spp.. -0.0005916106  
## Cymbella.spp.2. -0.0060445147  
## Scenedesmus.spp..3 -0.0353324165  
## morphospecies.3 -0.0038471598

rda.ford.rare.hel.all.lcscores=scores(rda.ford.rare.hel.all.treats,display="lc",choices=c(1:17))  
head(rda.ford.rare.hel.all.lcscores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.08915194 -0.18084790 -0.5107262 -0.18915433 0.4241764 -0.01653792  
## 3 -0.08915194 -0.18084790 -0.5107262 -0.18915433 0.4241764 -0.01653792  
## 4 -0.08915194 -0.18084790 -0.5107262 -0.18915433 0.4241764 -0.01653792  
## 5 -0.08915194 -0.18084790 -0.5107262 -0.18915433 0.4241764 -0.01653792  
## 6 0.12979585 0.06587423 -0.4064561 -0.06702372 -0.5377934 0.20121437  
## 7 0.12979585 0.06587423 -0.4064561 -0.06702372 -0.5377934 0.20121437  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 -0.2182955 -0.09522932 0.6380722 -0.08293353 0.5601421 -0.4041729  
## 3 -0.2182955 0.22689034 -0.4273872 -0.02033556 -0.2573892 0.3466650  
## 4 -0.2182955 0.24701354 -0.4250581 -0.03278315 -0.2724272 0.3423175  
## 5 -0.2182955 -0.37867455 0.2143731 0.13605224 -0.0303257 -0.2848095  
## 6 0.2110273 -0.02047035 0.2222879 -0.40677600 0.2803601 0.3821676  
## 7 0.2110273 0.34952091 -0.2465887 0.08636145 -0.1343408 0.2317190  
## PC6 PC7 PC8 PC9 PC10  
## 2 0.38716588 -0.21433944 0.53582401 -0.178192727 -0.03199625  
## 3 -0.20937580 0.14019816 0.22000890 -0.155918971 -0.01982417  
## 4 -0.20151382 0.11458469 0.19103013 -0.171848635 0.01930244  
## 5 0.02372373 -0.04044341 -0.94686303 0.505960334 0.03251798  
## 6 0.18218998 -0.09982195 -0.27847728 -0.005316743 0.20281277  
## 7 0.19873365 0.12397393 -0.09862529 0.100502397 -0.10790958

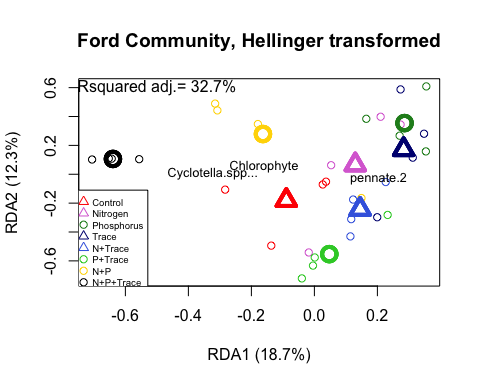
rda.ford.rare.hel.all.wascores=scores(rda.ford.rare.hel.all.treats,display="wa",choices=c(1:17))  
head(rda.ford.rare.hel.all.wascores)

## RDA1 RDA2 RDA3 RDA4 RDA5 RDA6  
## 2 -0.28324810 -0.10653696 -0.5470762 0.2027005 0.1560763 0.0339916190  
## 3 0.02661511 -0.07088944 -0.4897875 -0.3645527 0.7218046 0.1136484319  
## 4 0.03688224 -0.05154117 -0.4645080 -0.3425091 0.7097184 0.1278191146  
## 5 -0.13685700 -0.49442403 -0.5415329 -0.2522561 0.1091062 -0.3416108337  
## 6 0.05316143 0.06270143 -0.4360864 0.1860371 -0.3720221 0.1972386041  
## 7 0.27358350 0.34423374 -0.4339005 -0.1421278 -0.3746605 0.0002494031  
## RDA7 PC1 PC2 PC3 PC4 PC5  
## 2 0.05802674 -0.09522932 0.6380722 -0.08293353 0.5601421 -0.4041729  
## 3 -0.24207225 0.22689034 -0.4273872 -0.02033556 -0.2573892 0.3466650  
## 4 -0.25014266 0.24701354 -0.4250581 -0.03278315 -0.2724272 0.3423175  
## 5 -0.43899375 -0.37867455 0.2143731 0.13605224 -0.0303257 -0.2848095  
## 6 0.23819059 -0.02047035 0.2222879 -0.40677600 0.2803601 0.3821676  
## 7 0.19821362 0.34952091 -0.2465887 0.08636145 -0.1343408 0.2317190  
## PC6 PC7 PC8 PC9 PC10  
## 2 0.38716588 -0.21433944 0.53582401 -0.178192727 -0.03199625  
## 3 -0.20937580 0.14019816 0.22000890 -0.155918971 -0.01982417  
## 4 -0.20151382 0.11458469 0.19103013 -0.171848635 0.01930244  
## 5 0.02372373 -0.04044341 -0.94686303 0.505960334 0.03251798  
## 6 0.18218998 -0.09982195 -0.27847728 -0.005316743 0.20281277  
## 7 0.19873365 0.12397393 -0.09862529 0.100502397 -0.10790958

#weighted averages with P symbols  
#make P have a symbol diference  
symbols=ifelse(ford.rare.hel$phosphorus=="TRUE",1,ifelse(ford.rare.hel$phosphorus=="FALSE",2,0))  
plot(rda.ford.rare.hel.all.wascores[,1:2],col=colors,xlab="RDA1 (18.7%)",ylab="RDA2 (12.3%)",main="Ford Community, Hellinger transformed")  
points(rda.ford.rare.hel.all.lcscores[,1:2],col=colors,pch=symbols,cex=2,lwd=4)  
text(-0.5,0.6,"Rsquared adj.= 32.7%")  
# This command provides and R-squared for each taxon for each axis  
goodness(rda.ford.rare.hel.all.treats)

## RDA1 RDA2 RDA3 RDA4  
## pennate.1 3.903984e-01 0.4336145049 0.56718680 0.60627416  
## morphospecies.2 1.267907e-01 0.1626115678 0.17125102 0.35126230  
## Cymbella.spp.. 8.010873e-03 0.0142419039 0.03702353 0.10522544  
## Cymbella.spp.2. 1.910155e-01 0.2075287996 0.23296269 0.41263490  
## Scenedesmus.spp..3 1.599816e-03 0.4970262729 0.49867821 0.49867823  
## morphospecies.3 4.963778e-03 0.0055696778 0.04625120 0.15046429  
## morphospecies.4 1.093860e-03 0.0527125174 0.10145299 0.12875414  
## morphospecies.6 1.233987e-01 0.3938389865 0.39954894 0.40055948  
## Dolichospermum.spp.. 7.305475e-02 0.0971555429 0.16136389 0.20030740  
## Tabellaria.spp.. 8.056164e-02 0.1108419329 0.12099097 0.14197561  
## morphospecies.10 3.148250e-02 0.0604133781 0.17125729 0.26374602  
## morphospecies.11 6.731505e-03 0.0084653953 0.07447664 0.07627158  
## morphospecies.12 1.310368e-04 0.1228931597 0.18700059 0.30720037  
## morphospecies.13 5.213198e-02 0.0560372159 0.05608231 0.10483449  
## pennate.3 3.119614e-03 0.0036953142 0.26039105 0.29517880  
## morphospecies.14 3.203923e-03 0.0087678792 0.01058362 0.01329619  
## morphospecies.15 1.079209e-01 0.1092908062 0.14910113 0.21542809  
## morphospecies.16 7.397097e-02 0.0776446020 0.11617507 0.13266045  
## Coconeis.spp. 1.631630e-01 0.2559182869 0.28342554 0.45172376  
## Staurastrum.spp. 1.336721e-01 0.1453860197 0.16513499 0.16673278  
## morphospecies.17 8.765365e-02 0.0999180897 0.42411120 0.45528476  
## Selenastrum.spp... 5.092995e-01 0.5420733310 0.56400074 0.58611311  
## morphospecies.18 6.731505e-03 0.0084653953 0.07447664 0.07627158  
## Staurastrum.spp..2 8.010873e-03 0.0142419039 0.03702353 0.10522544  
## morphospecies.44 6.836868e-03 0.1712199079 0.17127502 0.19779398  
## morphospecies.45 8.424727e-03 0.0319404576 0.03405821 0.12639078  
## morphospecies.20 1.779685e-01 0.2915628627 0.40878245 0.44379336  
## morphospecies.21 3.507434e-02 0.0435948636 0.26403913 0.26454105  
## morphospecies.22 1.583494e-01 0.1972813441 0.24443996 0.28533125  
## morphospecies.23 7.860104e-04 0.0098996556 0.20496364 0.20735284  
## pennate.4 8.679959e-02 0.1348593474 0.14824577 0.25081133  
## morphospecies.24 2.961255e-01 0.3304040095 0.34880621 0.35304577  
## morphospecies.25 3.271501e-02 0.0829514000 0.09568712 0.15510414  
## morphospecies.26 8.968160e-04 0.1231420354 0.17009590 0.20200308  
## morphospecies.27 7.860585e-02 0.0807734664 0.08439003 0.39315800  
## Asterionella.spp.. 9.176729e-05 0.0004585062 0.02949047 0.08857957  
## morphospecies.28 1.465158e-02 0.0555481737 0.05923119 0.21980828  
## morphospecies.29 3.791249e-03 0.0330086880 0.14600724 0.17751787  
## pennate.5 1.372049e-02 0.0852673120 0.09672672 0.19991333  
## morphospecies.30 8.424727e-03 0.0319404576 0.03405821 0.12639078  
## Cosmarium.spp. 7.656469e-03 0.1383695906 0.17402744 0.18213099  
## morphospecies.31 NaN NaN NaN NaN  
## pennate.6 1.376093e-01 0.2160861595 0.27838718 0.29182492  
## morphospecies.31.1 1.754095e-01 0.1852367035 0.18933994 0.19273807  
## morphospecies.32 4.925624e-01 0.5210831113 0.53316358 0.54260426  
## Scenedesmus.spp..3.1 8.740212e-02 0.1230160930 0.14726008 0.14761155  
## morphospecies.33 NaN NaN NaN NaN  
## morphospecies.34 1.065004e-02 0.0416836488 0.06632487 0.06652828  
## Selenastrum.spp.. 1.633885e-01 0.1678774650 0.16911228 0.17291552  
## morphospecies.35 1.633885e-01 0.1678774650 0.16911228 0.17291552  
## morphospecies.36 1.633885e-01 0.1678774650 0.16911228 0.17291552  
## morphospecies.37 1.633885e-01 0.1678774650 0.16911228 0.17291552  
## morphospecies.38 NaN NaN NaN NaN  
## pennate.7 1.633885e-01 0.1678774650 0.16911228 0.17291552  
## morphospecies.38.1 NaN NaN NaN NaN  
## morphospecies.39 NaN NaN NaN NaN  
## pennate.8 NaN NaN NaN NaN  
## pennate.9 NaN NaN NaN NaN  
## Scenedesmus.spp..2. 6.503784e-03 0.0065293924 0.06372716 0.07225233  
## morphospecies.40 1.762661e-02 0.0211062958 0.08851149 0.19961068  
## Scenedesmus.spp.1. 1.442608e-01 0.3539550789 0.46955912 0.54214071  
## Cyclotella.spp... 6.308356e-01 0.6313833142 0.63303964 0.63341915  
## pennate.2 5.605569e-01 0.5691787338 0.64730064 0.66349018  
## Fragillaria.spp. 1.928789e-02 0.2343857568 0.26512848 0.26746141  
## morphospecies.7 1.805613e-01 0.2271891969 0.50860132 0.52005929  
## Chlorophyte 6.277457e-01 0.7112915065 0.75778924 0.76609334  
## Peridinium.spp... 1.374593e-01 0.4161902526 0.51462005 0.62088090  
## morphospecies.1 2.277866e-01 0.3732987230 0.41168258 0.60058818  
## Nitzschia.spp. 4.658976e-02 0.3523581344 0.45453751 0.46571374  
## morphospecies.43 1.633885e-01 0.1678774650 0.16911228 0.17291552  
## Pinnularia.spp... 6.321408e-02 0.1694685064 0.25706228 0.33005932  
## Microcystis.spp. 2.677565e-01 0.5532289787 0.55846177 0.56373824  
## Synedra.spp.. 3.870495e-02 0.1073031214 0.11546361 0.36045420  
## morphospecies.19 1.097413e-01 0.1490062188 0.15894515 0.44494232  
## morphospecies.9 7.053686e-02 0.0729687972 0.07328343 0.08705953  
## Pediastrum.spp. 5.571166e-03 0.0339676891 0.03712907 0.03812043  
## RDA5 RDA6 RDA7  
## pennate.1 0.72996032 0.7300905 0.7313253  
## morphospecies.2 0.54548705 0.5781773 0.5790533  
## Cymbella.spp.. 0.18661966 0.1989732 0.2000000  
## Cymbella.spp.2. 0.48360123 0.5474192 0.5636374  
## Scenedesmus.spp..3 0.55848913 0.5604669 0.5655804  
## morphospecies.3 0.15421169 0.1542938 0.1585853  
## morphospecies.4 0.13533962 0.3076431 0.3667039  
## morphospecies.6 0.52687403 0.5269289 0.5939794  
## Dolichospermum.spp.. 0.38369606 0.3890763 0.4146225  
## Tabellaria.spp.. 0.15981928 0.1724116 0.3243501  
## morphospecies.10 0.48060941 0.4824980 0.4825829  
## morphospecies.11 0.19183529 0.2080127 0.2258065  
## morphospecies.12 0.39824169 0.4030639 0.4439823  
## morphospecies.13 0.11919122 0.2025662 0.2118881  
## pennate.3 0.29587735 0.2960005 0.3003437  
## morphospecies.14 0.04499256 0.1291874 0.1497677  
## morphospecies.15 0.26749942 0.2683952 0.2872545  
## morphospecies.16 0.23833560 0.3174801 0.3926912  
## Coconeis.spp. 0.45502069 0.4581427 0.4606026  
## Staurastrum.spp. 0.19372160 0.1955209 0.2562529  
## morphospecies.17 0.58596637 0.6105459 0.6382291  
## Selenastrum.spp... 0.58831742 0.6058498 0.6064896  
## morphospecies.18 0.19183529 0.2080127 0.2258065  
## Staurastrum.spp..2 0.18661966 0.1989732 0.2000000  
## morphospecies.44 0.25684112 0.2623071 0.2857143  
## morphospecies.45 0.15197131 0.1601094 0.2258065  
## morphospecies.20 0.52080968 0.5398492 0.5507423  
## morphospecies.21 0.35915353 0.3599828 0.3606350  
## morphospecies.22 0.36809094 0.3792175 0.3866082  
## morphospecies.23 0.37507212 0.3755375 0.3755383  
## pennate.4 0.25296459 0.2530142 0.3203922  
## morphospecies.24 0.35557905 0.3560162 0.3563218  
## morphospecies.25 0.17168890 0.1924752 0.2258065  
## morphospecies.26 0.21791127 0.2187780 0.2258065  
## morphospecies.27 0.40109940 0.4135587 0.4146225  
## Asterionella.spp.. 0.11976115 0.2654287 0.2727273  
## morphospecies.28 0.26429580 0.2784488 0.3927037  
## morphospecies.29 0.18284751 0.2658222 0.3104242  
## pennate.5 0.22595872 0.2361634 0.3185185  
## morphospecies.30 0.15197131 0.1601094 0.2258065  
## Cosmarium.spp. 0.18272165 0.1846297 0.2000000  
## morphospecies.31 NaN NaN NaN  
## pennate.6 0.32860975 0.3802176 0.3802817  
## morphospecies.31.1 0.19600727 0.2127425 0.2165841  
## morphospecies.32 0.55156074 0.5954787 0.6056338  
## Scenedesmus.spp..3.1 0.14771422 0.1956127 0.2035568  
## morphospecies.33 NaN NaN NaN  
## morphospecies.34 0.06907207 0.2019257 0.2258065  
## Selenastrum.spp.. 0.17745518 0.2173591 0.2258065  
## morphospecies.35 0.17745518 0.2173591 0.2258065  
## morphospecies.36 0.17745518 0.2173591 0.2258065  
## morphospecies.37 0.17745518 0.2173591 0.2258065  
## morphospecies.38 NaN NaN NaN  
## pennate.7 0.17745518 0.2173591 0.2258065  
## morphospecies.38.1 NaN NaN NaN  
## morphospecies.39 NaN NaN NaN  
## pennate.8 NaN NaN NaN  
## pennate.9 NaN NaN NaN  
## Scenedesmus.spp..2. 0.07235458 0.1739510 0.2056077  
## morphospecies.40 0.22114188 0.2488711 0.2683437  
## Scenedesmus.spp.1. 0.54455432 0.5487155 0.5500559  
## Cyclotella.spp... 0.63951486 0.6395645 0.6414061  
## pennate.2 0.66898247 0.7163666 0.7278320  
## Fragillaria.spp. 0.26833748 0.2716280 0.2719339  
## morphospecies.7 0.54069112 0.5450259 0.5450857  
## Chlorophyte 0.77031823 0.7707358 0.7707492  
## Peridinium.spp... 0.62460580 0.6246076 0.6312447  
## morphospecies.1 0.60528179 0.6076435 0.6738977  
## Nitzschia.spp. 0.46643088 0.4862689 0.4862802  
## morphospecies.43 0.17745518 0.2173591 0.2258065  
## Pinnularia.spp... 0.33547777 0.3354877 0.3827769  
## Microcystis.spp. 0.57057712 0.5741860 0.5743757  
## Synedra.spp.. 0.36084159 0.3636782 0.3661229  
## morphospecies.19 0.44505631 0.4450950 0.4576250  
## morphospecies.9 0.26355636 0.3314260 0.3536847  
## Pediastrum.spp. 0.08075332 0.1904267 0.1905280

sp.rsq=goodness(rda.ford.rare.hel.all.treats)  
sp.aff=rownames(sp.rsq)[sp.rsq[,2]>0.555]  
l=length(na.omit(sp.aff))  
sp.aff.rows=match(na.omit(sp.aff)[1:l],rownames(rda.ford.rare.hel.all.spscores))  
text(rda.ford.rare.hel.all.spscores[sp.aff.rows,1:2],labels=rownames(rda.ford.rare.hel.all.spscores[sp.aff.rows,]),cex=0.8)  
legend(-0.76,-0.11,legend=c("Control","Nitrogen","Phosphorus","Trace","N+Trace","P+Trace","N+P","N+P+Trace"),pch=c(2,2,1,2,2,1,1,1), col=c("red","orchid","forestgreen","navy","royalblue","limegreen","gold","grey0"),pt.cex=1, cex=0.6)

 Interpretation: This RDA has a significant anova and the highest adjusted Rsquared for all of my sites at 32.7%. Treatments separate out but not in explicit patterns. N+P+trace diverges strongly from the other treatments. Microcystis is associated with trace and P treatments here, but is also close to N.. it has been associated with N and trace at the other sites. Chlorophytes and diatoms explain large amounts of variation and are near the N+P treatment, which also is separate from other treatments.