

# Package ‘sitePath’

August 9, 2025

**Type** Package

**Title** Phylogeny-based sequence clustering with site polymorphism

**Version** 1.25.0

**Description** Using site polymorphism is one of the ways to cluster DNA/protein sequences but it is possible for the sequences with the same polymorphism on a single site to be genetically distant. This package is aimed at clustering sequences using site polymorphism and their corresponding phylogenetic trees. By considering their location on the tree, only the structurally adjacent sequences will be clustered. However, the adjacent sequences may not necessarily have the same polymorphism. So a branch-and-bound like algorithm is used to minimize the entropy representing the purity of site polymorphism of each cluster.

**License** MIT + file LICENSE

**Depends** R (>= 4.1)

**Imports** RColorBrewer, Rcpp, ape, aplot, ggplot2, ggrepel, ggtree, graphics, grDevices, gridExtra, methods, parallel, seqinr, stats, tidytree, utils

**Suggests** BiocStyle, devtools, knitr, magick, rmarkdown, testthat

**LinkingTo** Rcpp

**RoxygenNote** 7.1.2

**Encoding** UTF-8

**VignetteBuilder** knitr

**URL** <https://wuaipinglab.github.io/sitePath/>

**BugReports** <https://github.com/wuaipinglab/sitePath/issues>

**biocViews** Alignment, MultipleSequenceAlignment, Phylogenetics, SNP, Software

**git\_url** <https://git.bioconductor.org/packages/sitePath>

**git\_branch** devel

**git\_last\_commit** dc3e9e7

**git\_last\_commit\_date** 2025-04-15

**Repository** Bioconductor 3.22

**Date/Publication** 2025-08-08

**Author** Chengyang Ji [aut, cre, cph] (ORCID:  
<https://orcid.org/0000-0001-9258-5453>),  
 Hangyu Zhou [ths],  
 Aiping Wu [ths]

**Maintainer** Chengyang Ji <chengyang.ji12@alumni.xjtlu.edu.cn>

## Contents

|                                       |           |
|---------------------------------------|-----------|
| allSitesName . . . . .                | 2         |
| as.data.frame.fixationSites . . . . . | 3         |
| extractSite . . . . .                 | 4         |
| extractTips . . . . .                 | 5         |
| fixationIndels . . . . .              | 6         |
| fixationPath . . . . .                | 7         |
| fixationSites . . . . .               | 7         |
| groupTips . . . . .                   | 9         |
| h3n2_align . . . . .                  | 10        |
| h3n2_tree . . . . .                   | 10        |
| lineagePath . . . . .                 | 11        |
| paraFixSites . . . . .                | 13        |
| parallelSites . . . . .               | 14        |
| phyMSAmatched . . . . .               | 16        |
| plot.phyMSAmatched . . . . .          | 17        |
| plotFixationSites . . . . .           | 18        |
| plotMutSites . . . . .                | 19        |
| plotParallelSites . . . . .           | 20        |
| plotSingleSite . . . . .              | 21        |
| reexports . . . . .                   | 22        |
| sars2_align . . . . .                 | 23        |
| sars2_tree . . . . .                  | 23        |
| setSiteNumbering . . . . .            | 23        |
| similarityMatrix . . . . .            | 24        |
| sitePath-deprecated . . . . .         | 25        |
| sitesMinEntropy . . . . .             | 25        |
| SNPsites . . . . .                    | 26        |
| zikv_align . . . . .                  | 27        |
| zikv_tree . . . . .                   | 27        |
| <b>Index</b>                          | <b>28</b> |

---

|              |                                           |
|--------------|-------------------------------------------|
| allSitesName | <i>Retrieve position of all the sites</i> |
|--------------|-------------------------------------------|

---

## Description

The function is a way to get position of the resulting sites from [SNPsites](#), [fixationSites](#) and [parallelSites](#). The numbering is consistent with what's being set by [setSiteNumbering](#)

**Usage**

```

allSitesName(x, ...)

## S3 method for class 'SNPsites'
allSitesName(x, ...)

## S3 method for class 'sitesMinEntropy'
allSitesName(x, ...)

## S3 method for class 'fixationSites'
allSitesName(x, ...)

## S3 method for class 'parallelSites'
allSitesName(x, ...)

## S3 method for class 'paraFixSites'
allSitesName(x, type = c("paraFix", "fixation", "parallel"), ...)
```

**Arguments**

|      |                                               |
|------|-----------------------------------------------|
| x    | The object containing the sites from analysis |
| ...  | Other arguments                               |
| type | Return fixation or parallel sites             |

**Value**

An integer vector for sites position

**Examples**

```

data(zikv_tree)
msaPath <- system.file('extdata', 'ZIKV.fasta', package = 'sitePath')
tree <- addMSA(zikv_tree, msaPath = msaPath, msaFormat = 'fasta')
snp <- SNPsites(tree)
allSitesName(snp)
```

---

as.data.frame.fixationSites

*Convert results to Data Frame*

---

**Description**

Convert return of functions in sitePath package to a [data.frame](#) so can be better worked with. The group name for each tip is the same as [groupTips](#).

A [fixationSites](#) object will output the mutation name of the fixation and the cluster name before and after the mutation.

An [SNPsites](#) object will output the tip name with the SNP and its position.

An [parallelSites](#) object will output the tip name with the group name and mutation info.

**Usage**

```
## S3 method for class 'fixationSites'
as.data.frame(x, row.names = NULL, optional = FALSE, ...)

## S3 method for class 'SNPsites'
as.data.frame(x, row.names = NULL, optional = FALSE, ...)

## S3 method for class 'parallelSites'
as.data.frame(x, row.names = NULL, optional = FALSE, ...)
```

**Arguments**

|           |                                           |
|-----------|-------------------------------------------|
| x         | The object to be converted to data.frame. |
| row.names | Unimplemented.                            |
| optional  | Unimplemented.                            |
| ...       | Other arguments.                          |

**Value**

A `data.frame` object.

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
fixations <- fixationSites(lineagePath(tree))
as.data.frame(fixations)
```

---

extractSite

*Extract tips for a single site*

---

**Description**

The functions in `sitePath` usually include the results on more than one site. The function `extractSite` can be used to extract the predicted result on a single site.

**Usage**

```
extractSite(x, site, ...)

## S3 method for class 'fixationSites'
extractSite(x, site, ...)
```

**Arguments**

|      |                                                                                                                        |
|------|------------------------------------------------------------------------------------------------------------------------|
| x    | A <code>fixationSites</code> or a <code>parallelSites</code> object. More type will be supported in the later version. |
| site | A site included in the result.                                                                                         |
| ...  | Other arguments                                                                                                        |

**Value**

The predicted result of a single site

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
mutations <- fixationSites(lineagePath(tree))
extractSite(mutations, 139)
```

---

|             |                                               |
|-------------|-----------------------------------------------|
| extractTips | <i>Extract grouped tips for a single site</i> |
|-------------|-----------------------------------------------|

---

**Description**

The result of [fixationSites](#) and [sitePath](#) contains all the possible sites with fixation mutation. The function `extractTips` retrieves the name of the tips involved in the fixation.

For [lineagePath](#), the function `extractTips` groups all the tree tips according to the amino acid/nucleotide of the site.

For [parallelSites](#) and [sitePara](#) object, the function `extractTips` retrieve all the tips with parallel mutation.

**Usage**

```
extractTips(x, ...)

## S3 method for class 'lineagePath'
extractTips(x, site, ...)

## S3 method for class 'sitesMinEntropy'
extractTips(x, site, ...)

## S3 method for class 'fixationSites'
extractTips(x, site, select = 1, ...)

## S3 method for class 'sitePath'
extractTips(x, select = 1, ...)

## S3 method for class 'parallelSites'
extractTips(x, site, ...)

## S3 method for class 'sitePara'
extractTips(x, ...)
```

**Arguments**

|      |                                                                       |
|------|-----------------------------------------------------------------------|
| x    | A <a href="#">fixationSites</a> or a <a href="#">sitePath</a> object. |
| ...  | Other arguments                                                       |
| site | A site predicted to experience fixation.                              |

**select** For a site, there theoretically might be more than one fixation on different lineages. You may use this argument to extract for a specific fixation of a site. The default is the first fixation of the site.

### Value

Tree tips grouped as [list](#)

### Examples

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
mutations <- fixationSites(lineagePath(tree))
extractTips(mutations, 139)
```

---

|                |                                   |
|----------------|-----------------------------------|
| fixationIndels | <i>Fixation indels prediction</i> |
|----------------|-----------------------------------|

---

### Description

The fixation of insertions of deletions.

### Usage

```
fixationIndels(x, ...)

## S3 method for class 'sitesMinEntropy'
fixationIndels(x, ...)
```

### Arguments

**x** The return from [sitesMinEntropy](#) function.

**...** Other arguments.

### Value

A fixationIndels object.

### Examples

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
fixationIndels(sitesMinEntropy(tree))
```

---

|              |                                                 |
|--------------|-------------------------------------------------|
| fixationPath | <i>Accumulation of fixed mutation as a tree</i> |
|--------------|-------------------------------------------------|

---

### Description

The tips are clustered according to the fixation sites. The transition of fixation sites will be plotted as a phylogenetic tree. The length of each branch represents the number of fixation mutation between two clusters. The name of the tree tips indicate the number of sequences in the cluster.

### Usage

```
fixationPath(x, ...)

## S3 method for class 'sitesMinEntropy'
fixationPath(x, minEffectiveSize = NULL, ...)

## S3 method for class 'fixationSites'
fixationPath(x, minEffectiveSize = NULL, ...)
```

### Arguments

|                  |                                                         |
|------------------|---------------------------------------------------------|
| x                | The return from <a href="#">fixationSites</a> function. |
| ...              | Further arguments passed to or from other methods.      |
| minEffectiveSize | The minimum size for a tip cluster.                     |

### Value

An fixationPath object

### Examples

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
paths <- lineagePath(tree)
mutations <- fixationSites(paths)
fixationPath(mutations)
```

---

|               |                                  |
|---------------|----------------------------------|
| fixationSites | <i>Fixation sites prediction</i> |
|---------------|----------------------------------|

---

### Description

After finding the [lineagePath](#) of a phylogenetic tree, fixationSites uses the result to find those sites that show fixation on some, if not all, of the lineages. The number of tips before and after the fixation mutation is expected to be more than minEffectiveSize. Also, the fixation will be skipped if the amino acid/nucleotide is gap or ambiguous character. A lineage has to have at least one fixation mutation to be reported.

**Usage**

```
fixationSites(paths, ...)

## S3 method for class 'lineagePath'
fixationSites(
  paths,
  minEffectiveSize = NULL,
  searchDepth = 1,
  method = c("compare", "insert", "delete"),
  ...
)

## S3 method for class 'sitesMinEntropy'
fixationSites(paths, ...)

## S3 method for class 'paraFixSites'
fixationSites(paths, ...)
```

**Arguments**

|                               |                                                                                                                                                                           |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>paths</code>            | A lineagePath object returned from <a href="#">lineagePath</a> function.                                                                                                  |
| <code>...</code>              | further arguments passed to or from other methods.                                                                                                                        |
| <code>minEffectiveSize</code> | The minimum number of tips in a group.                                                                                                                                    |
| <code>searchDepth</code>      | The function uses heuristic search but the termination of the search cannot be intrinsically decided. <code>searchDepth</code> is needed to tell the search when to stop. |
| <code>method</code>           | The strategy for predicting the fixation. The basic approach is entropy minimization and can be achieved by adding or removing fixation point, or by comparing the two.   |

**Value**

A fixationSites object.

**See Also**

[as.data.frame.fixationSites](#)

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
fixationSites(lineagePath(tree))
```

groupTips

*The grouping of tree tips***Description**

The tips between divergent nodes or fixation mutations on the lineages are each gathered as group.

**Usage**

```
groupTips(tree, ...)

## S3 method for class 'phyMSAmatched'
groupTips(
  tree,
  similarity = NULL,
  simMatrix = NULL,
  forbidTrivial = TRUE,
  tipnames = TRUE,
  ...
)

## S3 method for class 'lineagePath'
groupTips(tree, tipnames = TRUE, ...)

## S3 method for class 'sitesMinEntropy'
groupTips(tree, tipnames = TRUE, ...)

## S3 method for class 'fixationSites'
groupTips(tree, tipnames = TRUE, ...)

## S3 method for class 'fixationPath'
groupTips(tree, tipnames = TRUE, ...)
```

**Arguments**

|               |                                                                                                                                                                                                                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| tree          | The return from <a href="#">addMSA</a> , <a href="#">lineagePath</a> , <a href="#">sitesMinEntropy</a> or other functions.                                                                                                                                                            |
| ...           | Other arguments.                                                                                                                                                                                                                                                                      |
| similarity    | This decides how minor SNPs are to remove. If provided as fraction between 0 and 1, then the minimum number of SNP will be total tips times similarity. If provided as integer greater than 1, the minimum number will be similarity. The default similarity is 0.05 for lineagePath. |
| simMatrix     | Deprecated and will not have effect.                                                                                                                                                                                                                                                  |
| forbidTrivial | Does not allow trivial trimming.                                                                                                                                                                                                                                                      |
| tipnames      | If return tips as integer or tip names.                                                                                                                                                                                                                                               |

**Value**

groupTips returns grouping of tips.

**Examples**

```
data(zikv_tree)
data(zikv_align)
tree <- addMSA(zikv_tree, alignment = zikv_align)
groupTips(tree)
```

h3n2\_align

*Multiple sequence alignment of H3N2's HA protein***Description**

The raw protein sequences were downloaded from NCBI database and aligned using MAFFT (<https://mafft.cbrc.jp/alignment/software/>).

h3n2\_align\_reduced is a truncated version of h3n2\_align

**Usage**

```
data(h3n2_align)
```

```
data(h3n2_align_reduced)
```

**Format**

an alignment object

an alignment object

h3n2\_tree

*Phylogenetic tree of H3N2's HA protein***Description**

Tree was built from [h3n2\\_align](#) using RAxML (<http://www.exelixis-lab.org/>) with default settings.

h3n2\_tree\_reduced is a truncated version of h3n2\_tree

**Usage**

```
data(h3n2_tree)
```

```
data(h3n2_tree_reduced)
```

**Format**

a phylo object

a phylo object

lineagePath

*Resolving lineage paths using SNP***Description**

lineagePath finds the lineages of a phylogenetic tree providing the corresponding sequence alignment. This is done by finding 'major SNPs' which usually accumulate along the evolutionary pathways.

sneakPeek is intended to plot 'similarity' (actually the least percentage of 'major SNP') as a threshold against number of output lineagePath. This plot is intended to give user a rough view about how many lineages they could expect from the 'similarity' threshold in the function [lineagePath](#). The number of lineagePath is preferably not be too many or too few. The result excludes where the number of lineagePath is greater than number of tips divided by 20 or user-defined maxPath. The zero lineagePath result will also be excluded.

When used on the return of sneakPeek, a lineagePath with the closest similarity will be retrieved from the returned value.

similarity has no effect when using on [paraFixSites](#) object

**Usage**

```
lineagePath(tree, similarity, ...)
```

```
## S3 method for class 'phylo'
```

```
lineagePath(
  tree,
  similarity = NULL,
  alignment = NULL,
  seqType = c("AA", "DNA", "RNA"),
  reference = NULL,
  gapChar = "-",
  minSkipSize = NULL,
  ...
)
```

```
## S3 method for class 'treedata'
```

```
lineagePath(tree, ...)
```

```
## S3 method for class 'phyMSAmatched'
```

```
lineagePath(
  tree,
  similarity = NULL,
  simMatrix = NULL,
  forbidTrivial = TRUE,
  ...
)
```

```
sneakPeek(tree, step = 9, maxPath = NULL, minPath = 0, makePlot = TRUE)
```

```
## S3 method for class 'sneakPeekedPaths'
```

```
lineagePath(tree, similarity, ...)
```

```
## S3 method for class 'paraFixSites'
lineagePath(tree, similarity = NULL, ...)
```

### Arguments

|               |                                                                                                                                                                                                                                                             |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| tree          | The return from <a href="#">addMSA</a> or <a href="#">sneakPeek</a> function.                                                                                                                                                                               |
| similarity    | The parameter for identifying phylogenetic pathway using SNP. If provided as fraction between 0 and 1, then the minimum number of SNP will be total tips times Nmin. If provided as integer greater than 1, the minimum number will be Nmin.                |
| ...           | Other arguments.                                                                                                                                                                                                                                            |
| alignment     | An alignment object. This commonly can be from sequence parsing function in the <a href="#">seqinr</a> package. Sequence names in the alignment should include all tip.label in the tree                                                                    |
| seqType       | The type of the sequence in the alignment file. The default is "AA" for amino acid. The other options are "DNA" and "RNA".                                                                                                                                  |
| reference     | Name of reference for site numbering. The name has to be one of the sequences' name. The default uses the intrinsic alignment numbering                                                                                                                     |
| gapChar       | The character to indicate gap. The numbering will skip the gapChar for the reference sequence.                                                                                                                                                              |
| minSkipSize   | The minimum number of tips to have gap or ambiguous amino acid/nucleotide for a site to be ignored in other analysis. This will not affect the numbering. The default is 0.8.                                                                               |
| simMatrix     | Deprecated and will not have effect.                                                                                                                                                                                                                        |
| forbidTrivial | Does not allow trivial trimming.                                                                                                                                                                                                                            |
| step          | the 'similarity' window for calculating and plotting. To better see the impact of threshold on path number. The default is 10.                                                                                                                              |
| maxPath       | maximum number of path to return show in the plot. The number of path in the raw tree can be far greater than trimmed tree. To better see the impact of threshold on path number. This is preferably specified. The default is one 20th of tree tip number. |
| minPath       | minimum number of path to return show in the plot. To better see the impact of threshold on path number. The default is 1.                                                                                                                                  |
| makePlot      | Whether make a plot when return.                                                                                                                                                                                                                            |

### Value

Lineage path represent by node number.

[sneakPeek](#) return the similarity threshold against number of lineagePath. There will be a simple dot plot between threshold and path number if `makePlot` is TRUE.

### Examples

```
data('zikv_tree')
data('zikv_align')
tree <- addMSA(zikv_tree, alignment = zikv_align)
lineagePath(tree)
sneakPeek(tree, step = 3)
x <- sneakPeek(tree, step = 3)
lineagePath(x, similarity = 0.05)
```

---

|              |                                                             |
|--------------|-------------------------------------------------------------|
| paraFixSites | <i>The fixation sites with mutation on parallel lineage</i> |
|--------------|-------------------------------------------------------------|

---

## Description

The operation between the results of [fixationSites](#) and [parallelSites](#).

## Usage

```
paraFixSites(x, ...)

## S3 method for class 'phylo'
paraFixSites(
  x,
  alignment = NULL,
  seqType = c("AA", "DNA", "RNA"),
  Nmin = NULL,
  reference = NULL,
  gapChar = "-",
  minSkipSize = NULL,
  ...
)

## S3 method for class 'treedata'
paraFixSites(x, ...)

## S3 method for class 'lineagePath'
paraFixSites(
  x,
  minEffectiveSize = NULL,
  searchDepth = 1,
  method = c("compare", "insert", "delete"),
  ...
)

## S3 method for class 'sitesMinEntropy'
paraFixSites(
  x,
  category = c("intersect", "union", "parallelOnly", "fixationOnly"),
  minSNP = NULL,
  mutMode = c("all", "exact", "pre", "post"),
  ...
)
```

## Arguments

|           |                                                                                                                                                                                          |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| x         | A lineagePath object returned from <a href="#">lineagePath</a> function.                                                                                                                 |
| ...       | further arguments passed to or from other methods.                                                                                                                                       |
| alignment | An alignment object. This commonly can be from sequence parsing function in the <a href="#">seqinr</a> package. Sequence names in the alignment should include all tip.label in the tree |

|                  |                                                                                                                                                                                                                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| seqType          | The type of the sequence in the alignment file. The default is "AA" for amino acid. The other options are "DNA" and "RNA".                                                                                                                                                           |
| Nmin             | The parameter for identifying phylogenetic pathway using SNP. If provided as fraction between 0 and 1, then the minimum number of SNP will be total tips times Nmin. If provided as integer greater than 1, the minimum number will be Nmin.                                         |
| reference        | Name of reference for site numbering. The name has to be one of the sequences' name. The default uses the intrinsic alignment numbering                                                                                                                                              |
| gapChar          | The character to indicate gap. The numbering will skip the gapChar for the reference sequence.                                                                                                                                                                                       |
| minSkipSize      | The minimum number of tips to have gap or ambiguous amino acid/nucleotide for a site to be ignored in other analysis. This will not affect the numbering. The default is 0.8.                                                                                                        |
| minEffectiveSize | The minimum number of tips in a group.                                                                                                                                                                                                                                               |
| searchDepth      | The function uses heuristic search but the termination of the search cannot be intrinsically decided. searchDepth is needed to tell the search when to stop.                                                                                                                         |
| method           | The strategy for predicting the fixation. The basic approach is entropy minimization and can be achieved by adding or removing fixation point, or by comparing the two.                                                                                                              |
| category         | Could be parallelOnly, fixationOnly, intersect or union.                                                                                                                                                                                                                             |
| minSNP           | The minimum number of mutations to be qualified as parallel on at least two lineages. The default is 1.                                                                                                                                                                              |
| mutMode          | The strategy for finding parallel site. The default all is to consider any mutation regardless of the amino acid/nucleotide before and after mutation; Or exact to force mutation to be the same; Or pre/post to select the site having amino acid/nucleotide before/after mutation. |

### Value

A paraFixSites object.

### Examples

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
paraFixSites(zikv_tree_reduced, alignment = zikv_align_reduced)
```

---

parallelSites

*Mutation across multiple phylogenetic lineages*


---

### Description

A site may have mutated on parallel lineages. Mutation can occur on the same site across the phylogenetic lineages solved by [lineagePath](#). The site will be considered mutated in parallel if the mutation occurs on the non-overlap part of more than two lineages. The amino acid/nucleotide before and after the mutation can be allowed different on different lineages or only the exact same mutations are considered.

**Usage**

```
parallelSites(x, ...)

## S3 method for class 'lineagePath'
parallelSites(
  x,
  minSNP = NULL,
  mutMode = c("all", "exact", "pre", "post"),
  ...
)

## S3 method for class 'sitesMinEntropy'
parallelSites(
  x,
  minSNP = NULL,
  mutMode = c("all", "exact", "pre", "post"),
  ...
)

## S3 method for class 'paraFixSites'
parallelSites(x, ...)
```

**Arguments**

|                      |                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>x</code>       | A <a href="#">lineagePath</a> or a <a href="#">sitesMinEntropy</a> object.                                                                                                                                                                                                                                                  |
| <code>...</code>     | The arguments in <a href="#">sitesMinEntropy</a> .                                                                                                                                                                                                                                                                          |
| <code>minSNP</code>  | The minimum number of mutations to be qualified as parallel on at least two lineages. The default is 1.                                                                                                                                                                                                                     |
| <code>mutMode</code> | The strategy for finding parallel site. The default <code>all</code> is to consider any mutation regardless of the amino acid/nucleotide before and after mutation; Or <code>exact</code> to force mutation to be the same; Or <code>pre/post</code> to select the site having amino acid/nucleotide before/after mutation. |

**Value**

A `parallelSites` object

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
paths <- lineagePath(tree)
x <- sitesMinEntropy(paths)
parallelSites(x)
```

---

phyMSAmatched

Add matching sequence alignment to the tree

---

## Description

addMSA wraps [read.alignment](#) function in [seqinr](#) package and helps match names in tree and sequence alignment. Either provide the file path to an alignment file and its format or an alignment object from the return of [read.alignment](#) function. If both the file path and alignment object are given, the function will use the sequence in the alignment file.

## Usage

```
addMSA(tree, ...)

## S3 method for class 'phylo'
addMSA(
  tree,
  msaPath = "",
  msaFormat = c("fasta", "clustal", "phylip", "mase", "msf"),
  alignment = NULL,
  seqType = c("AA", "DNA", "RNA"),
  ...
)

## S3 method for class 'treedata'
addMSA(tree, ...)
```

## Arguments

|           |                                                                                                                                                                                                                                                                                                                                                                |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| tree      | A <a href="#">phylo</a> object. This commonly can be from tree parsing function in <a href="#">ape</a> or <a href="#">ggtree</a> . All the <code>tip.label</code> should be found in the sequence alignment. The tree is supposed to be fully resolved (bifurcated) and will be resolved by <a href="#">multi2di</a> if <a href="#">is.binary</a> gives FALSE. |
| ...       | Other arguments.                                                                                                                                                                                                                                                                                                                                               |
| msaPath   | The file path to the multiple sequence alignment file.                                                                                                                                                                                                                                                                                                         |
| msaFormat | The format of the multiple sequence alignment file. The internal uses the <a href="#">read.alignment</a> from <a href="#">seqinr</a> package to parse the sequence alignment. The default is "fasta" and it also accepts "clustal", "phylip", "mase", "msf".                                                                                                   |
| alignment | An alignment object. This commonly can be from sequence parsing function in the <a href="#">seqinr</a> package. Sequence names in the alignment should include all <code>tip.label</code> in the tree                                                                                                                                                          |
| seqType   | The type of the sequence in the alignment file. The default is "AA" for amino acid. The other options are "DNA" and "RNA".                                                                                                                                                                                                                                     |

## Value

Since 1.5.12, the function returns a phyMSAmatched object to avoid S3 methods used on phylo (better encapsulation).

**See Also**[read.alignment](#)**Examples**

```
data(zikv_tree)
msaPath <- system.file('extdata', 'ZIKV.fasta', package = 'sitePath')
addMSA(zikv_tree, msaPath = msaPath, msaFormat = 'fasta')
```

---

|                    |                              |
|--------------------|------------------------------|
| plot.phyMSAmatched | <i>Visualize the results</i> |
|--------------------|------------------------------|

---

**Description**

The plot function to visualize the return of functions in the package. The underlying function applies [ggplot2](#). The function name plot is used to keep the compatibility with previous versions, but they do not behave like the generic [plot](#) function since 1.5.4.

A [phyMSAmatched](#) object will be plotted as a tree diagram.

A [lineagePath](#) object will be plotted as a tree diagram and paths are black solid line while the trimmed nodes and tips will use gray dashed line.

A [parallelSites](#) object will be plotted as original phylogenetic tree marked with parallel mutations attached as dot plot.

A [fixationSites](#) object will be plotted as original phylogenetic tree marked with fixation substitutions.

A sitePath object can be extracted by using [extractSite](#) on the return of [fixationSites](#).

A [fixationIndels](#) object will be plotted as original phylogenetic tree marked with indel fixation.

A [fixationPath](#) object will be plotted as a phylo object. The tips are clustered according to the fixation sites. The transition of fixation sites will be plotted as a phylogenetic tree. The length of each branch represents the number of fixation mutation between two clusters.

**Usage**

```
## S3 method for class 'phyMSAmatched'
plot(x, y = TRUE, ...)

## S3 method for class 'lineagePath'
plot(x, y = TRUE, showTips = FALSE, ...)

## S3 method for class 'parallelSites'
plot(x, y = TRUE, ...)

## S3 method for class 'fixationSites'
plot(x, y = TRUE, tipsGrouping = NULL, ...)

## S3 method for class 'sitePath'
plot(x, y = NULL, select = NULL, showTips = FALSE, ...)

## S3 method for class 'fixationIndels'
plot(x, y = TRUE, ...)
```

```
## S3 method for class 'fixationPath'
plot(x, y = TRUE, ...)
```

### Arguments

|              |                                                                                                                                                                                                                                     |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| x            | The object to plot.                                                                                                                                                                                                                 |
| y            | Whether to show the fixation mutation between clusters. For lineagePath object and sitePath object, it is deprecated and no longer have effect since 1.5.4.                                                                         |
| ...          | Other arguments. Since 1.5.4, the function uses <a href="#">ggtree</a> as the base function to make plots so the arguments in <code>plot.phylo</code> will no longer work.                                                          |
| showTips     | Whether to plot the tip labels. The default is FALSE.                                                                                                                                                                               |
| tipsGrouping | A list to hold the grouping of tips for how the tree will be colored.                                                                                                                                                               |
| select       | For a sitePath object, it can have result on more than one evolution pathway. This is to select which path to plot. The default is NULL which will plot all the paths. It is the same as select in <a href="#">plotSingleSite</a> . |

### Value

A ggplot object to make the plot.

### Examples

```
data(zikv_tree)
data(zikv_align)
tree <- addMSA(zikv_tree, alignment = zikv_align)
plot(tree)
paths <- lineagePath(tree)
plot(paths)
parallel <- parallelSites(paths)
plot(parallel)
fixations <- fixationSites(paths)
plot(fixations)
sp <- extractSite(fixations, 139)
plot(sp)
x <- fixationPath(fixations)
plot(x)
```

---

|                   |                                          |
|-------------------|------------------------------------------|
| plotFixationSites | <i>Plot the result of fixation sites</i> |
|-------------------|------------------------------------------|

---

### Description

Visualize the results of [paraFixSites](#)

**Usage**

```
plotFixationSites(x, ...)

## S3 method for class 'fixationSites'
plotFixationSites(x, site = NULL, ...)

## S3 method for class 'paraFixSites'
plotFixationSites(x, site = NULL, ...)
```

**Arguments**

|      |                                                                                                                                         |
|------|-----------------------------------------------------------------------------------------------------------------------------------------|
| x    | return from <a href="#">paraFixSites</a>                                                                                                |
| ...  | further arguments passed to or from other methods.                                                                                      |
| site | the number of the site according to <a href="#">setSiteNumbering</a> . If not provided, all sites will be plotted as labels on the tree |

**Value**

A ggplot object.

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
paraFix <- paraFixSites(zikv_tree_reduced, alignment = zikv_align_reduced)
plotFixationSites(paraFix)
```

---

|              |                                     |
|--------------|-------------------------------------|
| plotMutSites | <i>Plot tree and mutation sites</i> |
|--------------|-------------------------------------|

---

**Description**

The mutated sites for each tip in a phylogenetic tree will be represented as colored dots positioned by their site number.

**Usage**

```
plotMutSites(x, ...)

## S3 method for class 'SNPsites'
plotMutSites(x, showTips = FALSE, ...)

## S3 method for class 'lineagePath'
plotMutSites(x, ...)

## S3 method for class 'parallelSites'
plotMutSites(x, ...)

## S3 method for class 'fixationSites'
plotMutSites(x, ...)
```

```
## S3 method for class 'paraFixSites'
plotMutSites(
  x,
  widthRatio = 0.75,
  fontSize = 3.88,
  dotSize = 1,
  lineSize = 0.5,
  ...
)
```

### Arguments

|            |                                                       |
|------------|-------------------------------------------------------|
| x          | An <a href="#">SNPsites</a> object.                   |
| ...        | Other arguments                                       |
| showTips   | Whether to plot the tip labels. The default is FALSE. |
| widthRatio | The width ratio between tree plot and SNP plot        |
| fontSize   | The font size of the mutation label in tree plot      |
| dotSize    | The dot size of SNP in SNP plot                       |
| lineSize   | The background line size in SNP plot                  |

### Value

A tree plot with SNP as dots for each tip.

### Examples

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
plotMutSites(SNPsites(tree))
```

---

|                   |                                          |
|-------------------|------------------------------------------|
| plotParallelSites | <i>Plot the result of fixation sites</i> |
|-------------------|------------------------------------------|

---

### Description

Visualize the results of [paraFixSites](#)

### Usage

```
plotParallelSites(x, ...)

## S3 method for class 'parallelSites'
plotParallelSites(x, site = NULL, ...)

## S3 method for class 'paraFixSites'
plotParallelSites(x, site = NULL, ...)
```

**Arguments**

|      |                                                                      |
|------|----------------------------------------------------------------------|
| x    | return from <a href="#">paraFixSites</a>                             |
| ...  | further arguments passed to or from other methods.                   |
| site | the number of the site according to <a href="#">setSiteNumbering</a> |

**Value**

A ggplot object.

**Examples**

```
data(zikv_tree)
data(zikv_align)
paraFix <- paraFixSites(zikv_tree, alignment = zikv_align)
plotParallelSites(paraFix)
```

---

|                |                                        |
|----------------|----------------------------------------|
| plotSingleSite | <i>Color the tree by a single site</i> |
|----------------|----------------------------------------|

---

**Description**

Plot and color the tree according to amino acid/nucleotide of the selected site. The color scheme depends on the seqType set in [addMSA](#) function.

For [lineagePath](#), the tree will be colored according to the amino acid of the site. The color scheme tries to assign distinguishable color for each amino acid.

For [parallelSites](#), the tree will be colored according to the amino acid of the site if the mutation is not fixed.

For [fixationSites](#), it will color the ancestral tips in red, descendant tips in blue and excluded tips in grey.

**Usage**

```
plotSingleSite(x, site, ...)

## S3 method for class 'lineagePath'
plotSingleSite(x, site, showPath = TRUE, showTips = FALSE, ...)

## S3 method for class 'sitesMinEntropy'
plotSingleSite(x, site, ...)

## S3 method for class 'parallelSites'
plotSingleSite(x, site, showPath = TRUE, ...)

## S3 method for class 'fixationSites'
plotSingleSite(x, site, select = NULL, ...)
```

**Arguments**

|                       |                                                                                                                                                                                                                                                                                    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>x</code>        | The object to plot.                                                                                                                                                                                                                                                                |
| <code>site</code>     | For <code>lineagePath</code> , it can be any site within sequence length. For <code>fixationSites</code> and <code>parallelSites</code> , it is restrained to a predicted fixation site. The numbering is consistent with the reference defined by <code>setSiteNumbering</code> . |
| <code>...</code>      | Other arguments. Since 1.5.4, the function uses <code>ggtree</code> as the base function to make plots so the arguments in <code>plot.phylo</code> will no longer work.                                                                                                            |
| <code>showPath</code> | If plot the lineage result from <code>lineagePath</code> . The default is <code>TRUE</code> .                                                                                                                                                                                      |
| <code>showTips</code> | Whether to plot the tip labels. The default is <code>FALSE</code> .                                                                                                                                                                                                                |
| <code>select</code>   | Select which fixation path in to plot. The default is <code>NULL</code> which will plot all the fixations.                                                                                                                                                                         |

**Value**

Since 1.5.4, the function returns a `ggplot` object so on longer behaviors like the generic `plot` function.

**See Also**

[plot.sitePath](#)

**Examples**

```
data(zikv_tree)
data(zikv_align)
tree <- addMSA(zikv_tree, alignment = zikv_align)
paths <- lineagePath(tree)
plotSingleSite(paths, 139)
fixations <- fixationSites(paths)
plotSingleSite(fixations, 139)
```

---

reexports

*Objects exported from other packages*


---

**Description**

These objects are imported from other packages. Follow the links below to see their documentation.

**ape** [as.phylo](#), [read.tree](#)

**seqinr** [read.alignment](#)

**tidytree** [as.treedata](#)

---

sars2\_align

*Multiple sequence alignment of SARS-CoV-2 genome CDS*


---

### Description

The raw sequences were downloaded from GISAID database (<https://www.gisaid.org/>) and aligned using MAFFT (<https://mafft.cbrc.jp/alignment/software/>) with default settings.

### Usage

```
data(sars2_align)
```

### Format

an alignment object

---

sars2\_tree

*Phylogenetic tree of SARS-CoV-2 genome CDS*


---

### Description

Tree was built from [sars2\\_align](#) using RAxML (<http://www.exelixis-lab.org/>) with default settings. The tip EPI\_ISL\_402125 was used as the outgroup to root the tree.

### Usage

```
data(sars2_tree)
```

### Format

a phylo object

---

setSiteNumbering

*Set site numbering to the reference sequence*


---

### Description

A reference sequence can be used to define a global site numbering scheme for multiple sequence alignment. The gap in the reference sequence will be skipped for the numbering. Also, the site that is gap or amino acid/nucleotide for too many tips will be ignored but won't affect numbering.

### Usage

```
setSiteNumbering(x, reference, gapChar, ...)
```

```
## S3 method for class 'phyMSAmatched'
```

```
setSiteNumbering(x, reference = NULL, gapChar = "-", minSkipSize = NULL, ...)
```

**Arguments**

|             |                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| x           | The object to set site numbering. It could be a <a href="#">phyMSAmatched</a> or a <a href="#">lineagePath</a> object.                                                        |
| reference   | Name of reference for site numbering. The name has to be one of the sequences' name. The default uses the intrinsic alignment numbering                                       |
| gapChar     | The character to indicate gap. The numbering will skip the gapChar for the reference sequence.                                                                                |
| ...         | Further arguments passed to or from other methods.                                                                                                                            |
| minSkipSize | The minimum number of tips to have gap or ambiguous amino acid/nucleotide for a site to be ignored in other analysis. This will not affect the numbering. The default is 0.8. |

**Value**

The input x with numbering mapped to reference.

**Examples**

```
data(zikv_tree)
msaPath <- system.file('extdata', 'ZIKV.fasta', package = 'sitePath')
tree <- addMSA(zikv_tree, msaPath = msaPath, msaFormat = 'fasta')
setSiteNumbering(tree)
```

---

|                  |                                     |
|------------------|-------------------------------------|
| similarityMatrix | <i>Similarity between sequences</i> |
|------------------|-------------------------------------|

---

**Description**

Get similarity between aligned sequences with gap ignored.

**Usage**

```
similarityMatrix(tree)
```

**Arguments**

|      |                                                  |
|------|--------------------------------------------------|
| tree | The return from <a href="#">addMSA</a> function. |
|------|--------------------------------------------------|

**Value**

A diagonal matrix of similarity between sequences.

**Examples**

```
data(zikv_tree)
data(zikv_align)
tree <- addMSA(zikv_tree, alignment = zikv_align)
simMatrix <- similarityMatrix(tree)
```

---

|                     |                                                   |
|---------------------|---------------------------------------------------|
| sitePath-deprecated | <i>Deprecated functions in package 'sitePath'</i> |
|---------------------|---------------------------------------------------|

---

## Description

These functions are provided for compatibility with older versions of 'sitePath' only, and will be defunct at the next release.

## Details

The following functions are deprecated and will be made defunct; use the replacement indicated below:

- multiFixationSites: [fixationSites](#)

---

|                 |                                  |
|-----------------|----------------------------------|
| sitesMinEntropy | <i>Fixation sites prediction</i> |
|-----------------|----------------------------------|

---

## Description

After finding the [lineagePath](#) of a phylogenetic tree, sitesMinEntropy perform entropy minimization on every site of the sequence to group the tips according to amino acid/nucleotide.

## Usage

```
sitesMinEntropy(x, ...)

## S3 method for class 'lineagePath'
sitesMinEntropy(
  x,
  minEffectiveSize = NULL,
  searchDepth = 1,
  method = c("compare", "insert", "delete"),
  ...
)
```

## Arguments

|                  |                                                                                                                                                                         |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| x                | A lineagePath object returned from <a href="#">lineagePath</a> function.                                                                                                |
| ...              | further arguments passed to or from other methods.                                                                                                                      |
| minEffectiveSize | The minimum number of tips in a group.                                                                                                                                  |
| searchDepth      | The function uses heuristic search but the termination of the search cannot be intrinsically decided. searchDepth is needed to tell the search when to stop.            |
| method           | The strategy for predicting the fixation. The basic approach is entropy minimization and can be achieved by adding or removing fixation point, or by comparing the two. |

**Value**

A sitesMinEntropy object.

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
sitesMinEntropy(lineagePath(tree))
```

---

SNPsites

*Finding sites with variation*

---

**Description**

Single nucleotide polymorphism (SNP) in the whole package refers to variation of amino acid. SNPsites will try to find SNP in the multiple sequence alignment. A reference sequence and gap character may be specified to number the site.

**Usage**

```
SNPsites(tree, ...)

## S3 method for class 'phyMSAmatched'
SNPsites(tree, minSNP = NULL, ...)
```

**Arguments**

|        |                                                                                       |
|--------|---------------------------------------------------------------------------------------|
| tree   | A <a href="#">phyMSAmatched</a> object.                                               |
| ...    | Other arguments                                                                       |
| minSNP | Minimum number of a mutation to be a SNP. The default is 10th of the total tree tips. |

**Value**

A SNPsites object.

**Examples**

```
data(zikv_tree_reduced)
data(zikv_align_reduced)
tree <- addMSA(zikv_tree_reduced, alignment = zikv_align_reduced)
SNPsites(tree)
```

---

|            |                                                              |
|------------|--------------------------------------------------------------|
| zikv_align | <i>Multiple sequence alignment of Zika virus polyprotein</i> |
|------------|--------------------------------------------------------------|

---

**Description**

The raw protein sequences were downloaded from ViPR database (<https://www.viprbrc.org/>) and aligned using MAFFT (<https://mafft.cbrc.jp/alignment/software/>). with default settings.

zikv\_align\_reduced is a truncated version of zikv\_align

**Usage**

```
data(zikv_align)
```

```
data(zikv_align_reduced)
```

**Format**

an alignment object

an alignment object

---

|           |                                                    |
|-----------|----------------------------------------------------|
| zikv_tree | <i>Phylogenetic tree of Zika virus polyprotein</i> |
|-----------|----------------------------------------------------|

---

**Description**

Tree was built from [zikv\\_align](#) using RAxML (<http://www.exelixis-lab.org/>) with default settings. The tip ANK57896 was used as outgroup to root the tree.

zikv\_tree\_reduced is a truncated version of zikv\_tree

**Usage**

```
data(zikv_tree)
```

```
data(zikv_tree_reduced)
```

**Format**

a phylo object

a phylo object

# Index

- \* **datasets**
  - h3n2\_align, [10](#)
  - h3n2\_tree, [10](#)
  - sars2\_align, [23](#)
  - sars2\_tree, [23](#)
  - zika\_align, [27](#)
  - zika\_tree, [27](#)
- \* **internal**
  - reexports, [22](#)
- addMSA, [9](#), [12](#), [21](#), [24](#)
- addMSA (phyMSAmatched), [16](#)
- allSitesName, [2](#)
- ape, [16](#)
- as.data.frame.fixationSites, [3](#), [8](#)
- as.data.frame.parallelSites
  - (as.data.frame.fixationSites), [3](#)
- as.data.frame.SNPsites
  - (as.data.frame.fixationSites), [3](#)
- as.phylo, [22](#)
- as.phylo (reexports), [22](#)
- as.treedata, [22](#)
- as.treedata (reexports), [22](#)
- data.frame, [3](#), [4](#)
- extractSite, [4](#), [17](#)
- extractTips, [5](#)
- fixationIndels, [6](#), [17](#)
- fixationPath, [7](#), [17](#)
- fixationSites, [2](#), [3](#), [5](#), [7](#), [7](#), [13](#), [17](#), [21](#), [25](#)
- ggplot2, [17](#)
- ggtree, [16](#), [18](#), [22](#)
- groupTips, [3](#), [9](#)
- h3n2\_align, [10](#), [10](#)
- h3n2\_align\_reduced (h3n2\_align), [10](#)
- h3n2\_tree, [10](#)
- h3n2\_tree\_reduced (h3n2\_tree), [10](#)
- is.binary, [16](#)
- lineagePath, [5](#), [7–9](#), [11](#), [11](#), [13–15](#), [17](#), [21](#), [22](#), [24](#), [25](#)
- list, [6](#)
- multi2di, [16](#)
- multiFixationSites
  - (sitePath-deprecated), [25](#)
- paraFixSites, [11](#), [13](#), [18–21](#)
- parallelSites, [2](#), [3](#), [5](#), [13](#), [14](#), [17](#), [21](#)
- phylo, [16](#)
- phyMSAmatched, [16](#), [17](#), [24](#), [26](#)
- plot, [17](#), [22](#)
- plot.fixationIndels
  - (plot.phyMSAmatched), [17](#)
- plot.fixationPath (plot.phyMSAmatched), [17](#)
- plot.fixationSites
  - (plot.phyMSAmatched), [17](#)
- plot.lineagePath (plot.phyMSAmatched), [17](#)
- plot.parallelSites
  - (plot.phyMSAmatched), [17](#)
- plot.phyMSAmatched, [17](#)
- plot.sitePath, [22](#)
- plot.sitePath (plot.phyMSAmatched), [17](#)
- plotFixationSites, [18](#)
- plotMutSites, [19](#)
- plotParallelSites, [20](#)
- plotSingleSite, [18](#), [21](#)
- read.alignment, [16](#), [17](#), [22](#)
- read.alignment (reexports), [22](#)
- read.tree, [22](#)
- read.tree (reexports), [22](#)
- reexports, [22](#)
- sars2\_align, [23](#), [23](#)
- sars2\_tree, [23](#)
- seqinr, [12](#), [13](#), [16](#)
- setSiteNumbering, [2](#), [19](#), [21](#), [22](#), [23](#)
- similarityMatrix, [24](#)
- sitePath-deprecated, [25](#)
- sitesMinEntropy, [6](#), [9](#), [15](#), [25](#)

sneakPeek (lineagePath), [11](#)  
SNP sites, [2](#), [3](#), [20](#), [26](#)  
zikh\_align, [27](#), [27](#)  
zikh\_align\_reduced (zikh\_align), [27](#)  
zikh\_tree, [27](#)  
zikh\_tree\_reduced (zikh\_tree), [27](#)