Measuring genetoc differentiation measurements on mahi mahi

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3/03/2020

Import libraries

```
library(adegenet)
library(poppr)
library(pegas)
library(hierfstat)
library(diveRsity)
```

Defining color palettes

```
myColmahi <- c("#fe9929", "#41ab5d", "#1d91c0", "#e7298a")
```

Importing genepop file (it takes ~5 minutes)

```
file = "~/Documents/Genetic_Diversity/Practice/Dolphinfish_data/mahi_fil_class.gen"
obj_mahi <- read.genepop(file, ncode =3)
```

```
##
##  Converting data from a Genepop .gen file to a genind object...
##
##
## File description:  3RAD mahi mahi filtered
##
## ...done.
```

```
obj_mahi
```

```
## /// GENIND OBJECT /////////
##
##  // 204 individuals; 8,159 loci; 15,493 alleles; size: 16.3 Mb
##
##  // Basic content
##    @tab:  204 x 15493 matrix of allele counts
##    @loc.n.all: number of alleles per locus (range: 1-4)
##    @loc.fac: locus factor for the 15493 columns of @tab
##    @all.names: list of allele names for each locus
##    @ploidy: ploidy of each individual  (range: 2-2)
##    @type:  codom
##    @call: read.genepop(file = file, ncode = 3)
```

```
##
##  // Optional content
##    @pop: population of each individual (group size range: 13-88)
```

Add strata and hierarchy to the object

```r
#Importing strata
mahiclass_strata <- read.table("~/Documents/Genetic_Diversity/Practice/Dolphinfish_data/mahi_fil_strata
mahiclass_strata
```

```
##               X Basins Ocean       Coast Latitude Site Year
## 1       BM08_04 INDPAC   PAC    EAST_PAC      NEP   BM 2008
## 2       BM08_05 INDPAC   PAC    EAST_PAC      NEP   BM 2008
## 3       BM08_12 INDPAC   PAC    EAST_PAC      NEP   BM 2008
## 4       BM08_13 INDPAC   PAC    EAST_PAC      NEP   BM 2008
## 5       BM08_14 INDPAC   PAC    EAST_PAC      NEP   BM 2008
## 6      CSL06_03 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 7      CSL06_15 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 8      CSL06_16 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 9      CSL06_17 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 10     CSL06_22 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 11     CSL06_25 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 12     CSL06_31 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 13    CSL06_599 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 14     CSL06_78 INDPAC   PAC    EAST_PAC      NEP  CSL 2006
## 15      EC06_04 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 16      EC06_05 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 17      EC06_12 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 18      EC06_14 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 19      EC06_20 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 20      EC06_28 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 21      EC06_33 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 22      EC06_37 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 23      EC06_41 INDPAC   PAC    EAST_PAC      SEP   EC 2006
## 24      GY03_06 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 25      GY03_08 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 26      GY03_11 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 27      GY03_14 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 28      GY03_15 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 29      GY03_20 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 30      GY03_24 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 31      GY03_26 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 32      GY03_27 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 33      GY03_28 INDPAC   PAC    EAST_PAC      NEP   GY 2003
## 34      HW07_02 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 35      HW07_06 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 36      HW07_10 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 37      HW07_11 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 38      HW07_13 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 39      HW07_15 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 40      HW07_19 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 41      HW07_27 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
## 42      HW07_30 INDPAC   PAC CENTRAL_PAC      CNP   HW 2007
```

```
## 43    JP05_08 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 44    JP05_20 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 45    JP05_23 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 46    JP05_28 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 47    JP05_31 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 48    JP05_35 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 49    JP05_40 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 50    JP05_42 INDPAC   PAC    WEST_PAC      NWP   JP 2005
## 51    MZ04_02 INDPAC   PAC    EAST_PAC      NEP   MZ 2004
## 52    MZ04_17 INDPAC   PAC    EAST_PAC      NEP   MZ 2004
## 53    NC05_01 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 54    NC05_11 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 55    NC05_18 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 56    NC05_24 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 57    NC05_28 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 58    NC05_31 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 59    NC05_36 INDPAC   PAC    WEST_PAC      SWP   NC 2005
## 60    OC07_10 INDPAC   PAC    EAST_PAC      NEP   OC 2007
## 61    OC07_21 INDPAC   PAC    EAST_PAC      NEP   OC 2007
## 62    OC07_34 INDPAC   PAC    EAST_PAC      NEP   OC 2007
## 63    OC07_35 INDPAC   PAC    EAST_PAC      NEP   OC 2007
## 64    OC07_42 INDPAC   PAC    EAST_PAC      NEP   OC 2007
## 65    PE06_02 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 66    PE06_05 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 67    PE06_06 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 68    PE06_10 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 69    PE06_11 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 70    PE06_14 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 71    PE06_26 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 72    PE06_29 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 73    PE06_31 INDPAC   PAC    EAST_PAC      SEP   PE 2006
## 74    PL06_67 INDPAC   PAC    EAST_PAC      NEP   PL 2006
## 75    PL06_70 INDPAC   PAC    EAST_PAC      NEP   PL 2006
## 76    PL06_73 INDPAC   PAC    EAST_PAC      NEP   PL 2006
## 77    PL06_76 INDPAC   PAC    EAST_PAC      NEP   PL 2006
## 78    PL06_79 INDPAC   PAC    EAST_PAC      NEP   PL 2006
## 79    PM04_02 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 80    PM04_11 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 81    PM04_15 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 82    PM04_18 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 83    PM04_20 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 84    PM04_22 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 85    PM04_23 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 86    PM04_29 INDPAC   PAC    EAST_PAC      NEP   PM 2004
## 87    TT05_07 INDPAC   PAC CENTRAL_PAC      CSP   TT 2005
## 88    TT05_21 INDPAC   PAC CENTRAL_PAC      CSP   TT 2005
## 89    CA07_02    ATL   ATL    EAST_PAC      CAR   CA 2007
## 90    CA07_26    ATL   ATL    WEST_ATL      CAR   CA 2007
## 91    CA07_35    ATL   ATL    WEST_ATL      CAR   CA 2007
## 92    CA07_39    ATL   ATL    WEST_ATL      CAR   CA 2007
## 93    CA07_44    ATL   ATL    WEST_ATL      CAR   CA 2007
## 94    CA07_48    ATL   ATL    WEST_ATL      CAR   CA 2007
## 95    CA07_56    ATL   ATL    WEST_ATL      CAR   CA 2007
## 96    CA07_64    ATL   ATL    WEST_ATL      CAR   CA 2007
```

```
## 97    CA07_65    ATL   ATL    WEST_ATL      CAR   CA 2007
## 98    CO11_28    ATL   ATL    WEST_ATL      CAR   CO 2011
## 99    DK06_02    ATL   ATL    EAST_ATL     EATL   DK 2006
## 100   DK06_04    ATL   ATL    EAST_ATL     EATL   DK 2006
## 101   DK06_14    ATL   ATL    EAST_ATL     EATL   DK 2006
## 102   DK06_17    ATL   ATL    EAST_ATL     EATL   DK 2006
## 103   EU11_04    ATL   ATL    WEST_ATL      NWA   US 2011
## 104   EU11_06    ATL   ATL    WEST_ATL      NWA   US 2011
## 105   EU11_10    ATL   ATL    WEST_ATL      NWA   US 2011
## 106   EU11_11    ATL   ATL    WEST_ATL      NWA   US 2011
## 107   EU11_12    ATL   ATL    WEST_ATL      NWA   US 2011
## 108   EU11_18    ATL   ATL    WEST_ATL      NWA   US 2011
## 109   EU11_19    ATL   ATL    WEST_ATL      NWA   US 2011
## 110   EU11_20    ATL   ATL    WEST_ATL      NWA   US 2011
## 111   EU11_28    ATL   ATL    WEST_ATL      NWA   US 2011
## 112   EU11_30    ATL   ATL    WEST_ATL      NWA   US 2011
## 113   EU11_32    ATL   ATL    WEST_ATL      NWA   US 2011
## 114   EU11_34    ATL   ATL    WEST_ATL      NWA   US 2011
## 115   EU11_36    ATL   ATL    WEST_ATL      NWA   US 2011
## 116   EU11_38    ATL   ATL    WEST_ATL      NWA   US 2011
## 117   EU11_40    ATL   ATL    WEST_ATL      NWA   US 2011
## 118  FLa11_08    ATL   ATL    WEST_ATL      NWA   US 2011
## 119  FLa11_09    ATL   ATL    WEST_ATL      NWA   US 2011
## 120  SAI11_02    ATL   ATL    WEST_ATL      CAR   CO 2011
## 121  SAI11_05    ATL   ATL    WEST_ATL      CAR   CO 2011
## 122  SCH06_01    ATL   ATL    EAST_ATL     EATL   DK 2006
## 123  SCH06_05    ATL   ATL    EAST_ATL     EATL   DK 2006
## 124  SCH06_11    ATL   ATL    EAST_ATL     EATL   DK 2006
## 125  SCH06_14    ATL   ATL    EAST_ATL     EATL   DK 2006
## 126  SCH06_27    ATL   ATL    EAST_ATL     EATL   DK 2006
## 127  SCH06_29    ATL   ATL    EAST_ATL     EATL   DK 2006
## 128   TX06_01    ATL   ATL    WEST_ATL       GM   TX 2006
## 129   TX06_03    ATL   ATL    WEST_ATL       GM   TX 2006
## 130   TX06_04    ATL   ATL    WEST_ATL       GM   TX 2006
## 131   TX06_05    ATL   ATL    WEST_ATL       GM   TX 2006
## 132   TX06_06    ATL   ATL    WEST_ATL       GM   TX 2006
## 133   TX06_10    ATL   ATL    WEST_ATL       GM   TX 2006
## 134   TX06_12    ATL   ATL    WEST_ATL       GM   TX 2006
## 135   TX06_17    ATL   ATL    WEST_ATL       GM   TX 2006
## 136   TX06_22    ATL   ATL    WEST_ATL       GM   TX 2006
## 137   RE05_01 INDPAC   IND    WEST_IND      WEI   RE 2005
## 138   RE05_02 INDPAC   IND    WEST_IND      WEI   RE 2005
## 139   RE05_04 INDPAC   IND    WEST_IND      WEI   RE 2005
## 140   RE05_05 INDPAC   IND    WEST_IND      WEI   RE 2005
## 141   RE05_06 INDPAC   IND    WEST_IND      WEI   RE 2005
## 142   RE05_07 INDPAC   IND    WEST_IND      WEI   RE 2005
## 143   RE05_08 INDPAC   IND    WEST_IND      WEI   RE 2005
## 144   RE05_12 INDPAC   IND    WEST_IND      WEI   RE 2005
## 145   RE05_15 INDPAC   IND    WEST_IND      WEI   RE 2005
## 146   RE05_16 INDPAC   IND    WEST_IND      WEI   RE 2005
## 147   RE05_20 INDPAC   IND    WEST_IND      WEI   RE 2005
## 148   RE05_23 INDPAC   IND    WEST_IND      WEI   RE 2005
## 149   RE05_24 INDPAC   IND    WEST_IND      WEI   RE 2005
## 150  SA11_400 INDPAC   IND    WEST_IND      SWI   SA 2012
```

```
## 151  SA11_403 INDPAC   IND    WEST_IND      SWI   SA 2012
## 152  SA11_408 INDPAC   IND    WEST_IND      SWI   SA 2012
## 153  SA11_409 INDPAC   IND    WEST_IND      SWI   SA 2012
## 154  SA11_410 INDPAC   IND    WEST_IND      SWI   SA 2012
## 155  SA12_401 INDPAC   IND    WEST_IND      SWI   SA 2012
## 156  SA12_404 INDPAC   IND    WEST_IND      SWI   SA 2012
## 157  SA12_406 INDPAC   IND    WEST_IND      SWI   SA 2012
## 158  SA12_407 INDPAC   IND    WEST_IND      SWI   SA 2012
## 159   SE06_01 INDPAC   IND    WEST_IND      WEI   SE 2006
## 160   SE06_02 INDPAC   IND    WEST_IND      WEI   SE 2006
## 161   SE06_04 INDPAC   IND    WEST_IND      WEI   SE 2006
## 162   SE06_06 INDPAC   IND    WEST_IND      WEI   SE 2006
## 163   SE06_07 INDPAC   IND    WEST_IND      WEI   SE 2006
## 164   SE06_13 INDPAC   IND    WEST_IND      WEI   SE 2006
## 165   SE06_14 INDPAC   IND    WEST_IND      WEI   SE 2006
## 166   SE06_15 INDPAC   IND    WEST_IND      WEI   SE 2006
## 167   SE06_17 INDPAC   IND    WEST_IND      WEI   SE 2006
## 168   SE06_23 INDPAC   IND    WEST_IND      WEI   SE 2006
## 169   SE06_31 INDPAC   IND    WEST_IND      WEI   SE 2006
## 170   SE06_32 INDPAC   IND    WEST_IND      WEI   SE 2006
## 171   SE06_34 INDPAC   IND    WEST_IND      WEI   SE 2006
## 172   SE06_44 INDPAC   IND    WEST_IND      WEI   SE 2006
## 173   SR05_11 INDPAC   IND    WEST_IND      WEI   RE 2005
## 174   SR05_12 INDPAC   IND    WEST_IND      WEI   RE 2005
## 175   SR05_13 INDPAC   IND    WEST_IND      WEI   RE 2005
## 176   SR05_14 INDPAC   IND    WEST_IND      WEI   RE 2005
## 177   SR05_15 INDPAC   IND    WEST_IND      WEI   RE 2005
## 178   SR05_19 INDPAC   IND    WEST_IND      WEI   RE 2005
## 179   SR05_20 INDPAC   IND    WEST_IND      WEI   RE 2005
## 180   SR05_21 INDPAC   IND    WEST_IND      WEI   RE 2005
## 181   SR05_22 INDPAC   IND    WEST_IND      WEI   RE 2005
## 182   SR05_23 INDPAC   IND    WEST_IND      WEI   RE 2005
## 183   TL07_20 INDPAC   IND    EAST_IND      EAI   TL 2007
## 184   TL07_23 INDPAC   IND    EAST_IND      EAI   TL 2007
## 185   TL07_28 INDPAC   IND    EAST_IND      EAI   TL 2007
## 186   TL07_31 INDPAC   IND    EAST_IND      EAI   TL 2007
## 187   TL07_32 INDPAC   IND    EAST_IND      EAI   TL 2007
## 188   TL07_33 INDPAC   IND    EAST_IND      EAI   TL 2007
## 189   TL07_35 INDPAC   IND    EAST_IND      EAI   TL 2007
## 190   TL07_38 INDPAC   IND    EAST_IND      EAI   TL 2007
## 191   TL07_44 INDPAC   IND    EAST_IND      EAI   TL 2007
## 192   TN06_06    MED   MED         MED      MED   TN 2006
## 193   TN06_08    MED   MED         MED      MED   TN 2006
## 194   TN06_21    MED   MED         MED      MED   TN 2006
## 195   TN06_24    MED   MED         MED      MED   TN 2006
## 196   TN06_26    MED   MED         MED      MED   TN 2006
## 197   TN06_28    MED   MED         MED      MED   TN 2006
## 198   TN06_32    MED   MED         MED      MED   TN 2006
## 199   TN06_35    MED   MED         MED      MED   TN 2006
## 200   TN06_38    MED   MED         MED      MED   TN 2006
## 201   TN06_42    MED   MED         MED      MED   TN 2006
## 202   TN06_46    MED   MED         MED      MED   TN 2006
## 203   TN06_48    MED   MED         MED      MED   TN 2006
## 204   TN06_50    MED   MED         MED      MED   TN 2006
```

```r
#Add strata to obj
strata(obj_mahi) <- mahiclass_strata
#Add hierarchechies
hier(obj_mahi) <- ~Basins/Ocean/Coast/Latitude/Site/Year
obj_mahi$hierarchy
```

```
## ~Basins/Ocean/Coast/Latitude/Site/Year
```

```r
obj_mahi
```

```
## /// GENIND OBJECT /////////
##
##  // 204 individuals; 8,159 loci; 15,493 alleles; size: 16.3 Mb
##
##  // Basic content
##    @tab:  204 x 15493 matrix of allele counts
##    @loc.n.all: number of alleles per locus (range: 1-4)
##    @loc.fac: locus factor for the 15493 columns of @tab
##    @all.names: list of allele names for each locus
##    @ploidy: ploidy of each individual  (range: 2-2)
##    @type:  codom
##    @call: read.genepop(file = file, ncode = 3)
##
##  // Optional content
##    @pop: population of each individual (group size range: 13-88)
##    @strata: a data frame with 7 columns ( X, Basins, Ocean, Coast, Latitude, Site, ... )
##    @hierarchy: ~Basins/Ocean/Coast/Latitude/Site/Year
```

Generating objects for each Ocean Basin

```r
obj_mahi$pop #visualizing names
```

```
##   [1] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [10] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [19] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [28] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [37] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [46] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [55] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [64] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [73] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21
##  [82] TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TT07_21 TX06_22 TX06_22
##  [91] TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22
## [100] TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22
## [109] TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22
## [118] TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22
## [127] TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22 TX06_22
## [136] TX06_22 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44
## [145] TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44
## [154] TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44
## [163] TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44
## [172] TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44
## [181] TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44 TL07_44
```

```
## [190] TL07_44 TL07_44 TN06_50 TN06_50 TN06_50 TN06_50 TN06_50 TN06_50 TN06_50
## [199] TN06_50 TN06_50 TN06_50 TN06_50 TN06_50 TN06_50
## Levels: TT07_21 TX06_22 TL07_44 TN06_50
```

```r
PAC <- popsub(obj_mahi, sublist=c("TT07_21"))
ATL <- popsub(obj_mahi, sublist=c("TX06_22"))
IND <- popsub(obj_mahi, sublist=c("TL07_44"))
MED <- popsub(obj_mahi, sublist=c("TN06_50"))
```

Diversity estimates

```r
mahi.smry <- summary(obj_mahi)
```

Global Hardy-Weinberg test, Barlett test, t test

This takes ~10 minutes

```r
hw <- hw.test(obj_mahi, B = 1000)
```

```r
barletttest.out <- bartlett.test(list(mahi.smry$Hexp, mahi.smry$Hobs)) # difference of means
barletttest.out
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  list(mahi.smry$Hexp, mahi.smry$Hobs)
## Bartlett's K-squared = 510.81, df = 1, p-value < 2.2e-16
```

```r
ttest.out <- t.test(mahi.smry$Hexp, mahi.smry$Hobs, paired=TRUE,var.equal=TRUE)
ttest.out
```

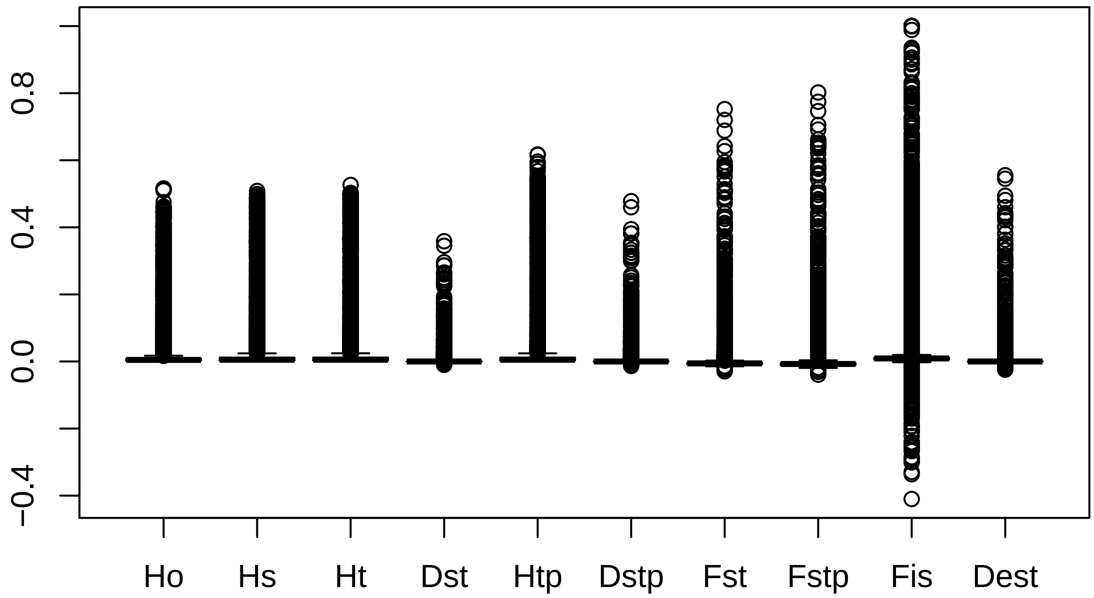
```
##
##  Paired t-test
##
## data:  mahi.smry$Hexp and mahi.smry$Hobs
## t = 21.314, df = 8158, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.005748358 0.006912816
## sample estimates:
## mean of the differences
##             0.006330587
```

Genetic differentiation

```r
#Converting and calculation basic stats per locus/population
obj_mahihier <- genind2hierfstat(obj_mahi)
Basic <- basic.stats(obj_mahihier,diploid=TRUE,digits=4)
Basic$overall
```

```
##     Ho     Hs     Ht    Dst    Htp   Dstp    Fst   Fstp    Fis   Dest
## 0.0209 0.0254 0.0280 0.0025 0.0288 0.0034 0.0907 0.1174 0.1783 0.0035
```

```
# Ho = Observed heterozygositis
# Hs = Observed gene diversities
# Ht = Overall gene diversity
# Dst = Ht - Hs (amount of gene diversity among samples)
# Dst' = np/(np-1)Dst
# Fst = Dst/Ht (not Nei's Gst)
# Fst' =  Dst'/Ht'
# Fis = 1- Ho/Hs
# Dest = Jost D (2008)
basic_mahiplot <- boxplot(Basic$perloc[,1:10], col=myColmahi)
```



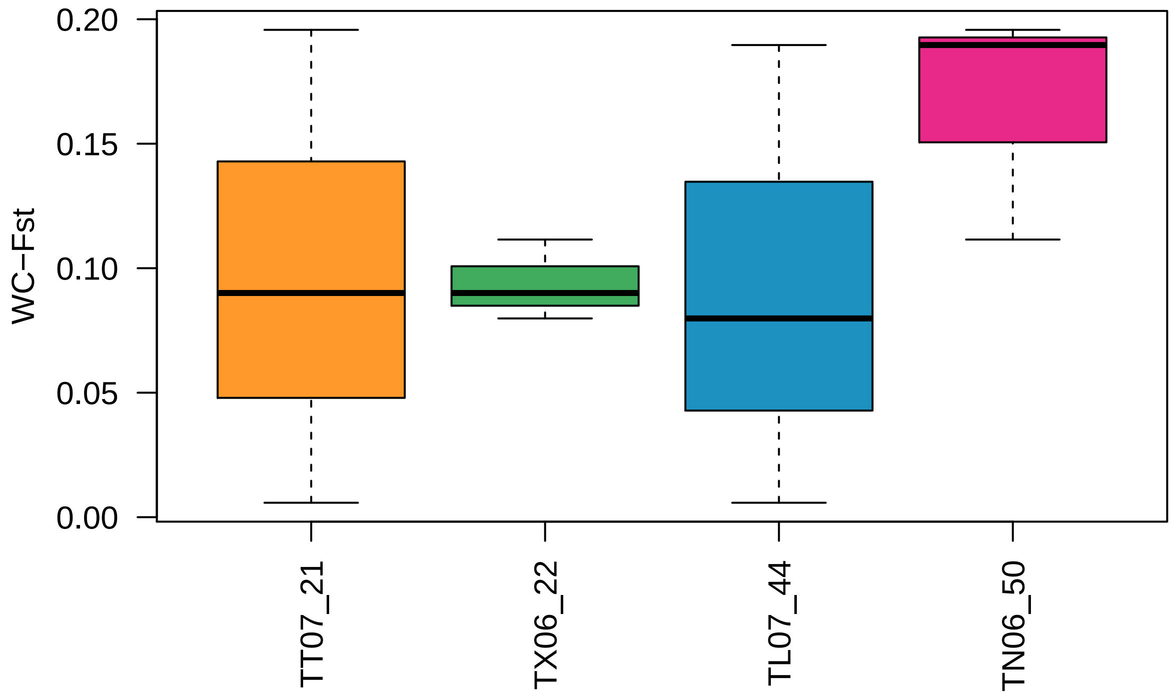
Weir & Cockerham pairwise Fst (Weir & Cockerham 1984)

The following function takes ~ 5 minutes to run.

```
matFstWC <- pairwise.WCfst(obj_mahihier,diploid=TRUE)
matFstWC
```

```
##             TT07_21    TX06_22     TL07_44   TN06_50
## TT07_21          NA 0.09004821 0.005796182 0.1957339
## TX06_22 0.090048208         NA 0.079830596 0.1115124
## TL07_44 0.005796182 0.07983060          NA 0.1896361
## TN06_50 0.195733852 0.11151238 0.189636086        NA
```

```
matFstWC2 <- matFstWC[-5,-5]
temp2 <- matFstWC2
WC <-boxplot(temp2, col=myColmahi, ylab="WC-Fst", las =2)
```



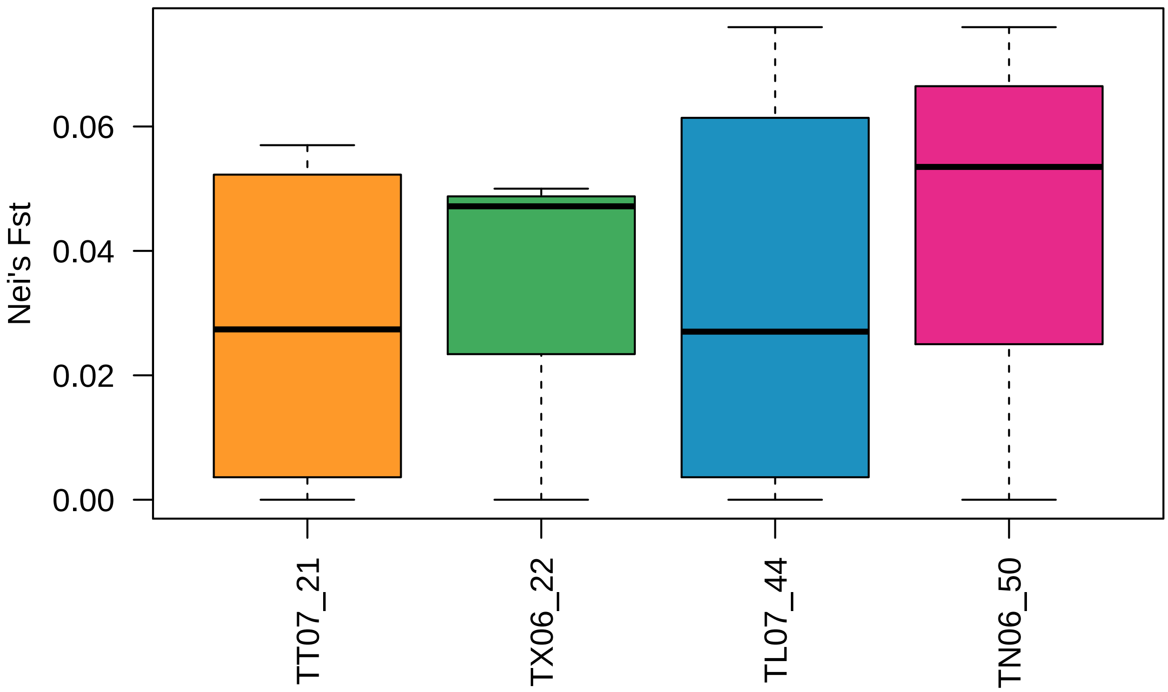
Nei's pairwise Fst (Nei 1987)

The following function takes ~ 5 minutes to run.

```
matFst <- pairwise.fst(obj_mahi,res.type="matrix") # Do not ruthis takes a couple of minutes
matFst
```

```
##             TT07_21    TX06_22     TL07_44    TN06_50
## TT07_21 0.000000000 0.04752891 0.007230564 0.05699694
## TX06_22 0.047528912 0.00000000 0.046810249 0.05000579
## TL07_44 0.007230564 0.04681025 0.000000000 0.07596739
## TN06_50 0.056996940 0.05000579 0.075967395 0.00000000
```

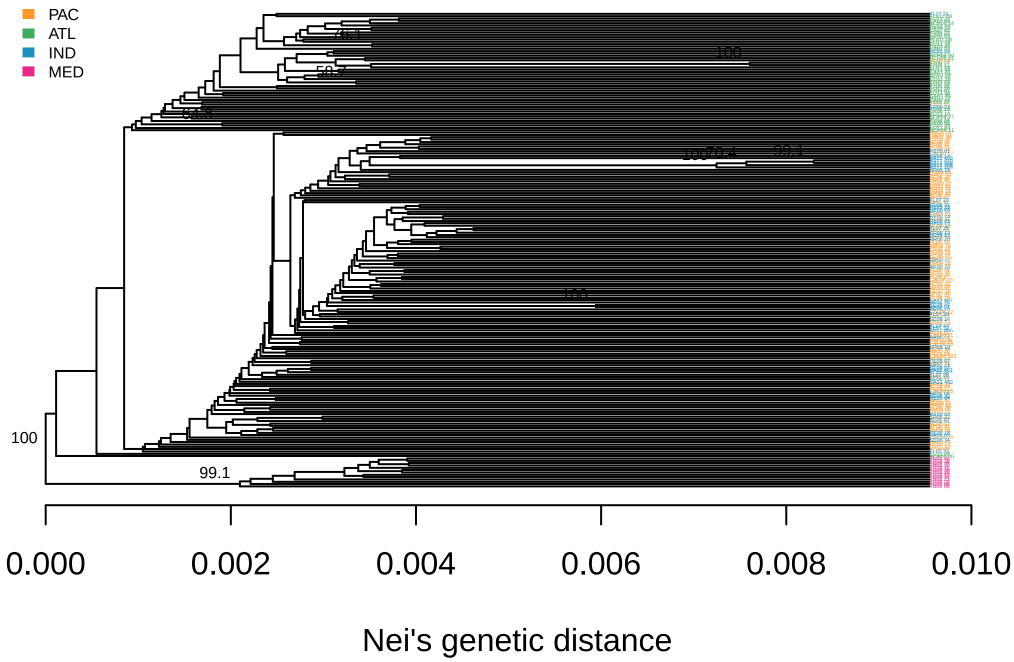
```
matFst_2 <- matFst[-5,-5]
temp <- matFst_2
Nei <- boxplot(temp, col=myColmahi, ylab="Nei's Fst", las = 2)
```



Plot Nei's tree

This function takes ~15 minutes to run.

```
library(RColorBrewer)
tree <- aboot(obj_mahi, tree = "upgma", distance = nei.dist, sample = 1000, showtree = F, cutoff = 50, c
cols <- brewer.pal(n = nPop(obj_mahi), name = "Paired")
plot.phylo(tree, cex = 0.2, font = 0.5, adj = 0, tip.color =  myColmahi[pop(obj_mahi)])
nodelabels(tree$node.label, adj = c(1.3, -0.5), frame = "n", cex = 0.5,font = 1, xpd = TRUE)
legend('topleft', legend = c("PAC", "ATL", "IND", "MED"), fill = myColmahi, border = FALSE, bty = "n", c
axis(side = 1)
title(xlab = " Nei's genetic distance")
```



AMOVA, groups are defined as Oceans and sampling sites

This piece of code takes ~ 6 minutes.

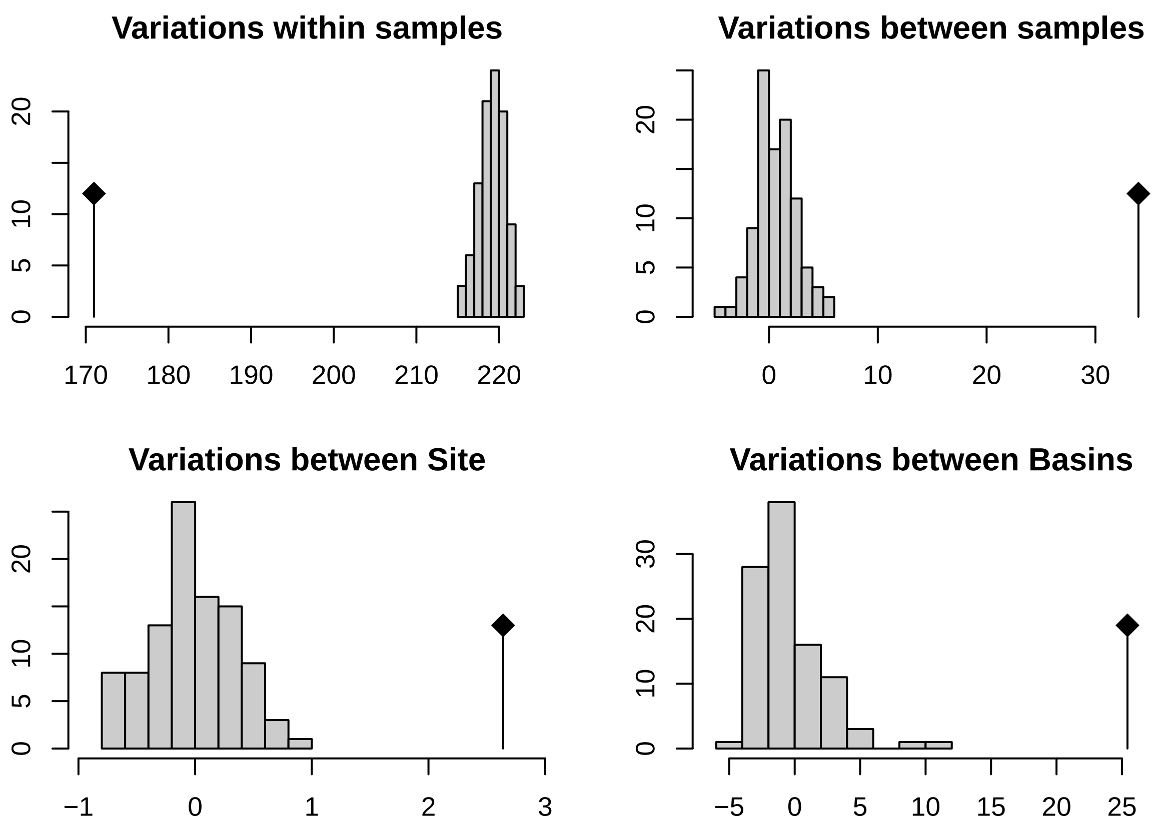
```
amova.result <- poppr.amova(obj_mahi, ~ Basins/Site, within = TRUE, missing = "geno", nperm = 1000, cut
```

```
##
## Found 149611 missing values.
##
## 12 genotypes contained missing values greater than 20%
##
## Removing 12 genotypes: CSL06_599, EC06_14, MZ04_17, PE06_06, PE06_26,
## PM04_22, TT07_21, SA12_401, SE06_04, SE06_17, TL07_28, TL07_32

## Distance matrix is non-euclidean.

## Using quasieuclid correction method. See ?quasieuclid for details.
```

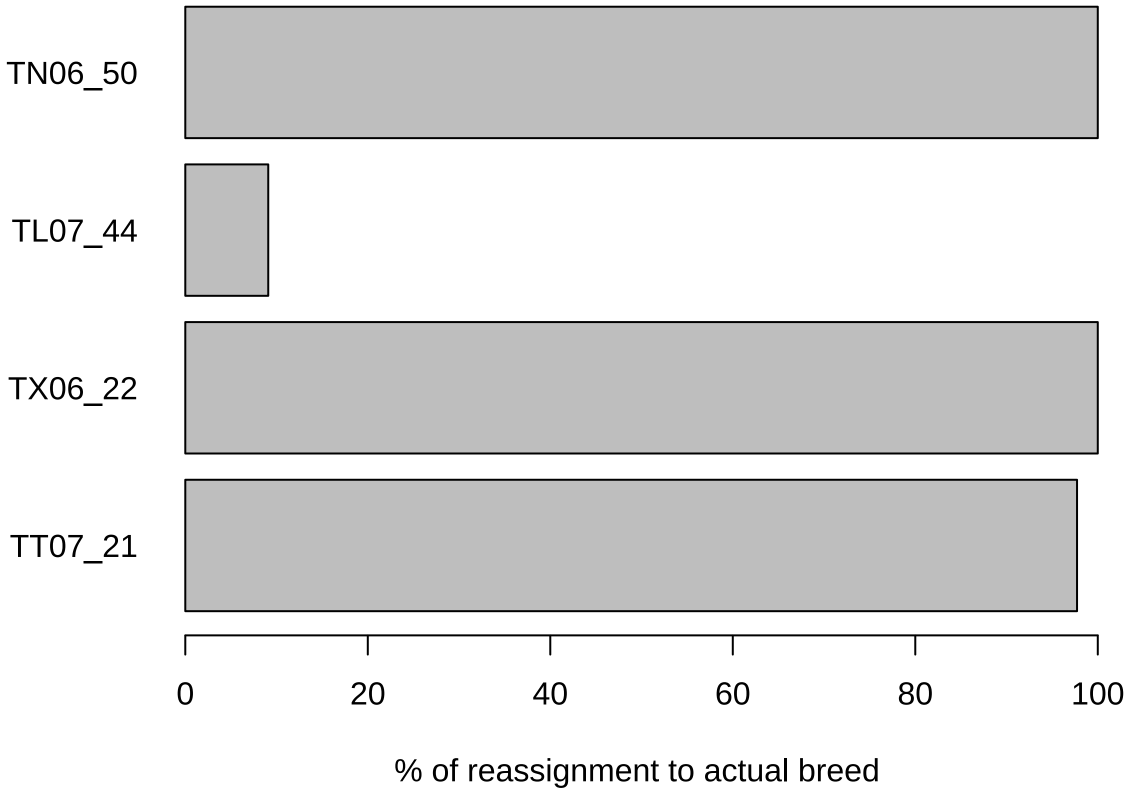
```
amova.test <- randtest(amova.result)
plot(amova.test)
```



Variance explained by dPCA

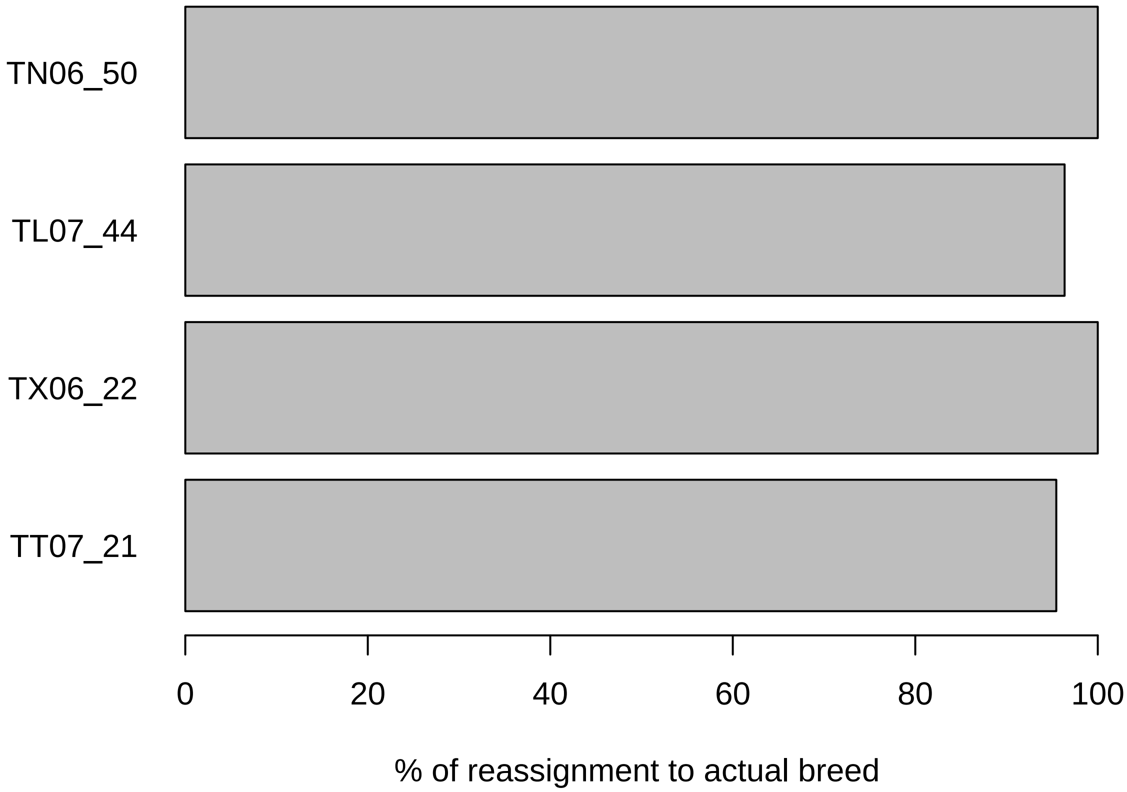
What happens if we only use the first 3 PCs?

```
temp <- summary(dapc(obj_mahi, n.da=100, n.pca=3))$assign.per.pop*100
par(mar=c(4.5,7.5,1,1))
barplot(temp, xlab="% of reassignment to actual breed",
        horiz=TRUE, las=1)
```



What if we use 100PCs?

```
temp <- summary(dapc(obj_mahi, n.da=100, n.pca=100))$assign.per.pop*100
par(mar=c(4.5,7.5,1,1))
barplot(temp, xlab="% of reassignment to actual breed", horiz=TRUE, las=1)
```



Estimating the alpha score: optimal number of PCs

```
dapc <- dapc(obj_mahi, n.da=100, n.pca=100)
temp <- a.score(dapc)
names(temp)
```

```
## [1] "tab"       "pop.score" "mean"
```

```
temp$tab[1:4,1:4]
```

```
##          TT07_21   TX06_22   TL07_44    TN06_50
## sim.1 0.07954545 0.3125000 0.1454545 0.30769231
## sim.2 0.06818182 0.2500000 0.2000000 0.00000000
## sim.3 0.04545455 0.1458333 0.1272727 0.15384615
## sim.4 0.06818182 0.2500000 0.1454545 0.07692308
```

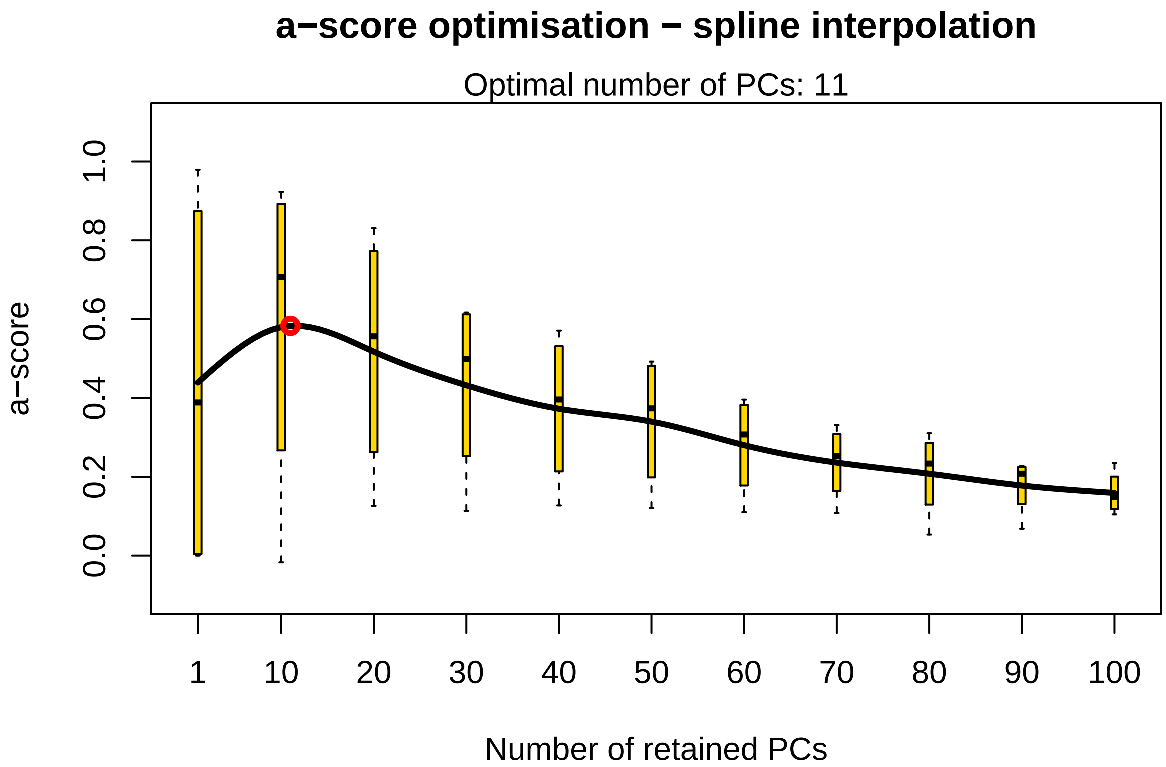
```
temp$pop.score
```

```
##    TT07_21    TX06_22    TL07_44    TN06_50
## 0.09886364 0.23958333 0.16000000 0.14615385
```

```
temp$mean
```

```
## [1] 0.1611502
```

```
temp <- optim.a.score(dapc)
```



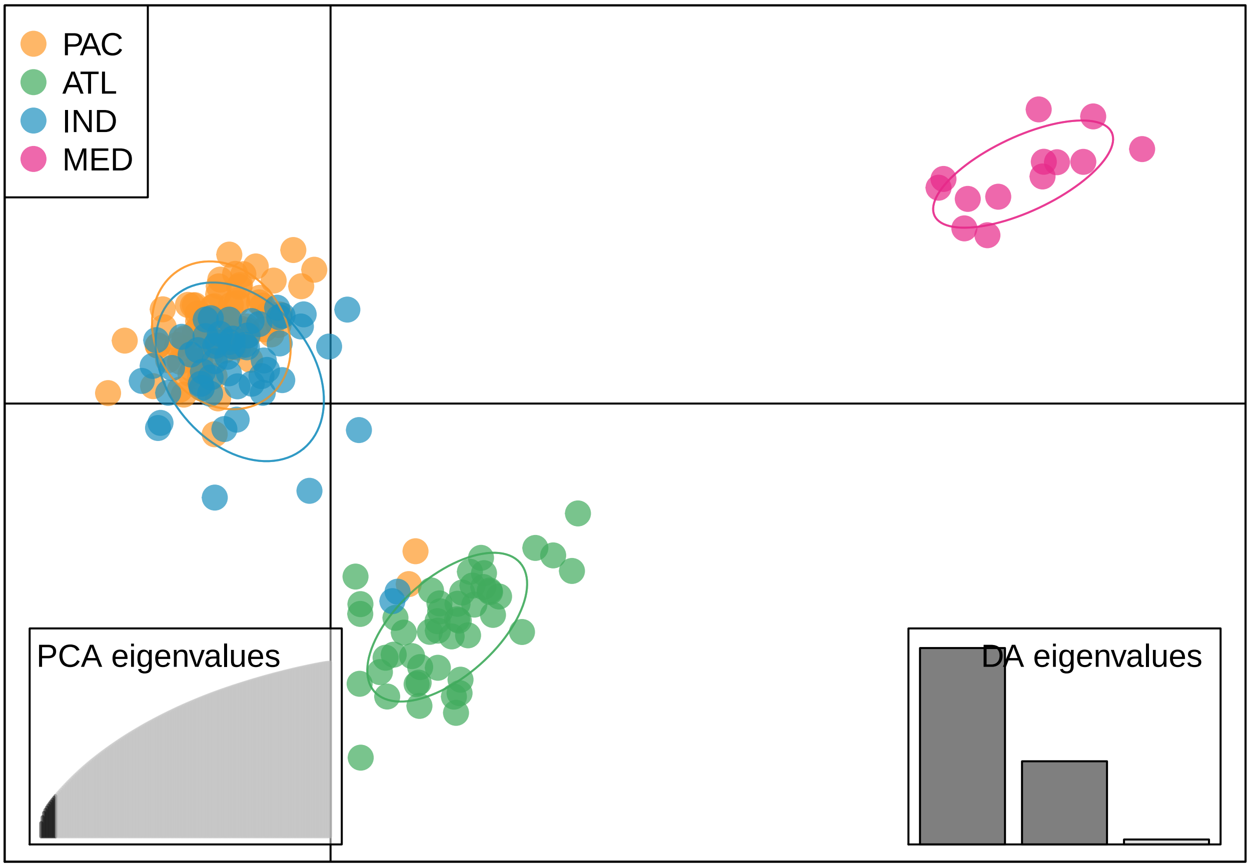
Using the optimal number of principal components

```
dapc <- dapc(obj_mahi, n.da=100, n.pca=11)
dapc
```

```
##  #################################################
##  # Discriminant Analysis of Principal Components #
##  #################################################
## class: dapc
## $call: dapc.genind(x = obj_mahi, n.pca = 11, n.da = 100)
##
## $n.pca: 11 first PCs of PCA used
## $n.da: 3 discriminant functions saved
## $var (proportion of conserved variance): 0.232
##
## $eig (eigenvalues): 1028 435.3 25.89  vector    length content
## 1 $eig      3      eigenvalues
## 2 $grp      204    prior group assignment
## 3 $prior    4      prior group probabilities
## 4 $assign   204    posterior group assignment
## 5 $pca.cent 15493  centring vector of PCA
## 6 $pca.norm 15493  scaling vector of PCA
## 7 $pca.eig  203    eigenvalues of PCA
##
##   data.frame    nrow  ncol content
## 1 $tab          204   11   retained PCs of PCA
## 2 $means        4     11   group means
## 3 $loadings     11    3    loadings of variables
```

```
## 4 $ind.coord    204   3    coordinates of individuals (principal components)
## 5 $grp.coord    4     3    coordinates of groups
## 6 $posterior    204   4    posterior membership probabilities
## 7 $pca.loadings 15493 11   PCA loadings of original variables
## 8 $var.contr    15493 3    contribution of original variables
```

```r
scatter(dapc, col=myColmahi,pch=20, cex=2.5, cstar = 0, clab=0,
        txt.leg = c("PAC", "ATL", "IND", "MED"), scree.pca = TRUE,
        csub = 0.2, add=TRUE, posi.pca = "bottom", legend = TRUE, posi.leg = "topleft")
```



Graphing posterior probabilities of assignment for each individual

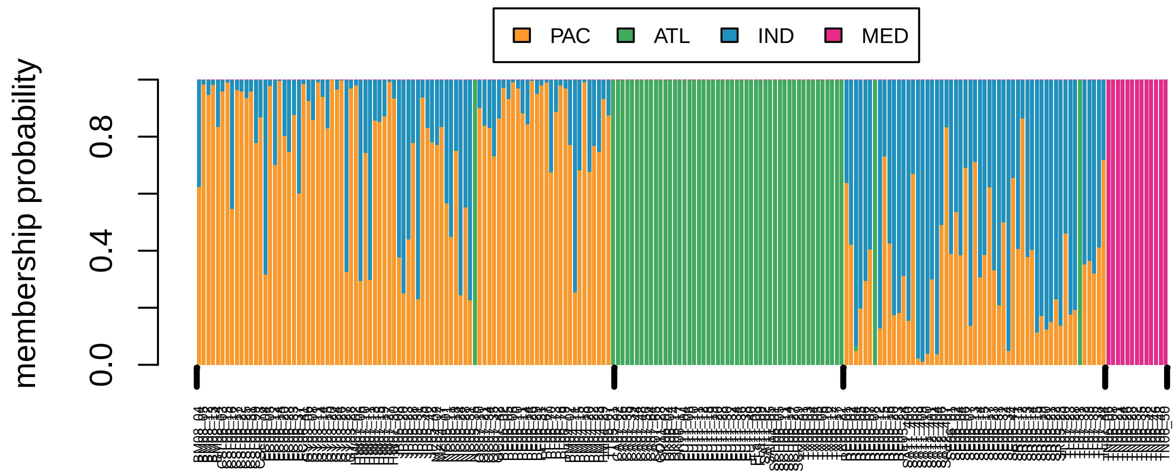
```r
par(mar=c(3.0,4.1,12,1.1), xpd=TRUE)
compoplot(dapc, posi=list(x=75,y=1.25), cleg=.7, col=myColmahi, txt.leg = c("PAC", "ATL", "IND", "MED")
axis(1,at=0.5,labels="BM08_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=1.7,labels="BM08_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=2.9,labels="BM08_12",las=2,tick=F,cex.axis=0.38)
axis(1,at=4.1,labels="BM08_13",las=2,tick=F,cex.axis=0.38)
axis(1,at=5.3,labels="BM08_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=6.5,labels="CSL06_03",las=2,tick=F,cex.axis=0.38)
axis(1,at=7.7,labels="CSL06_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=8.9,labels="CSL06_16",las=2,tick=F,cex.axis=0.38)
axis(1,at=10.1,labels="CSL06_17",las=2,tick=F,cex.axis=0.38)
axis(1,at=11.3,labels="CSL06_22",las=2,tick=F,cex.axis=0.38)
axis(1,at=12.5,labels="CSL06_25",las=2,tick=F,cex.axis=0.38)
```

```
axis(1,at=13.7,labels="CSL06_31",las=2,tick=F,cex.axis=0.38)
axis(1,at=14.9,labels="CSL06_99",las=2,tick=F,cex.axis=0.38)
axis(1,at=16.1,labels="CSL06_78",las=2,tick=F,cex.axis=0.38)
axis(1,at=17.3,labels="EC06_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=18.5,labels="EC06_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=19.7,labels="EC06_12",las=2,tick=F,cex.axis=0.38)
axis(1,at=20.9,labels="EC06_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=22.1,labels="EC06_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=23.3,labels="EC06_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=24.5,labels="EC06_33",las=2,tick=F,cex.axis=0.38)
axis(1,at=25.7,labels="EC06_37",las=2,tick=F,cex.axis=0.38)
axis(1,at=26.9,labels="EC06_41",las=2,tick=F,cex.axis=0.38)
axis(1,at=28.1,labels="GY03_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=29.3,labels="GY03_08",las=2,tick=F,cex.axis=0.38)
axis(1,at=30.5,labels="GY03_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=31.7,labels="GY03_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=32.9,labels="GY03_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=34.1,labels="GY03_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=35.3,labels="GY03_24",las=2,tick=F,cex.axis=0.38)
axis(1,at=36.5,labels="GY03_26",las=2,tick=F,cex.axis=0.38)
axis(1,at=37.7,labels="GY03_27",las=2,tick=F,cex.axis=0.38)
axis(1,at=38.9,labels="GY03_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=40.1,labels="HW07_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=41.3,labels="HW07_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=42.5,labels="HW07_10",las=2,tick=F,cex.axis=0.38)
axis(1,at=43.7,labels="HW07_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=44.9,labels="HW07_13",las=2,tick=F,cex.axis=0.38)
axis(1,at=46.1,labels="HW07_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=47.3,labels="HW07_19",las=2,tick=F,cex.axis=0.38)
axis(1,at=48.5,labels="HW07_27",las=2,tick=F,cex.axis=0.38)
axis(1,at=49.7,labels="HW07_30",las=2,tick=F,cex.axis=0.38)
axis(1,at=50.9,labels="JP05_08",las=2,tick=F,cex.axis=0.38)
axis(1,at=52.1,labels="JP05_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=53.3,labels="JP05_23",las=2,tick=F,cex.axis=0.38)
axis(1,at=54.5,labels="JP05_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=55.7,labels="JP05_31",las=2,tick=F,cex.axis=0.38)
axis(1,at=56.9,labels="JP05_35",las=2,tick=F,cex.axis=0.38)
axis(1,at=58.1,labels="JP05_40",las=2,tick=F,cex.axis=0.38)
axis(1,at=59.3,labels="JP05_42",las=2,tick=F,cex.axis=0.38)
axis(1,at=60.5,labels="MZ04_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=61.7,labels="MZ04_17",las=2,tick=F,cex.axis=0.38)
axis(1,at=62.9,labels="NC05_01",las=2,tick=F,cex.axis=0.38)
axis(1,at=64.1,labels="NC05_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=65.3,labels="NC05_18",las=2,tick=F,cex.axis=0.38)
axis(1,at=66.5,labels="NC05_24",las=2,tick=F,cex.axis=0.38)
axis(1,at=67.7,labels="NC05_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=68.9,labels="NC05_31",las=2,tick=F,cex.axis=0.38)
axis(1,at=70.1,labels="NC05_36",las=2,tick=F,cex.axis=0.38)
axis(1,at=71.3,labels="OC07_10",las=2,tick=F,cex.axis=0.38)
axis(1,at=72.5,labels="OC07_21",las=2,tick=F,cex.axis=0.38)
axis(1,at=73.7,labels="OC07_34",las=2,tick=F,cex.axis=0.38)
axis(1,at=74.9,labels="OC07_35",las=2,tick=F,cex.axis=0.38)
axis(1,at=76.1,labels="OC07_42",las=2,tick=F,cex.axis=0.38)
```

```
axis(1,at=77.3,labels="PE06_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=78.5,labels="PE06_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=79.7,labels="PE06_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=80.9,labels="PE06_10",las=2,tick=F,cex.axis=0.38)
axis(1,at=82.1,labels="PE06_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=83.3,labels="PE06_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=84.5,labels="PE06_26",las=2,tick=F,cex.axis=0.38)
axis(1,at=85.7,labels="PE06_29",las=2,tick=F,cex.axis=0.38)
axis(1,at=86.9,labels="PE06_31",las=2,tick=F,cex.axis=0.38)
axis(1,at=88.1,labels="PL06_67",las=2,tick=F,cex.axis=0.38)
axis(1,at=89.3,labels="PL06_70",las=2,tick=F,cex.axis=0.38)
axis(1,at=90.5,labels="PL06_73",las=2,tick=F,cex.axis=0.38)
axis(1,at=91.7,labels="PL06_76",las=2,tick=F,cex.axis=0.38)
axis(1,at=92.9,labels="PL06_79",las=2,tick=F,cex.axis=0.38)
axis(1,at=94.1,labels="PM04_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=95.3,labels="PM04_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=96.5,labels="PM04_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=97.7,labels="PM04_18",las=2,tick=F,cex.axis=0.38)
axis(1,at=98.9,labels="PM04_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=100.1,labels="PM04_22",las=2,tick=F,cex.axis=0.38)
axis(1,at=101.3,labels="PM04_23",las=2,tick=F,cex.axis=0.38)
axis(1,at=102.5,labels="PM04_29",las=2,tick=F,cex.axis=0.38)
axis(1,at=103.7,labels="TT05_07",las=2,tick=F,cex.axis=0.38)
axis(1,at=104.9,labels="TT05_21",las=2,tick=F,cex.axis=0.38)
axis(1,at=106.1,labels="CA07_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=107.3,labels="CA07_26",las=2,tick=F,cex.axis=0.38)
axis(1,at=108.5,labels="CA07_35",las=2,tick=F,cex.axis=0.38)
axis(1,at=109.7,labels="CA07_39",las=2,tick=F,cex.axis=0.38)
axis(1,at=110.9,labels="CA07_44",las=2,tick=F,cex.axis=0.38)
axis(1,at=112.1,labels="CA07_48",las=2,tick=F,cex.axis=0.38)
axis(1,at=113.3,labels="CA07_56",las=2,tick=F,cex.axis=0.38)
axis(1,at=114.5,labels="CA07_64",las=2,tick=F,cex.axis=0.38)
axis(1,at=115.7,labels="CA07_65",las=2,tick=F,cex.axis=0.38)
axis(1,at=116.9,labels="CO11_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=118.1,labels="DK06_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=119.3,labels="DK06_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=120.5,labels="DK06_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=121.7,labels="DK06_17",las=2,tick=F,cex.axis=0.38)
axis(1,at=122.9,labels="EU11_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=124.1,labels="EU11_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=125.3,labels="EU11_10",las=2,tick=F,cex.axis=0.38)
axis(1,at=126.5,labels="EU11_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=127.7,labels="EU11_12",las=2,tick=F,cex.axis=0.38)
axis(1,at=128.9,labels="EU11_18",las=2,tick=F,cex.axis=0.38)
axis(1,at=130.1,labels="EU11_19",las=2,tick=F,cex.axis=0.38)
axis(1,at=131.3,labels="EU11_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=132.5,labels="EU11_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=133.7,labels="EU11_30",las=2,tick=F,cex.axis=0.38)
axis(1,at=134.9,labels="EU11_32",las=2,tick=F,cex.axis=0.38)
axis(1,at=136.1,labels="EU11_34",las=2,tick=F,cex.axis=0.38)
axis(1,at=137.3,labels="EU11_36",las=2,tick=F,cex.axis=0.38)
axis(1,at=138.5,labels="EU11_38",las=2,tick=F,cex.axis=0.38)
axis(1,at=139.7,labels="EU11_40",las=2,tick=F,cex.axis=0.38)
```

```
axis(1,at=140.9,labels="FLa11_08",las=2,tick=F,cex.axis=0.38)
axis(1,at=142.1,labels="FLa11_09",las=2,tick=F,cex.axis=0.38)
axis(1,at=143.3,labels="SAI11_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=144.5,labels="SAI11_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=145.7,labels="SCH06_01",las=2,tick=F,cex.axis=0.38)
axis(1,at=146.9,labels="SCH06_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=148.1,labels="SCH06_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=149.3,labels="SCH06_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=150.5,labels="SCH06_27",las=2,tick=F,cex.axis=0.38)
axis(1,at=151.7,labels="SCH06_29",las=2,tick=F,cex.axis=0.38)
axis(1,at=152.9,labels="TX06_01",las=2,tick=F,cex.axis=0.38)
axis(1,at=154.1,labels="TX06_03",las=2,tick=F,cex.axis=0.38)
axis(1,at=155.3,labels="TX06_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=156.5,labels="TX06_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=157.7,labels="TX06_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=158.9,labels="TX06_10",las=2,tick=F,cex.axis=0.38)
axis(1,at=160.1,labels="TX06_12",las=2,tick=F,cex.axis=0.38)
axis(1,at=161.3,labels="TX06_17",las=2,tick=F,cex.axis=0.38)
axis(1,at=162.5,labels="TX06_22",las=2,tick=F,cex.axis=0.38)
axis(1,at=163.7,labels="RE05_01",las=2,tick=F,cex.axis=0.38)
axis(1,at=164.9,labels="RE05_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=166.1,labels="RE05_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=167.3,labels="RE05_05",las=2,tick=F,cex.axis=0.38)
axis(1,at=168.5,labels="RE05_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=169.7,labels="RE05_07",las=2,tick=F,cex.axis=0.38)
axis(1,at=170.9,labels="RE05_08",las=2,tick=F,cex.axis=0.38)
axis(1,at=172.1,labels="RE05_12",las=2,tick=F,cex.axis=0.38)
axis(1,at=173.3,labels="RE05_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=174.5,labels="RE05_16",las=2,tick=F,cex.axis=0.38)
axis(1,at=175.7,labels="RE05_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=176.9,labels="RE05_23",las=2,tick=F,cex.axis=0.38)
axis(1,at=178.1,labels="RE05_24",las=2,tick=F,cex.axis=0.38)
axis(1,at=179.3,labels="SA11_400",las=2,tick=F,cex.axis=0.38)
axis(1,at=180.5,labels="SA11_403",las=2,tick=F,cex.axis=0.38)
axis(1,at=181.7,labels="SA11_408",las=2,tick=F,cex.axis=0.38)
axis(1,at=182.9,labels="SA11_409",las=2,tick=F,cex.axis=0.38)
axis(1,at=184.1,labels="SA11_410",las=2,tick=F,cex.axis=0.38)
axis(1,at=185.3,labels="SA12_401",las=2,tick=F,cex.axis=0.38)
axis(1,at=186.5,labels="SA12_404",las=2,tick=F,cex.axis=0.38)
axis(1,at=187.7,labels="SA12_406",las=2,tick=F,cex.axis=0.38)
axis(1,at=188.9,labels="SA12_407",las=2,tick=F,cex.axis=0.38)
axis(1,at=190.1,labels="SE06_01",las=2,tick=F,cex.axis=0.38)
axis(1,at=191.3,labels="SE06_02",las=2,tick=F,cex.axis=0.38)
axis(1,at=192.5,labels="SE06_04",las=2,tick=F,cex.axis=0.38)
axis(1,at=193.7,labels="SE06_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=194.9,labels="SE06_07",las=2,tick=F,cex.axis=0.38)
axis(1,at=196.1,labels="SE06_13",las=2,tick=F,cex.axis=0.38)
axis(1,at=197.3,labels="SE06_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=198.5,labels="SE06_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=199.7,labels="SE06_17",las=2,tick=F,cex.axis=0.38)
axis(1,at=200.9,labels="SE06_23",las=2,tick=F,cex.axis=0.38)
axis(1,at=202.1,labels="SE06_31",las=2,tick=F,cex.axis=0.38)
axis(1,at=203.3,labels="SE06_32",las=2,tick=F,cex.axis=0.38)
```

```r
axis(1,at=204.5,labels="SE06_34",las=2,tick=F,cex.axis=0.38)
axis(1,at=205.7,labels="SE06_44",las=2,tick=F,cex.axis=0.38)
axis(1,at=206.9,labels="SR05_11",las=2,tick=F,cex.axis=0.38)
axis(1,at=208.1,labels="SR05_12",las=2,tick=F,cex.axis=0.38)
axis(1,at=209.3,labels="SR05_13",las=2,tick=F,cex.axis=0.38)
axis(1,at=210.5,labels="SR05_14",las=2,tick=F,cex.axis=0.38)
axis(1,at=211.7,labels="SR05_15",las=2,tick=F,cex.axis=0.38)
axis(1,at=212.9,labels="SR05_19",las=2,tick=F,cex.axis=0.38)
axis(1,at=214.1,labels="SR05_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=215.3,labels="SR05_21",las=2,tick=F,cex.axis=0.38)
axis(1,at=216.5,labels="SR05_22",las=2,tick=F,cex.axis=0.38)
axis(1,at=217.7,labels="SR05_23",las=2,tick=F,cex.axis=0.38)
axis(1,at=218.9,labels="TL07_20",las=2,tick=F,cex.axis=0.38)
axis(1,at=220.1,labels="TL07_23",las=2,tick=F,cex.axis=0.38)
axis(1,at=221.3,labels="TL07_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=222.5,labels="TL07_31",las=2,tick=F,cex.axis=0.38)
axis(1,at=223.7,labels="TL07_32",las=2,tick=F,cex.axis=0.38)
axis(1,at=224.9,labels="TL07_33",las=2,tick=F,cex.axis=0.38)
axis(1,at=226.1,labels="TL07_35",las=2,tick=F,cex.axis=0.38)
axis(1,at=227.3,labels="TL07_38",las=2,tick=F,cex.axis=0.38)
axis(1,at=228.5,labels="TL07_44",las=2,tick=F,cex.axis=0.38)
axis(1,at=229.7,labels="TN06_06",las=2,tick=F,cex.axis=0.38)
axis(1,at=230.9,labels="TN06_08",las=2,tick=F,cex.axis=0.38)
axis(1,at=232.1,labels="TN06_21",las=2,tick=F,cex.axis=0.38)
axis(1,at=233.3,labels="TN06_24",las=2,tick=F,cex.axis=0.38)
axis(1,at=234.5,labels="TN06_26",las=2,tick=F,cex.axis=0.38)
axis(1,at=235.7,labels="TN06_28",las=2,tick=F,cex.axis=0.38)
axis(1,at=236.9,labels="TN06_32",las=2,tick=F,cex.axis=0.38)
axis(1,at=238.1,labels="TN06_35",las=2,tick=F,cex.axis=0.38)
axis(1,at=239.3,labels="TN06_38",las=2,tick=F,cex.axis=0.38)
axis(1,at=240.5,labels="TN06_42",las=2,tick=F,cex.axis=0.38)
axis(1,at=241.7,labels="TN06_46",las=2,tick=F,cex.axis=0.38)
axis(1,at=242.9,labels="TN06_48",las=2,tick=F,cex.axis=0.38)
axis(1,at=244.1,labels="TN06_50",las=2,tick=F,cex.axis=0.38)
axis(1, at= 0.2, labels=F, lwd=3, lwd.ticks = 3)
axis(1, at= 105.4, labels=F, lwd=3, lwd.ticks = 3)
axis(1, at= 163.1, labels=F, lwd=3, lwd.ticks = 3)
axis(1, at= 229.1, labels=F, lwd=3, lwd.ticks = 3)
axis(1, at= 244.7, labels=F, lwd=3, lwd.ticks = 3)
```



Mantel Test for all sample sites

Importing coordinates

```
setPop(obj_mahi) <- ~Site
# Adding coordinates to our genind object
mahi_coords <- read.table("~/Documents/Genetic_Diversity/Practice/Dolphinfish_data/mahi_coordinates.csv
mahi_coords
```

```
##         x       y
## 1   24.58 -112.00
## 2   22.84 -109.95
## 3   -1.06  -81.18
## 4   27.77 -110.91
## 5   20.15 -156.43
## 6   35.45  141.24
## 7   23.22 -106.55
## 8  -21.26  166.75
## 9   15.74 -104.32
## 10 -14.07  -76.99
## 11  28.87 -114.44
## 12  14.59  -92.39
## 13 -17.18 -149.46
## 14  19.40  -87.40
## 15  11.52  -74.25
## 16  14.73  -17.72
## 17  28.22  -79.86
## 18  21.02  -97.10
## 19 -20.37   55.57
## 20 -34.51   18.62
## 21  -4.86   55.49
## 22  11.99  100.75
## 23  37.28   11.21
```

```
rownames(mahi_coords) <- c("BM","CSL","EC","GY","HW","JP","MZ","NC","OC","PE","PL","PM","TT","CA","CO",
mahi_coords
```

```
##           x       y
```

```
## BM   24.58 -112.00
## CSL  22.84 -109.95
## EC   -1.06  -81.18
## GY   27.77 -110.91
## HW   20.15 -156.43
## JP   35.45  141.24
## MZ   23.22 -106.55
## NC  -21.26  166.75
## OC   15.74 -104.32
## PE  -14.07  -76.99
## PL   28.87 -114.44
## PM   14.59  -92.39
## TT  -17.18 -149.46
## CA   19.40  -87.40
## CO   11.52  -74.25
## DK   14.73  -17.72
## US   28.22  -79.86
## TX   21.02  -97.10
## RE  -20.37   55.57
## SA  -34.51   18.62
## SE   -4.86   55.49
## TL   11.99  100.75
## TN   37.28   11.21
```

```r
other(obj_mahi) <- mahi_coords
obj_mahi$other
```

```
## [[1]]
##          x       y
## BM   24.58 -112.00
## CSL  22.84 -109.95
## EC   -1.06  -81.18
## GY   27.77 -110.91
## HW   20.15 -156.43
## JP   35.45  141.24
## MZ   23.22 -106.55
## NC  -21.26  166.75
## OC   15.74 -104.32
## PE  -14.07  -76.99
## PL   28.87 -114.44
## PM   14.59  -92.39
## TT  -17.18 -149.46
## CA   19.40  -87.40
## CO   11.52  -74.25
## DK   14.73  -17.72
## US   28.22  -79.86
## TX   21.02  -97.10
## RE  -20.37   55.57
## SA  -34.51   18.62
## SE   -4.86   55.49
## TL   11.99  100.75
## TN   37.28   11.21
```

Defining geneetic and geographic distances and running the Mantel Test

```
obj_mahi$pop
```

```
##   [1] BM  BM  BM  BM  BM  CSL CSL CSL CSL CSL CSL CSL CSL CSL EC  EC  EC  EC 
##  [19] EC  EC  EC  EC  EC  GY  GY  GY  GY  GY  GY  GY  GY  GY  GY  HW  HW  HW 
##  [37] HW  HW  HW  HW  HW  HW  JP  JP  JP  JP  JP  JP  JP  JP  MZ  MZ  NC  NC 
##  [55] NC  NC  NC  NC  NC  OC  OC  OC  OC  OC  PE  PE  PE  PE  PE  PE  PE  PE 
##  [73] PE  PL  PL  PL  PL  PL  PM  PM  PM  PM  PM  PM  PM  PM  TT  TT  CA  CA 
##  [91] CA  CA  CA  CA  CA  CA  CA  CO  DK  DK  DK  DK  US  US  US  US  US  US 
## [109] US  US  US  US  US  US  US  US  US  US  US  CO  CO  DK  DK  DK  DK  DK 
## [127] DK  TX  TX  TX  TX  TX  TX  TX  TX  TX  RE  RE  RE  RE  RE  RE  RE  RE 
## [145] RE  RE  RE  RE  RE  SA  SA  SA  SA  SA  SA  SA  SA  SA  SE  SE  SE  SE 
## [163] SE  SE  SE  SE  SE  SE  SE  SE  SE  SE  RE  RE  RE  RE  RE  RE  RE  RE 
## [181] RE  RE  TL  TL  TL  TL  TL  TL  TL  TL  TL  TN  TN  TN  TN  TN  TN  TN 
## [199] TN  TN  TN  TN  TN  TN 
## 23 Levels: BM CSL EC GY HW JP MZ NC OC PE PL PM TT CA CO DK US TX RE SA ... TN
```

```
mahi_gp <- genind2genpop(obj_mahi)
```

```
## 
##  Converting data from a genind to a genpop object... 
## 
## ...done.
```

```
mahi_gp
```

```
## /// GENPOP OBJECT /////////
## 
##  // 23 populations; 8,159 loci; 15,493 alleles; size: 5.6 Mb
## 
##  // Basic content
##    @tab:  23 x 15493 matrix of allele counts
##    @loc.n.all: number of alleles per locus (range: 1-4)
##    @loc.fac: locus factor for the 15493 columns of @tab
##    @all.names: list of allele names for each locus
##    @ploidy: ploidy of each individual  (range: 2-2)
##    @type:  codom
##    @call: genind2genpop(x = obj_mahi)
## 
##  // Optional content
##    @other: a list containing: elements without names
```

```
Dgen <- dist.genpop(mahi_gp, method =2)
Dgeo <- dist(mahi_coords)
ibd <- mantel.randtest(Dgen, Dgeo)
ibd
```

```
## Monte-Carlo test
## Call: mantel.randtest(m1 = Dgen, m2 = Dgeo) 
## 
## Observation: -0.1287036 
## 
## Based on 999 replicates
## Simulated p-value: 0.806 
## Alternative hypothesis: greater
```

```
##
##      Std.Obs  Expectation     Variance
## -0.907903678 -0.001890612  0.019509568
```

```r
plot(ibd)
```