GDSiMS: Gene Drive Simulator of Mosquito Spread

Generated by Doxygen 1.10.0

Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

Chapter 5

Namespace Documentation

5.1 constants Namespace Reference

Variables

- const int max_dev = 20
- const int num_gen = 6

5.1.1 Variable Documentation

5.1.1.1 max_dev

```
const int constants::max_dev = 20
```

5.1.1.2 num_gen

```
const int constants::num_gen = 6
```

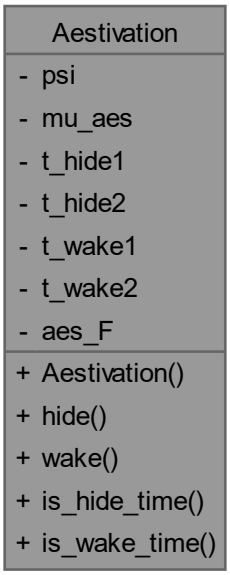
Chapter 6

Class Documentation

6.1 Aestivation Class Reference

`#include <Aestivation.h>`

Collaboration diagram for Aestivation:



Public Member Functions

- Aestivation (AestivationParams *params, int sites_size)
- void hide (std::vector< Patch * > &sites)
- void wake (int day, std::vector< Patch * > &sites)
- bool is_hide_time (int day)
- bool is_wake_time (int day)

Private Attributes

- double psi
- double mu_aes
- int t_hide1
- int t_hide2
- int t_wake1
- int t_wake2
- std::vector< std::array< std::array< long long int, num_gen >, num_gen > > aes_F

6.1.1 Constructor & Destructor Documentation

6.1.1.1 Aestivation()

```
Aestivation::Aestivation (
            AestivationParams * params,
            int sites_size )
```

6.1.2 Member Function Documentation

6.1.2.1 hide()

```
void Aestivation::hide (
            std::vector< Patch * > & sites )
```

Here is the call graph for this function:

Here is the caller graph for this function:

6.1.2.2 is_hide_time()

```
bool Aestivation::is_hide_time (
            int day )
```

Here is the caller graph for this function:

6.1.2.3 is_wake_time()

```
bool Aestivation::is_wake_time (
            int day )
```

Here is the caller graph for this function:

6.1.2.4 wake()

```
void Aestivation::wake (
            int day,
            std::vector< Patch * > & sites )
```

Here is the call graph for this function:

Here is the caller graph for this function:

6.1.3 Member Data Documentation

6.1.3.1 aes_F

```
std::vector<std::array<std::array<long long int, num_gen>, num_gen> > Aestivation::aes_↩
F  [private]
```

6.1.3.2 mu_aes

```
double Aestivation::mu_aes  [private]
```

6.1.3.3 psi

```
double Aestivation::psi  [private]
```

6.1.3.4 t_hide1

```
int Aestivation::t_hide1  [private]
```

6.1.3.5 t_hide2

```
int Aestivation::t_hide2  [private]
```

6.1.3.6 t_wake1

```
int Aestivation::t_wake1  [private]
```

6.1.3.7 t_wake2

```
int Aestivation::t_wake2  [private]
```

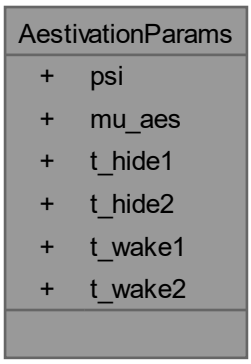
The documentation for this class was generated from the following files:

- Aestivation.h
- Aestivation.cpp

6.2 AestivationParams Struct Reference

`#include <Params.h>`

Collaboration diagram for AestivationParams:



Public Attributes

- double psi = 0.0
- double mu_aes = 0.0
- int t_hide1 = 0
- int t_hide2 = 0
- int t_wake1 = 0
- int t_wake2 = 0

6.2.1 Member Data Documentation

6.2.1.1 mu_aes

```
double AestivationParams::mu_aes = 0.0
```

6.2.1.2 psi

```
double AestivationParams::psi = 0.0
```

6.2.1.3 t_hide1

```
int AestivationParams::t_hide1 = 0
```

6.2.1.4 t_hide2

```
int AestivationParams::t_hide2 = 0
```

6.2.1.5 t_wake1

```
int AestivationParams::t_wake1 = 0
```

6.2.1.6 t_wake2

```
int AestivationParams::t_wake2 = 0
```

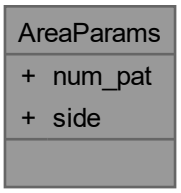
The documentation for this struct was generated from the following file:

- Params.h

6.3 AreaParams Struct Reference

```
#include <Params.h>
```

Collaboration diagram for AreaParams:



Public Attributes

- int num_pat = 50
- double side = 1.0

6.3.1 Member Data Documentation

6.3.1.1 num_pat

```
int AreaParams::num_pat = 50
```

6.3.1.2 side

```
double AreaParams::side = 1.0
```

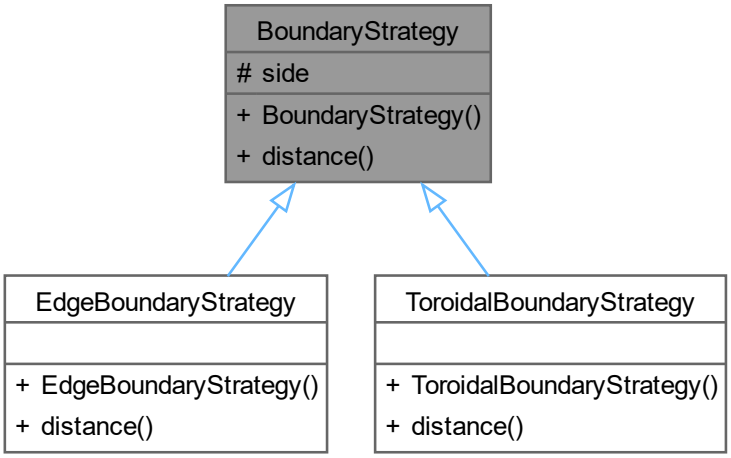
The documentation for this struct was generated from the following file:

- Params.h

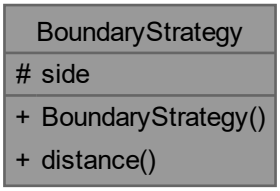
6.4 BoundaryStrategy Class Reference

```
#include <BoundaryStrategy.h>
```

Inheritance diagram for BoundaryStrategy:



Collaboration diagram for BoundaryStrategy:



Public Member Functions

- BoundaryStrategy (double side)
- virtual double distance (const Point &p1, const Point &p2)=0

Protected Attributes

- double side

6.4.1 Constructor & Destructor Documentation

6.4.1.1 BoundaryStrategy()

```
BoundaryStrategy::BoundaryStrategy (
            double side )  [inline]
```

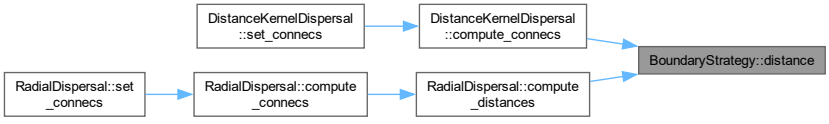
6.4.2 Member Function Documentation

6.4.2.1 distance()

```
virtual double BoundaryStrategy::distance (
            const Point & p1,
            const Point & p2 )  [pure virtual]
```

Implemented in ToroidalBoundaryStrategy, and EdgeBoundaryStrategy.

Here is the caller graph for this function:



6.4.3 Member Data Documentation

6.4.3.1 side

```
double BoundaryStrategy::side  [protected]
```

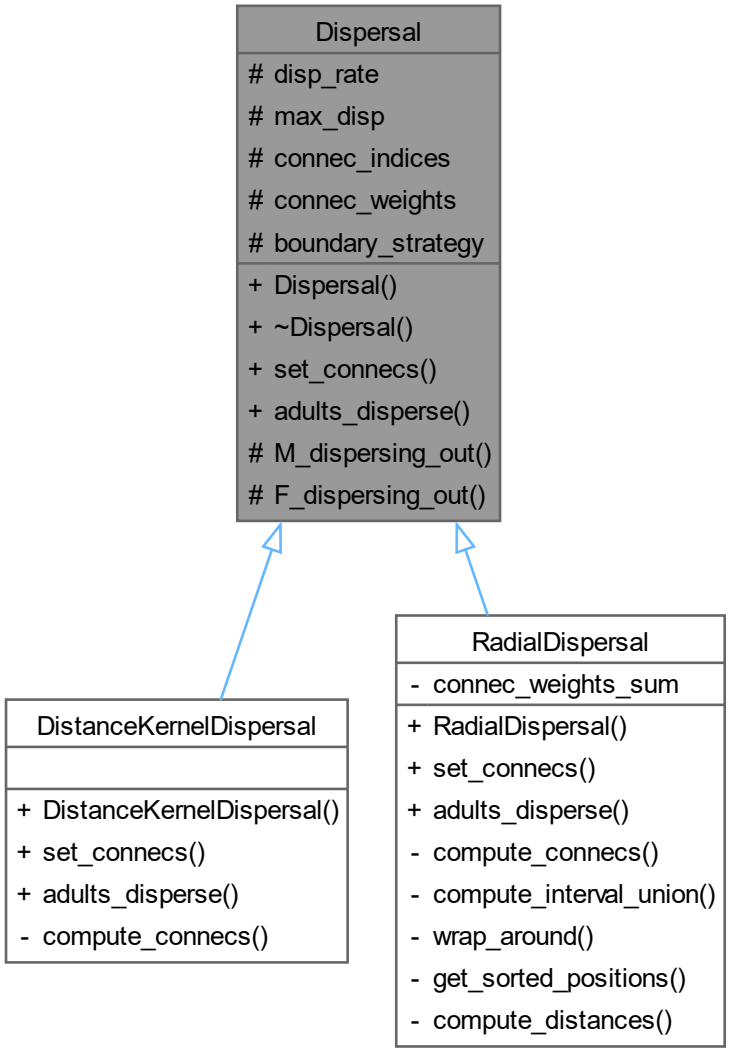
The documentation for this class was generated from the following file:

- BoundaryStrategy.h

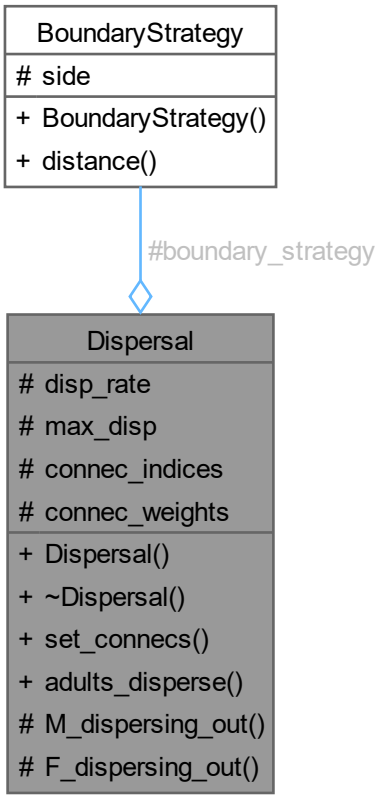
6.5 Dispersal Class Reference

`#include <Dispersal.h>`

Inheritance diagram for Dispersal:



Collaboration diagram for Dispersal:



Public Member Functions

- Dispersal (DispersalParams *params, BoundaryType boundary, double side)
- ~Dispersal ()
- virtual void set_connecs (std::vector< Patch * > &sites)=0
- virtual void adults_disperse (std::vector< Patch * > &sites)=0

Protected Member Functions

- std::vector< std::array< long long int, num_gen > > M_dispersing_out (const std::vector< Patch * > &sites)
- std::vector< std::array< std::array< long long int, num_gen >, num_gen > > F_dispersing_out (const std::vector< Patch * > &sites)

Protected Attributes

- double disp_rate
- double max_disp
- std::vector< std::vector< int > > connec_indices
- std::vector< std::vector< double > > connec_weights
- BoundaryStrategy * boundary_strategy

6.5.1 Constructor & Destructor Documentation

6.5.1.1 Dispersal()

```
Dispersal::Dispersal (
            DispersalParams * params,
            BoundaryType boundary,
            double side )
```

6.5.1.2 ~Dispersal()

```
Dispersal::~Dispersal ( )
```

6.5.2 Member Function Documentation

6.5.2.1 adults_disperse()

```
virtual void Dispersal::adults_disperse (
            std::vector< Patch * > & sites )  [pure virtual]
```

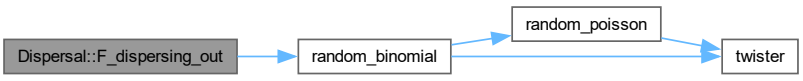
Implemented in DistanceKernelDispersal, and RadialDispersal.

Here is the caller graph for this function:

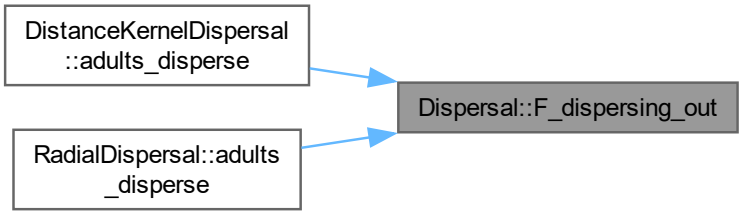
6.5.2.2 F_dispersing_out()

```
std::vector< std::array< std::array< long long int, num_gen >, num_gen > > Dispersal::F_↩
dispersing_out (
            const std::vector< Patch * > & sites )  [protected]
```

Here is the call graph for this function:



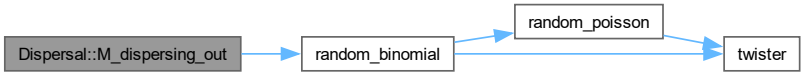
Here is the caller graph for this function:



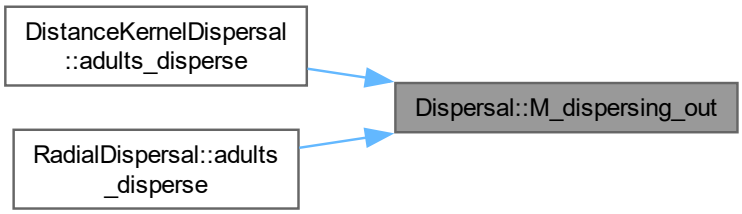
6.5.2.3 M_dispersing_out()

```
std::vector< std::array< long long int, num_gen > > Dispersal::M_dispersing_out (
            const std::vector< Patch * > & sites )  [protected]
```

Here is the call graph for this function:



Here is the caller graph for this function:



6.5.2.4 set_connecs()

```
virtual void Dispersal::set_connecs (
            std::vector< Patch * > & sites )  [pure virtual]
```

Implemented in DistanceKernelDispersal, and RadialDispersal.

Here is the caller graph for this function:

6.5.3 Member Data Documentation

6.5.3.1 boundary_strategy

```
BoundaryStrategy* Dispersal::boundary_strategy  [protected]
```

6.5.3.2 connec_indices

```
std::vector<std::vector<int> > Dispersal::connec_indices  [protected]
```

6.5.3.3 connec_weights

```
std::vector<std::vector<double> > Dispersal::connec_weights  [protected]
```

6.5.3.4 disp_rate

```
double Dispersal::disp_rate  [protected]
```

6.5.3.5 max_disp

```
double Dispersal::max_disp  [protected]
```

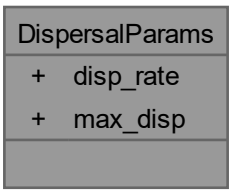
The documentation for this class was generated from the following files:

- Dispersal.h
- Dispersal.cpp

6.6 DispersalParams Struct Reference

`#include <Params.h>`

Collaboration diagram for DispersalParams:



Public Attributes

- double disp_rate = 0.01
- double max_disp = 0.2

6.6.1 Member Data Documentation

6.6.1.1 disp_rate

```
double DispersalParams::disp_rate = 0.01
```

6.6.1.2 max_disp

```
double DispersalParams::max_disp = 0.2
```

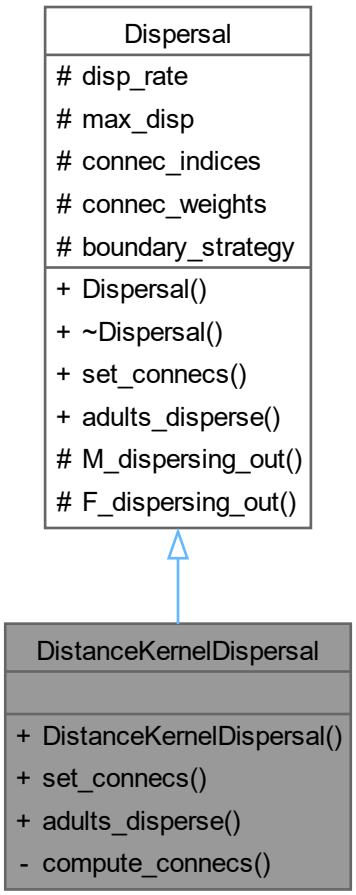
The documentation for this struct was generated from the following file:

- Params.h

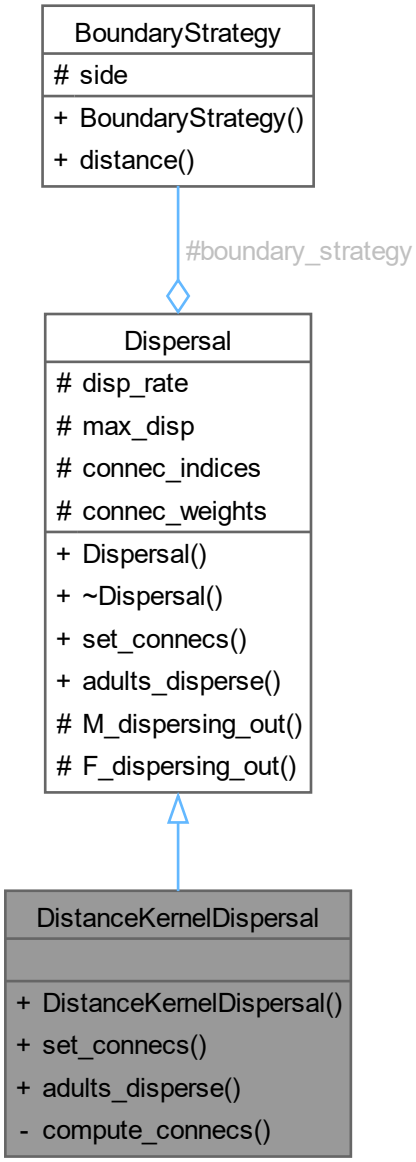
6.7 DistanceKernelDispersal Class Reference

`#include <Dispersal.h>`

Inheritance diagram for DistanceKernelDispersal:



Collaboration diagram for DistanceKernelDispersal:



Public Member Functions

- DistanceKernelDispersal (DispersalParams *params, BoundaryType boundary, double side)
- void set_connecs (std::vector< Patch * > &sites) override
- void adults_disperse (std::vector< Patch * > &sites) override

Public Member Functions inherited from Dispersal

- Dispersal (DispersalParams *params, BoundaryType boundary, double side)
- ~Dispersal ()

Private Member Functions

- std::pair< std::vector< std::vector< int > >, std::vector< std::vector< double > > > compute_connecs (std::vector< Patch * > &sites)

Additional Inherited Members

Protected Member Functions inherited from Dispersal

- std::vector< std::array< long long int, num_gen > > M_dispersing_out (const std::vector< Patch * > &sites)
- std::vector< std::array< std::array< long long int, num_gen >, num_gen > > F_dispersing_out (const std::vector< Patch * > &sites)

Protected Attributes inherited from Dispersal

- double disp_rate
- double max_disp
- std::vector< std::vector< int > > connec_indices
- std::vector< std::vector< double > > connec_weights
- BoundaryStrategy * boundary_strategy

6.7.1 Constructor & Destructor Documentation

6.7.1.1 DistanceKernelDispersal()

```
DistanceKernelDispersal::DistanceKernelDispersal (
            DispersalParams * params,
            BoundaryType boundary,
            double side )  [inline]
```

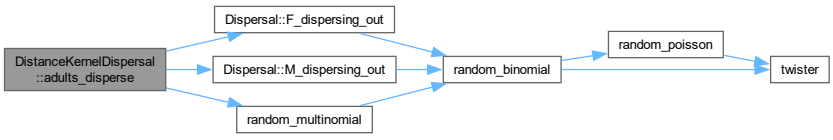
6.7.2 Member Function Documentation

6.7.2.1 adults_disperse()

```
void DistanceKernelDispersal::adults_disperse (
            std::vector< Patch * > & sites )  [override], [virtual]
```

Implements Dispersal.

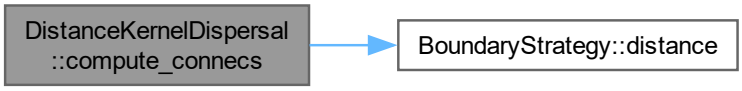
Here is the call graph for this function:



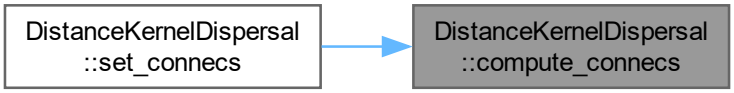
6.7.2.2 compute_connecs()

```
std::pair< std::vector< std::vector< int > >, std::vector< std::vector< double > > > DistanceKernelDispersal::compute_connecs (
            std::vector< Patch * > & sites )  [private]
```

Here is the call graph for this function:



Here is the caller graph for this function:

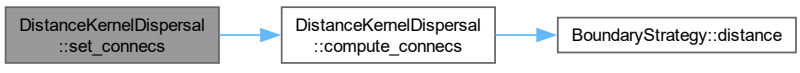


6.7.2.3 set_connecs()

```
void DistanceKernelDispersal::set_connecs (
            std::vector< Patch * > & sites )  [override], [virtual]
```

Implements Dispersal.

Here is the call graph for this function:



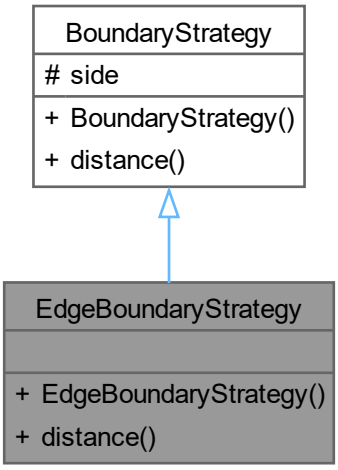
The documentation for this class was generated from the following files:

- Dispersal.h
- Dispersal.cpp

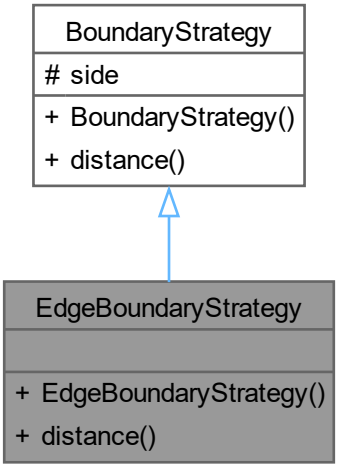
6.8 EdgeBoundaryStrategy Class Reference

`#include <BoundaryStrategy.h>`

Inheritance diagram for EdgeBoundaryStrategy:



Collaboration diagram for EdgeBoundaryStrategy:



Public Member Functions

- EdgeBoundaryStrategy (double side)
- double distance (const Point &p1, const Point &p2) override

Public Member Functions inherited from BoundaryStrategy

- BoundaryStrategy (double side)

Additional Inherited Members

Protected Attributes inherited from BoundaryStrategy

- double side

6.8.1 Constructor & Destructor Documentation

6.8.1.1 EdgeBoundaryStrategy()

```
EdgeBoundaryStrategy::EdgeBoundaryStrategy (
            double side )  [inline]
```

6.8.2 Member Function Documentation

6.8.2.1 distance()

```
double EdgeBoundaryStrategy::distance (
            const Point & p1,
            const Point & p2 )  [override], [virtual]
```

Implements BoundaryStrategy.

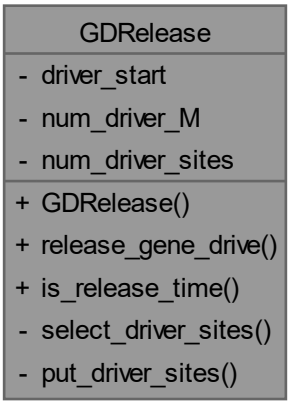
The documentation for this class was generated from the following files:

- BoundaryStrategy.h
- BoundaryStrategy.cpp

6.9 GDRelease Class Reference

```
#include <GDRelease.h>
```

Collaboration diagram for GDRelease:



Public Member Functions

- GDRelease (ReleaseParams *params)
- void release_gene_drive (std::vector< Patch * > &sites)
- bool is_release_time (int day)

Private Member Functions

- std::vector< Patch * > select_driver_sites (int num_rel_sites, const std::vector< Patch * > &sites)
- void put_driver_sites (std::vector< Patch * > &rel_sites, std::vector< Patch * > &sites)

Private Attributes

- int driver_start
- int num_driver_M
- int num_driver_sites

6.9.1 Constructor & Destructor Documentation

6.9.1.1 GDRelease()

```
GDRelease::GDRelease (
            ReleaseParams * params )
```

6.9.2 Member Function Documentation

6.9.2.1 is_release_time()

```
bool GDRelease::is_release_time (
            int day )
```

Here is the caller graph for this function:

6.9.2.2 put_driver_sites()

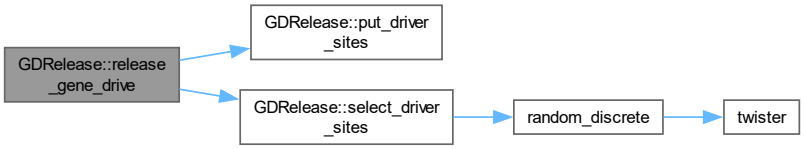
```
void GDRelease::put_driver_sites (
            std::vector< Patch * > & rel_sites,
            std::vector< Patch * > & sites )  [private]
```

Here is the caller graph for this function:

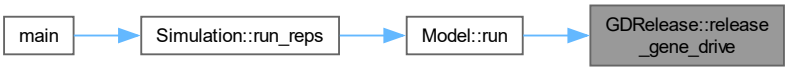
6.9.2.3 release_gene_drive()

```
void GDRelease::release_gene_drive (
            std::vector< Patch * > & sites )
```

Here is the call graph for this function:



Here is the caller graph for this function:

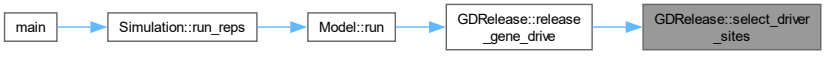


6.9.2.4 select_driver_sites()

```
std::vector< Patch * > GDRelease::select_driver_sites (
            int num_rel_sites,
            const std::vector< Patch * > & sites )  [private]
```

Here is the call graph for this function:

Here is the caller graph for this function:



6.9.3 Member Data Documentation

6.9.3.1 driver_start

```
int GDRelease::driver_start  [private]
```

6.9.3.2 num_driver_M

```
int GDRelease::num_driver_M  [private]
```

6.9.3.3 num_driver_sites

```
int GDRelease::num_driver_sites  [private]
```

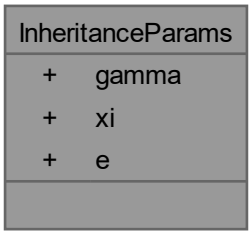
The documentation for this class was generated from the following files:

- GDRelease.h
- GDRelease.cpp

6.10 InheritanceParams Struct Reference

```
#include <Params.h>
```

Collaboration diagram for InheritanceParams:



Public Attributes

- double gamma = 0.025
- double xi = 0.2
- double e = 0.95

6.10.1 Member Data Documentation

6.10.1.1 e

```
double InheritanceParams::e = 0.95
```

6.10.1.2 gamma

```
double InheritanceParams::gamma = 0.025
```

6.10.1.3 xi

```
double InheritanceParams::xi = 0.2
```

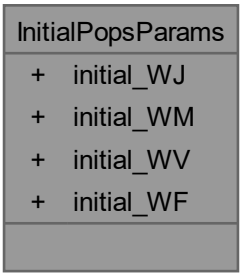
The documentation for this struct was generated from the following file:

- Params.h

6.11 InitialPopsParams Struct Reference

```
#include <Params.h>
```

Collaboration diagram for InitialPopsParams:



Public Attributes

- int initial_WJ = 10000
- int initial_WM = 50000
- int initial_WV = 10000
- int initial_WF = 40000

6.11.1 Member Data Documentation

6.11.1.1 initial_WF

```
int InitialPopsParams::initial_WF = 40000
```

6.11.1.2 initial_WJ

```
int InitialPopsParams::initial_WJ = 10000
```

6.11.1.3 initial_WM

```
int InitialPopsParams::initial_WM = 50000
```

6.11.1.4 initial_WV

```
int InitialPopsParams::initial_WV = 10000
```

The documentation for this struct was generated from the following file:

- Params.h

6.12 LifeParams Struct Reference

```
#include <Params.h>
```

Collaboration diagram for LifeParams:

Public Attributes

- double mu_j = 0.05
- double mu_a = 0.125
- double beta = 100.0
- double theta = 9.0
- double alpha0 = 100000.0
- double mean_dev = 15.0
- int min_dev = 10

6.12.1 Member Data Documentation

6.12.1.1 alpha0

```
double LifeParams::alpha0 = 100000.0
```

6.12.1.2 beta

```
double LifeParams::beta = 100.0
```

6.12.1.3 mean_dev

```
double LifeParams::mean_dev = 15.0
```

6.12.1.4 min_dev

```
int LifeParams::min_dev = 10
```

6.12.1.5 mu_a

```
double LifeParams::mu_a = 0.125
```

6.12.1.6 mu_j

```
double LifeParams::mu_j = 0.05
```

6.12.1.7 theta

```
double LifeParams::theta = 9.0
```

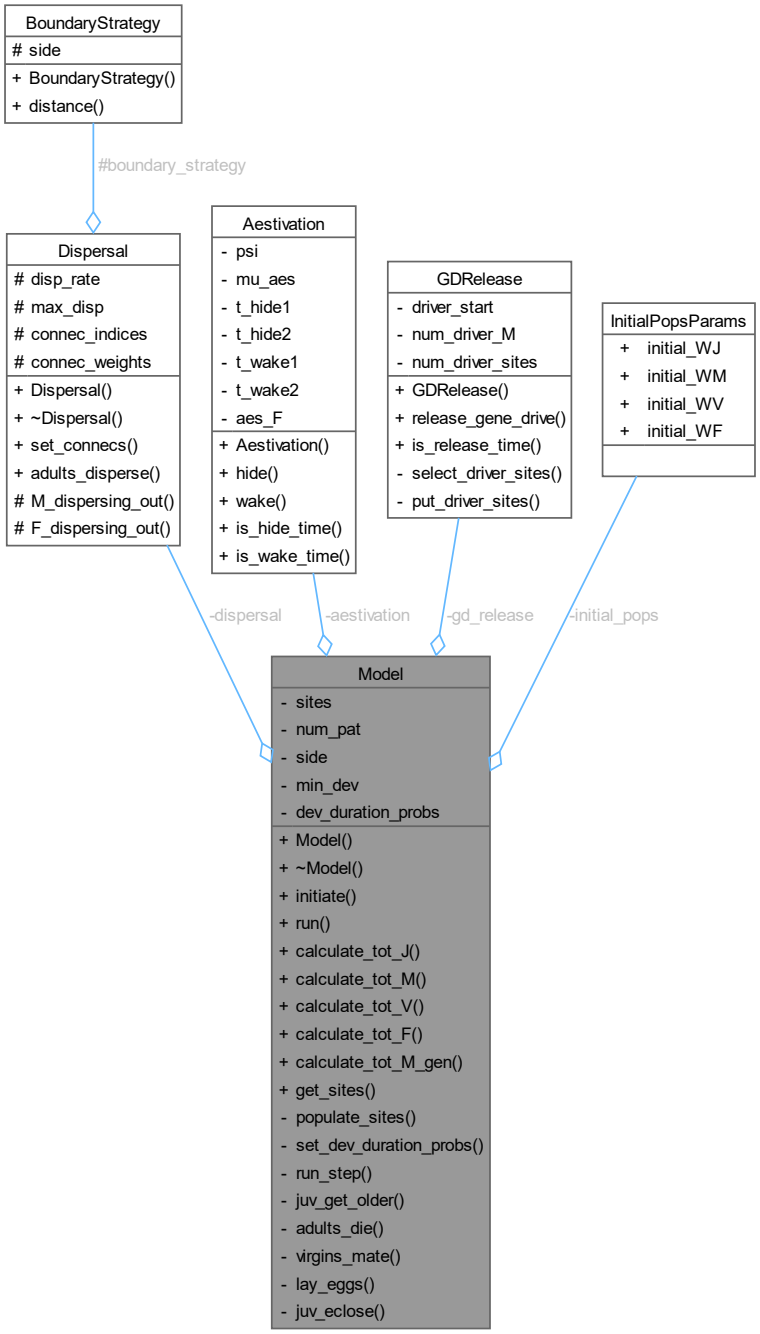
The documentation for this struct was generated from the following file:

- Params.h

6.13 Model Class Reference

`#include <Model.h>`

Collaboration diagram for Model:



Public Member Functions

- Model (AreaParams *area, InitialPopsParams *initial, LifeParams *life, AestivationParams *aes, DispersalParams *disp, ReleaseParams *rel, BoundaryType boundary=BoundaryType::Toroid, DispersalType disp_type=DispersalType::DistanceKernel, std::vector< Point > coords={})

- ~Model ()
- void initiate ()
- void run (int day, const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen > &inher_fraction)
- long long int calculate_tot_J ()
- long long int calculate_tot_M ()
- long long int calculate_tot_V ()
- long long int calculate_tot_F ()
- std::array< long long int, num_gen > calculate_tot_M_gen ()
- std::vector< Patch * > get_sites () const

Private Member Functions

- void populate_sites ()
- void set_dev_duration_probs (int min_time, int max_time)
- void run_step (int day, const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen > &inher_fraction)
- void juv_get_older ()
- void adults_die ()
- void virgins_mate ()
- void lay_eggs (const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen > &inher_fraction)
- void juv_eclose ()

Private Attributes

- std::vector< Patch * > sites
- Dispersal * dispersal
- Aestivation * aestivation
- GDRelease * gd_release
- int num_pat
- double side
- InitialPopsParams * initial_pops
- int min_dev
- std::array< double, max_dev+1 > dev_duration_probs

6.13.1 Constructor & Destructor Documentation

6.13.1.1 Model()

```
Model::Model (
            AreaParams * area,
            InitialPopsParams * initial,
            LifeParams * life,
            AestivationParams * aes,
            DispersalParams * disp,
            ReleaseParams * rel,
            BoundaryType boundary = BoundaryType::Toroid,
            DispersalType disp_type = DispersalType::DistanceKernel,
            std::vector< Point > coords = {} )
```

6.13.1.2 ~Model()

```
Model::~Model ( )
```

6.13.2 Member Function Documentation

6.13.2.1 adults_die()

```
void Model::adults_die ( )  [private]
```

Here is the caller graph for this function:

6.13.2.2 calculate_tot_F()

```
long long int Model::calculate_tot_F ( )
```

Here is the caller graph for this function:

6.13.2.3 calculate_tot_J()

```
long long int Model::calculate_tot_J ( )
```

Here is the caller graph for this function:

6.13.2.4 calculate_tot_M()

```
long long int Model::calculate_tot_M ( )
```

Here is the caller graph for this function:

6.13.2.5 calculate_tot_M_gen()

```
std::array< long long int, num_gen > Model::calculate_tot_M_gen ( )
```

Here is the caller graph for this function:

6.13.2.6 calculate_tot_V()

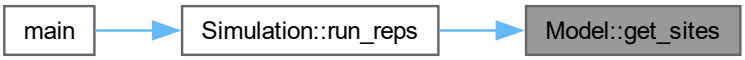
```
long long int Model::calculate_tot_V ( )
```

Here is the caller graph for this function:

6.13.2.7 get_sites()

```
std::vector< Patch * > Model::get_sites ( ) const
```

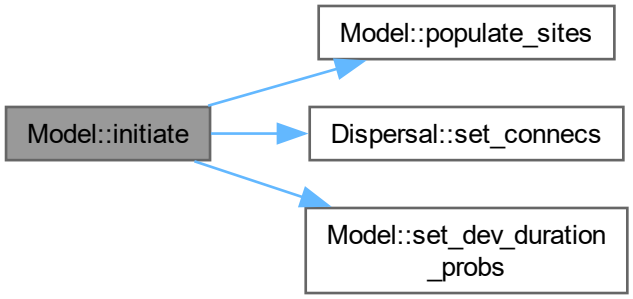
Here is the caller graph for this function:



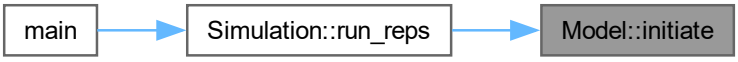
6.13.2.8 initiate()

```
void Model::initiate ( )
```

Here is the call graph for this function:



Here is the caller graph for this function:



6.13.2.9 juv_eclose()

```
void Model::juv_eclose ( )  [private]
```

Here is the caller graph for this function:

6.13.2.10 juv_get_older()

```
void Model::juv_get_older ( )  [private]
```

Here is the caller graph for this function:

6.13.2.11 lay_eggs()

```
void Model::lay_eggs (
            const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen
> & inher_fraction )  [private]
```

Here is the caller graph for this function:

6.13.2.12 populate_sites()

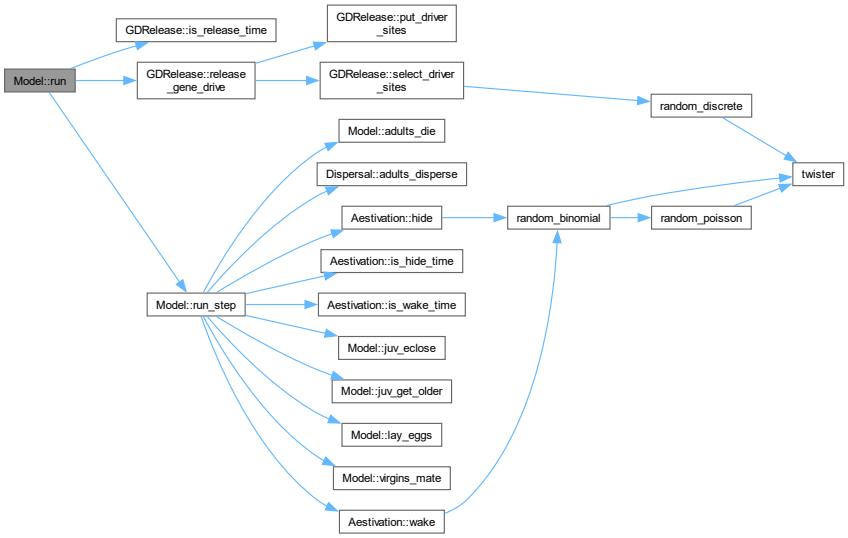
```
void Model::populate_sites ( )  [private]
```

Here is the caller graph for this function:

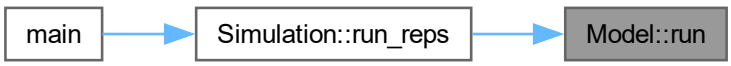
6.13.2.13 run()

```
void Model::run (
            int day,
            const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen
> & inher_fraction )
```

Here is the call graph for this function:



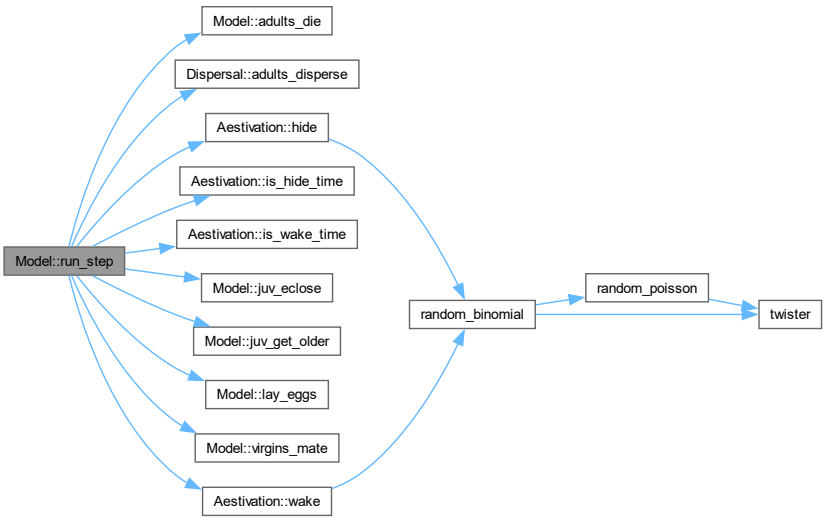
Here is the caller graph for this function:



6.13.2.14 run_step()

```
void Model::run_step (
            int day,
            const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen
> & inher_fraction )  [private]
```

Here is the call graph for this function:



Here is the caller graph for this function:

6.13.2.15 set_dev_duration_probs()

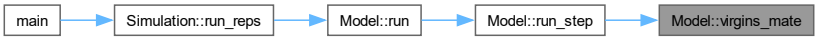
```
void Model::set_dev_duration_probs (
            int min_time,
            int max_time )  [private]
```

Here is the caller graph for this function:

6.13.2.16 virgins_mate()

```
void Model::virgins_mate ( )  [private]
```

Here is the caller graph for this function:



6.13.3 Member Data Documentation

6.13.3.1 aestivation

```
Aestivation* Model::aestivation  [private]
```

6.13.3.2 dev_duration_probs

```
std::array<double, max_dev+1> Model::dev_duration_probs  [private]
```

6.13.3.3 dispersal

```
Dispersal* Model::dispersal  [private]
```

6.13.3.4 gd_release

```
GDRelease* Model::gd_release  [private]
```

6.13.3.5 initial_pops

```
InitialPopsParams* Model::initial_pops  [private]
```

6.13.3.6 min_dev

```
int Model::min_dev  [private]
```

6.13.3.7 num_pat

```
int Model::num_pat  [private]
```

6.13.3.8 side

```
double Model::side  [private]
```

6.13.3.9 sites

```
std::vector<Patch*> Model::sites  [private]
```

The documentation for this class was generated from the following files:

- Model.h
- Model.cpp

6.14 Patch Class Reference

```
#include <Patch.h>
```

Collaboration diagram for Patch:

Public Member Functions

- Patch (LifeParams ∗par, double side)
- Patch (LifeParams ∗par, Point point)
- void populate (int initial_WJ, int initial_WM, int initial_WV, int initial_WF)
- Point get_coords () const
- std::array< long long int, num_gen > get_M () const

- std::array< std::array< long long int, num_gen >, num_gen > get_F () const
- long long int calculate_tot_J ()
- long long int calculate_tot_M ()
- long long int calculate_tot_V ()
- long long int calculate_tot_F ()
- void juv_get_older (int max_dev)
- void adults_die ()
- void virgins_mate ()
- void lay_eggs (const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen > &f, const std::array< double, max_dev+1 > &dev_duration_probs)
- void juv_eclose ()
- void update_comp ()
- void update_mate ()
- void M_disperse_out (const std::array< long long int, num_gen > &m_out)
- void F_disperse_out (const std::array< std::array< long long int, num_gen >, num_gen > &f_out)
- void M_disperse_in (int gen, long long int m_in)
- void F_disperse_in (int f_gen, int m_gen, long long int f_disp)
- void F_hide (const std::array< std::array< long long int, num_gen >, num_gen > &f_try)
- void F_wake (const std::array< std::array< long long int, num_gen >, num_gen > &f_wake)
- void add_driver_M (int num_driver_M)

Private Attributes

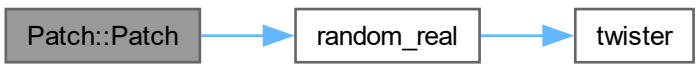
- LifeParams * params
- Point coords
- std::array< std::array< long long int, max_dev+1 >, num_gen > J
- std::array< long long int, num_gen > M
- std::array< long long int, num_gen > V
- std::array< std::array< long long int, num_gen >, num_gen > F
- long double comp
- long double mate_rate

6.14.1 Constructor & Destructor Documentation

6.14.1.1 Patch() [1/2]

```
Patch::Patch (
            LifeParams * par,
            double side )
```

Here is the call graph for this function:



6.14.1.2 Patch() [2/2]

```
Patch::Patch (
            LifeParams * par,
            Point point )
```

Here is the call graph for this function:

6.14.2 Member Function Documentation

6.14.2.1 add_driver_M()

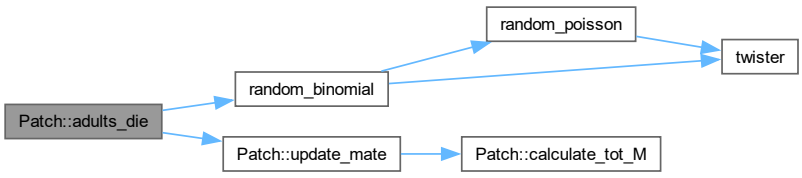
```
void Patch::add_driver_M (
            int num_driver_M )
```

Here is the call graph for this function:

6.14.2.2 adults_die()

```
void Patch::adults_die ( )
```

Here is the call graph for this function:



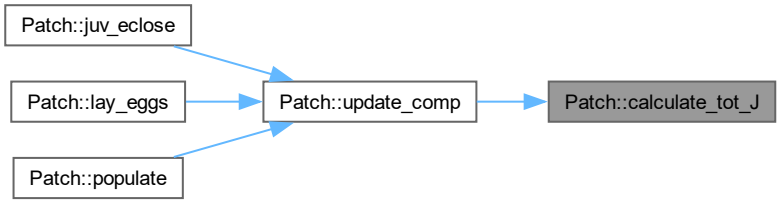
6.14.2.3 calculate_tot_F()

```
long long int Patch::calculate_tot_F ( )
```

6.14.2.4 calculate_tot_J()

```
long long int Patch::calculate_tot_J ( )
```

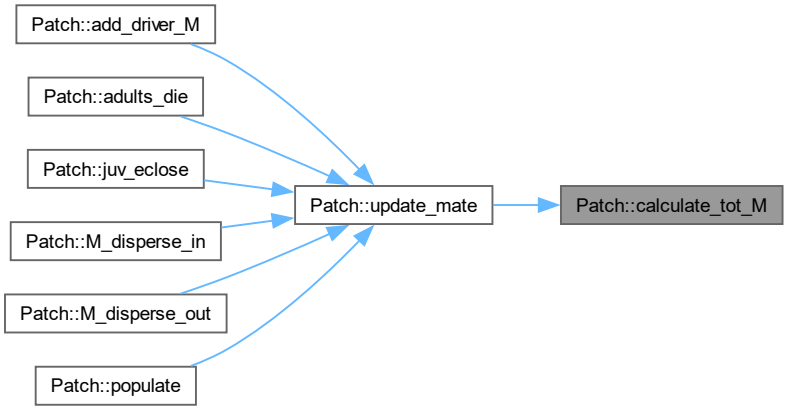
Here is the caller graph for this function:



6.14.2.5 calculate_tot_M()

```
long long int Patch::calculate_tot_M ( )
```

Here is the caller graph for this function:



6.14.2.6 calculate_tot_V()

```
long long int Patch::calculate_tot_V ( )
```

6.14.2.7 F_disperse_in()

```
void Patch::F_disperse_in (
            int f_gen,
            int m_gen,
            long long int f_disp )
```

6.14.2.8 F_disperse_out()

```
void Patch::F_disperse_out (
            const std::array< std::array< long long int, num_gen >, num_gen > & f_out )
```

6.14.2.9 F_hide()

```
void Patch::F_hide (
            const std::array< std::array< long long int, num_gen >, num_gen > & f_try )
```

6.14.2.10 F_wake()

```
void Patch::F_wake (
            const std::array< std::array< long long int, num_gen >, num_gen > & f_wake )
```

6.14.2.11 get_coords()

```
Point Patch::get_coords ( ) const
```

6.14.2.12 get_F()

```
std::array< std::array< long long int, num_gen >, num_gen > Patch::get_F ( ) const
```

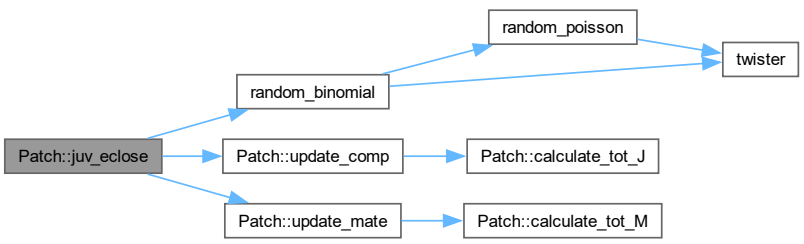
6.14.2.13 get_M()

```
std::array< long long int, num_gen > Patch::get_M ( ) const
```

6.14.2.14 juv_eclose()

```
void Patch::juv_eclose ( )
```

Here is the call graph for this function:



6.14.2.15 juv_get_older()

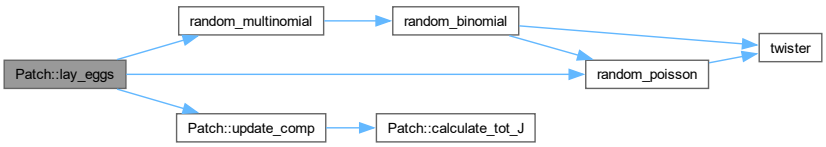
```
void Patch::juv_get_older (
            int max_dev )
```

Here is the call graph for this function:

6.14.2.16 lay_eggs()

```
void Patch::lay_eggs (
            const std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen
> & f,
            const std::array< double, max_dev+1 > & dev_duration_probs )
```

Here is the call graph for this function:



6.14.2.17 M_disperse_in()

```
void Patch::M_disperse_in (
            int gen,
            long long int m_in )
```

Here is the call graph for this function:

6.14.2.18 M_disperse_out()

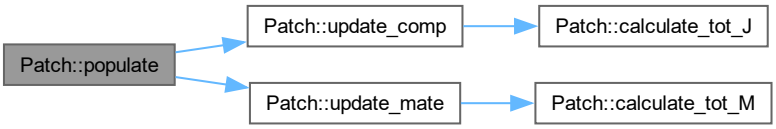
```
void Patch::M_disperse_out (
            const std::array< long long int, num_gen > & m_out )
```

Here is the call graph for this function:

6.14.2.19 populate()

```
void Patch::populate (
            int initial_WJ,
            int initial_WM,
            int initial_WV,
            int initial_WF )
```

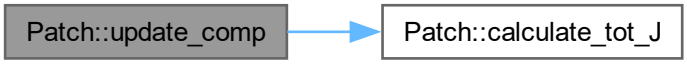
Here is the call graph for this function:



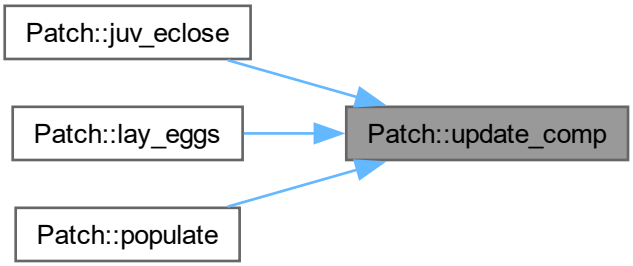
6.14.2.20 update_comp()

```
void Patch::update_comp ( )
```

Here is the call graph for this function:



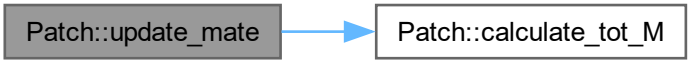
Here is the caller graph for this function:



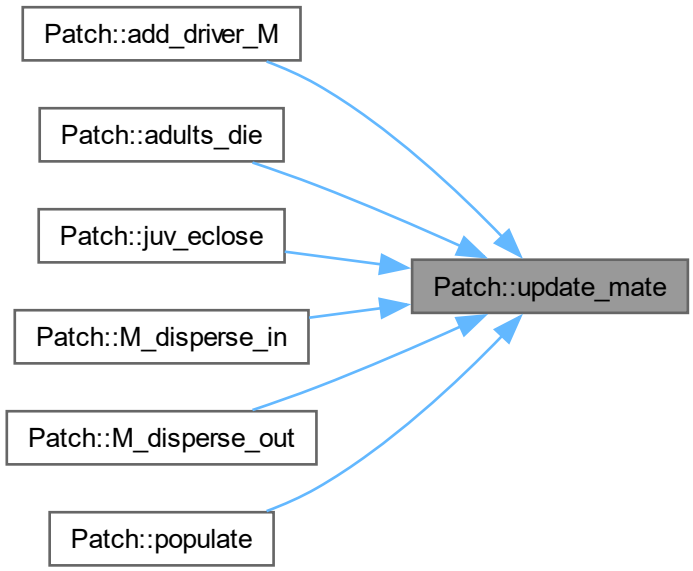
6.14.2.21 update_mate()

```
void Patch::update_mate ( )
```

Here is the call graph for this function:



Here is the caller graph for this function:



6.14.2.22 virgins_mate()

```
void Patch::virgins_mate ( )
```

Here is the call graph for this function:

6.14.3 Member Data Documentation

6.14.3.1 comp

```
long double Patch::comp  [private]
```

6.14.3.2 coords

```
Point Patch::coords  [private]
```

6.14.3.3 F

```
std::array<std::array<long long int, num_gen>, num_gen> Patch::F  [private]
```

6.14.3.4 J

```
std::array<std::array<long long int, max_dev+1>, num_gen> Patch::J  [private]
```

6.14.3.5 M

```
std::array<long long int, num_gen> Patch::M  [private]
```

6.14.3.6 mate_rate

```
long double Patch::mate_rate  [private]
```

6.14.3.7 params

```
LifeParams* Patch::params  [private]
```

6.14.3.8 V

```
std::array<long long int, num_gen> Patch::V  [private]
```

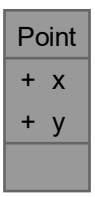
The documentation for this class was generated from the following files:

- Patch.h
- Patch.cpp

6.15 Point Struct Reference

```
#include <Point.h>
```

Collaboration diagram for Point:



Public Attributes

- double x = 0
- double y = 0

6.15.1 Member Data Documentation

6.15.1.1 x

```
double Point::x = 0
```

6.15.1.2 y

```
double Point::y = 0
```

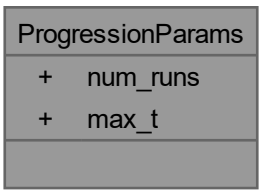
The documentation for this struct was generated from the following file:

- Point.h

6.16 ProgressionParams Struct Reference

```
#include <Params.h>
```

Collaboration diagram for ProgressionParams:



Public Attributes

- int num_runs = 1
- int max_t = 1000

6.16.1 Member Data Documentation

6.16.1.1 max_t

```
int ProgressionParams::max_t = 1000
```

6.16.1.2 num_runs

```
int ProgressionParams::num_runs = 1
```

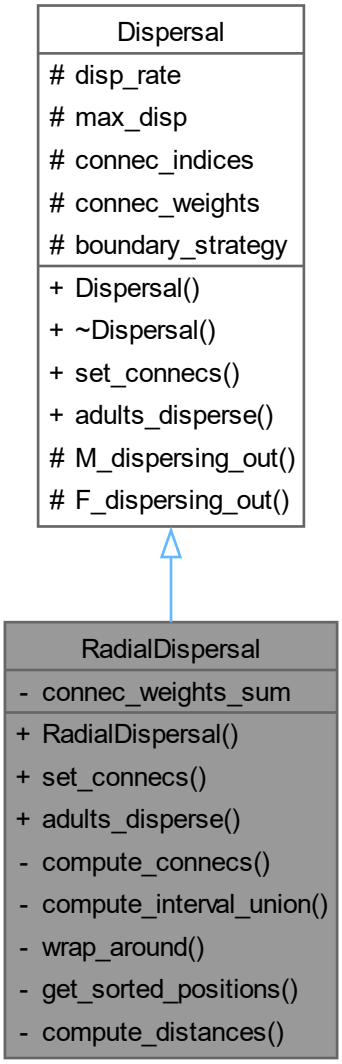
The documentation for this struct was generated from the following file:

- Params.h

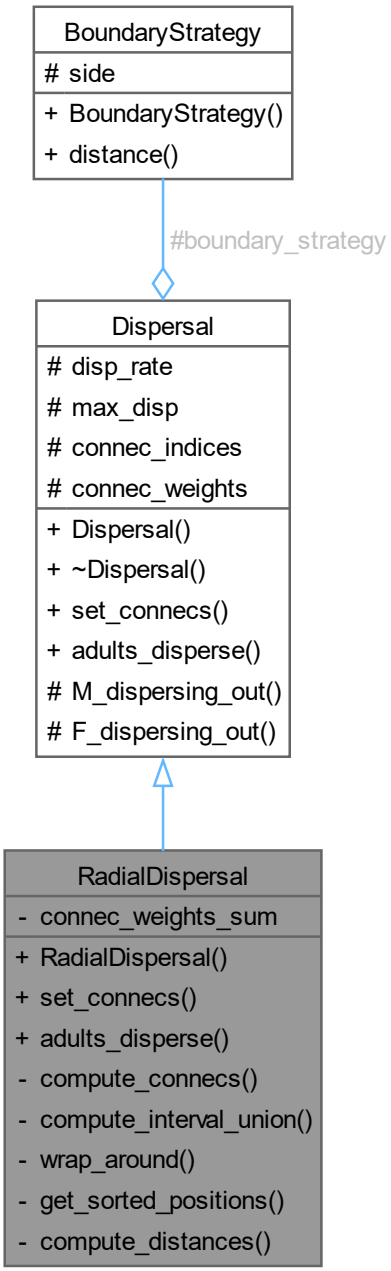
6.17 RadialDispersal Class Reference

```
#include <Dispersal.h>
```

Inheritance diagram for RadialDispersal:



Collaboration diagram for RadialDispersal:



Public Member Functions

- RadialDispersal (DispersalParams *params, BoundaryType boundary, double side)
- void set_connecs (std::vector< Patch * > &sites) override
- void adults_disperse (std::vector< Patch * > &sites) override

Public Member Functions inherited from Dispersal

- Dispersal (DispersalParams *params, BoundaryType boundary, double side)
- ~Dispersal ()

Private Member Functions

- std::pair< std::vector< std::vector< int > >, std::vector< std::vector< double > > > compute_connecs (std::vector< Patch * > &sites)
- std::pair< std::vector< std::pair< double, double > >, double > compute_interval_union (const std::pair< double, double > &qq, const std::vector< std::pair< double, double > > &input)
- double wrap_around (double value, double range)
- std::vector< int > get_sorted_positions (const std::vector< double > &numbers)
- std::vector< std::vector< double > > compute_distances (const std::vector< Patch * > &sites)

Private Attributes

- std::vector< double > connec_weights_sum

Additional Inherited Members

Protected Member Functions inherited from Dispersal

- std::vector< std::array< long long int, num_gen > > M_dispersing_out (const std::vector< Patch * > &sites)
- std::vector< std::array< std::array< long long int, num_gen >, num_gen > > F_dispersing_out (const std::vector< Patch * > &sites)

Protected Attributes inherited from Dispersal

- double disp_rate
- double max_disp
- std::vector< std::vector< int > > connec_indices
- std::vector< std::vector< double > > connec_weights
- BoundaryStrategy * boundary_strategy

6.17.1 Constructor & Destructor Documentation

6.17.1.1 RadialDispersal()

```
RadialDispersal::RadialDispersal (
            DispersalParams * params,
            BoundaryType boundary,
            double side )
```

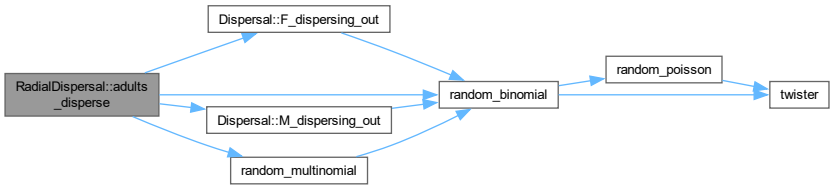
6.17.2 Member Function Documentation

6.17.2.1 adults_disperse()

```
void RadialDispersal::adults_disperse (
            std::vector< Patch * > & sites )  [override], [virtual]
```

Implements Dispersal.

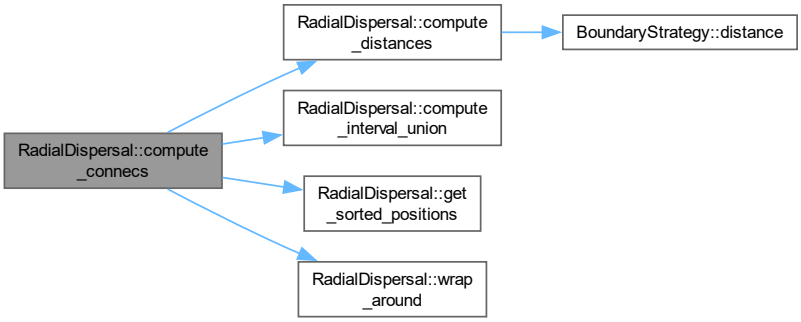
Here is the call graph for this function:



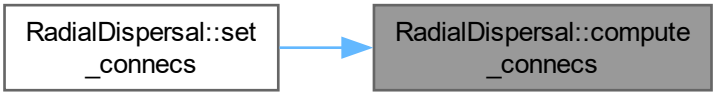
6.17.2.2 compute_connecs()

```
std::pair< std::vector< std::vector< int > >, std::vector< std::vector< double > > > Radial↩
Dispersal::compute_connecs (
            std::vector< Patch * > & sites )  [private]
```

Here is the call graph for this function:



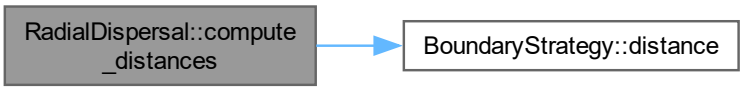
Here is the caller graph for this function:



6.17.2.3 compute_distances()

```
std::vector< std::vector< double > > RadialDispersal::compute_distances (
            const std::vector< Patch * > & sites )  [private]
```

Here is the call graph for this function:



Here is the caller graph for this function:

6.17.2.4 compute_interval_union()

```
std::pair< std::vector< std::pair< double, double > >, double > RadialDispersal::compute_↩
interval_union (
            const std::pair< double, double > & qq,
            const std::vector< std::pair< double, double > > & input )  [private]
```

Here is the caller graph for this function:

6.17.2.5 get_sorted_positions()

```
std::vector< int > RadialDispersal::get_sorted_positions (
            const std::vector< double > & numbers )  [private]
```

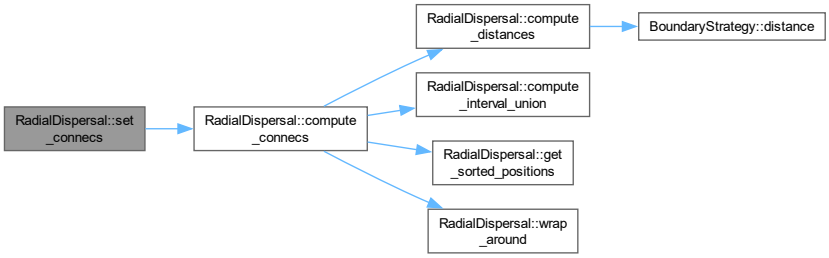
Here is the caller graph for this function:

6.17.2.6 set_connecs()

```
void RadialDispersal::set_connecs (
            std::vector< Patch * > & sites )  [override], [virtual]
```

Implements Dispersal.

Here is the call graph for this function:



6.17.2.7 wrap_around()

```
double RadialDispersal::wrap_around (
            double value,
            double range )  [private]
```

Here is the caller graph for this function:

6.17.3 Member Data Documentation

6.17.3.1 connec_weights_sum

```
std::vector<double> RadialDispersal::connec_weights_sum  [private]
```

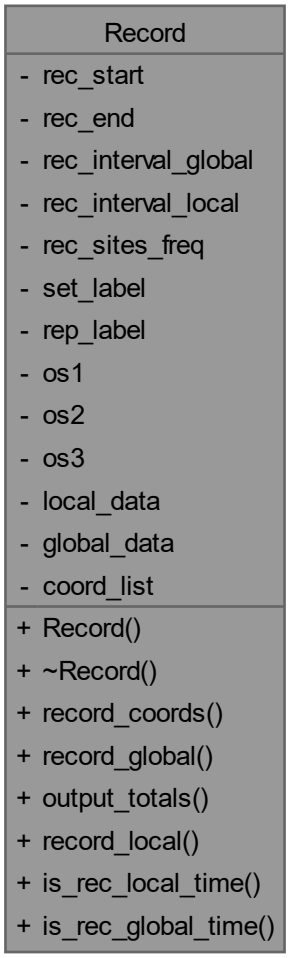
The documentation for this class was generated from the following files:

- Dispersal.h
- Dispersal.cpp

6.18 Record Class Reference

```
#include <Record.h>
```

Collaboration diagram for Record:



Public Member Functions

- Record (RecordParams *rec_params, int rep)
- ~Record ()
- void record_coords (const std::vector< Patch * > &sites)
- void record_global (int day, const std::array< long long int, num_gen > &tot_M_gen)
- void output_totals (int day, long long int tot_J, long long int tot_M, long long int tot_V, long long int tot_F)
- void record_local (int day, const std::vector< Patch * > &sites)
- bool is_rec_local_time (int day)
- bool is_rec_global_time (int day)

Private Attributes

- int rec_start
- int rec_end
- int rec_interval_global
- int rec_interval_local
- int rec_sites_freq
- int set_label
- int rep_label
- std::ostringstream os1
- std::ostringstream os2
- std::ostringstream os3
- std::ofstream local_data
- std::ofstream global_data
- std::ofstream coord_list

6.18.1 Constructor & Destructor Documentation

6.18.1.1 Record()

```
Record::Record (
            RecordParams * rec_params,
            int rep )
```

6.18.1.2 ~Record()

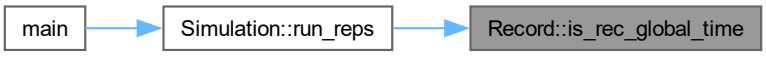
```
Record::~Record ( )
```

6.18.2 Member Function Documentation

6.18.2.1 is_rec_global_time()

```
bool Record::is_rec_global_time (
            int day )
```

Here is the caller graph for this function:



6.18.2.2 is_rec_local_time()

```
bool Record::is_rec_local_time (
            int day )
```

Here is the caller graph for this function:

6.18.2.3 output_totals()

```
void Record::output_totals (
            int day,
            long long int tot_J,
            long long int tot_M,
            long long int tot_V,
            long long int tot_F )
```

Here is the caller graph for this function:

6.18.2.4 record_coords()

```
void Record::record_coords (
            const std::vector< Patch * > & sites )
```

Here is the caller graph for this function:

6.18.2.5 record_global()

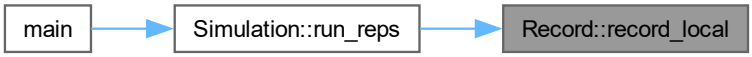
```
void Record::record_global (
            int day,
            const std::array< long long int, num_gen > & tot_M_gen )
```

Here is the caller graph for this function:

6.18.2.6 record_local()

```
void Record::record_local (
            int day,
            const std::vector< Patch * > & sites )
```

Here is the caller graph for this function:



6.18.3 Member Data Documentation

6.18.3.1 coord_list

```
std::ofstream Record::coord_list  [private]
```

6.18.3.2 global_data

```
std::ofstream Record::global_data  [private]
```

6.18.3.3 local_data

```
std::ofstream Record::local_data  [private]
```

6.18.3.4 os1

```
std::ostringstream Record::os1  [private]
```

6.18.3.5 os2

```
std::ostringstream Record::os2  [private]
```

6.18.3.6 os3

```
std::ostringstream Record::os3  [private]
```

6.18.3.7 rec_end

```
int Record::rec_end  [private]
```

6.18.3.8 rec_interval_global

```
int Record::rec_interval_global  [private]
```

6.18.3.9 rec_interval_local

```
int Record::rec_interval_local  [private]
```

6.18.3.10 rec_sites_freq

```
int Record::rec_sites_freq  [private]
```

6.18.3.11 rec_start

```
int Record::rec_start  [private]
```

6.18.3.12 rep_label

```
int Record::rep_label  [private]
```

6.18.3.13 set_label

```
int Record::set_label  [private]
```

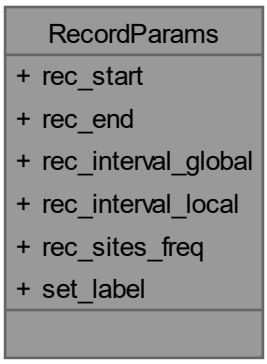
The documentation for this class was generated from the following files:

- Record.h
- Record.cpp

6.19 RecordParams Struct Reference

`#include <Params.h>`

Collaboration diagram for RecordParams:



Public Attributes

- int rec_start = 0
- int rec_end = 1000
- int rec_interval_global = 1
- int rec_interval_local = 200
- int rec_sites_freq = 1
- int set_label = 1

6.19.1 Member Data Documentation

6.19.1.1 rec_end

```
int RecordParams::rec_end = 1000
```

6.19.1.2 rec_interval_global

```
int RecordParams::rec_interval_global = 1
```

6.19.1.3 rec_interval_local

```
int RecordParams::rec_interval_local = 200
```

6.19.1.4 rec_sites_freq

```
int RecordParams::rec_sites_freq = 1
```

6.19.1.5 rec_start

```
int RecordParams::rec_start = 0
```

6.19.1.6 set_label

```
int RecordParams::set_label = 1
```

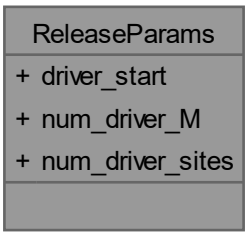
The documentation for this struct was generated from the following file:

- Params.h

6.20 ReleaseParams Struct Reference

```
#include <Params.h>
```

Collaboration diagram for ReleaseParams:



Public Attributes

- int driver_start = 200
- int num_driver_M = 1000
- int num_driver_sites = 5

6.20.1 Member Data Documentation

6.20.1.1 driver_start

```
int ReleaseParams::driver_start = 200
```

6.20.1.2 num_driver_M

```
int ReleaseParams::num_driver_M = 1000
```

6.20.1.3 num_driver_sites

```
int ReleaseParams::num_driver_sites = 5
```

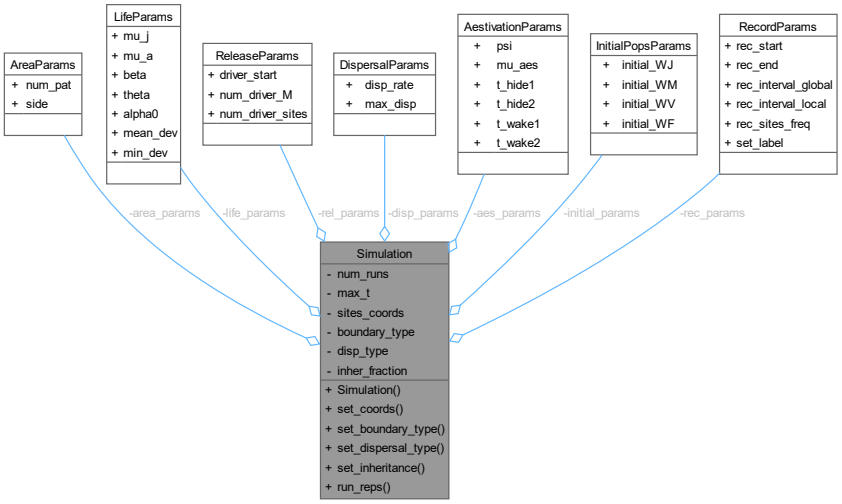
The documentation for this struct was generated from the following file:

- Params.h

6.21 Simulation Class Reference

```
#include <Simulation.h>
```

Collaboration diagram for Simulation:



Public Member Functions

- Simulation (ProgressionParams &prog, AreaParams &area, LifeParams &life, ReleaseParams &rel, DispersalParams &disp, AestivationParams &aes, InitialPopsParams &initial, RecordParams &rec)
- void set_coords (const std::string &coords_file)
- void set_boundary_type (BoundaryType boundary)
- void set_dispersal_type (DispersalType disp)
- void set_inheritance (InheritanceParams inher_params)
- void run_reps ()

Private Attributes

- int num_runs
- int max_t
- AreaParams * area_params
- LifeParams * life_params
- ReleaseParams * rel_params
- DispersalParams * disp_params
- AestivationParams * aes_params
- InitialPopsParams * initial_params
- RecordParams * rec_params
- std::vector< Point > sites_coords
- BoundaryType boundary_type
- DispersalType disp_type
- std::array< std::array< std::array< double, num_gen >, num_gen >, num_gen > inher_fraction

6.21.1 Constructor & Destructor Documentation

6.21.1.1 Simulation()

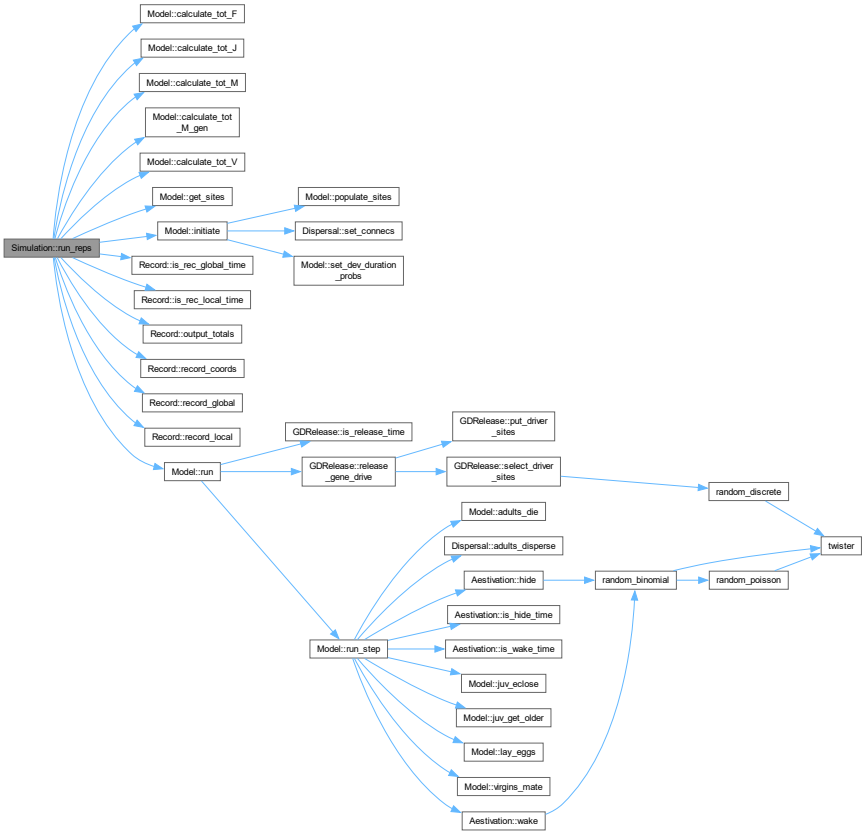
```
Simulation::Simulation (
            ProgressionParams & prog,
            AreaParams & area,
            LifeParams & life,
            ReleaseParams & rel,
            DispersalParams & disp,
            AestivationParams & aes,
            InitialPopsParams & initial,
            RecordParams & rec )
```

6.21.2 Member Function Documentation

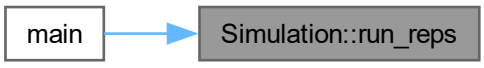
6.21.2.1 run_reps()

```
void Simulation::run_reps ( )
```

Here is the call graph for this function:



Here is the caller graph for this function:



6.21.2.2 set_boundary_type()

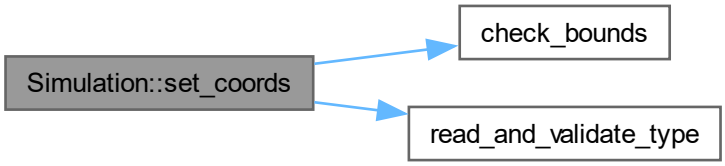
```
void Simulation::set_boundary_type (
            BoundaryType boundary )
```

Here is the caller graph for this function:

6.21.2.3 set_coords()

```
void Simulation::set_coords (
            const std::string & coords_file )
```

Here is the call graph for this function:



6.21.2.4 set_dispersal_type()

```
void Simulation::set_dispersal_type (
            DispersalType disp )
```

Here is the caller graph for this function:

6.21.2.5 set_inheritance()

```
void Simulation::set_inheritance (
            InheritanceParams inher_params )
```

Here is the caller graph for this function:

6.21.3 Member Data Documentation

6.21.3.1 aes_params

```
AestivationParams* Simulation::aes_params  [private]
```

6.21.3.2 area_params

```
AreaParams* Simulation::area_params  [private]
```

6.21.3.3 boundary_type

```
BoundaryType Simulation::boundary_type  [private]
```

6.21.3.4 disp_params

```
DispersalParams* Simulation::disp_params  [private]
```

6.21.3.5 disp_type

```
DispersalType Simulation::disp_type  [private]
```

6.21.3.6 inher_fraction

```
std::array<std::array<std::array <double, num_gen>, num_gen>, num_gen> Simulation::inher_↩
fraction  [private]
```

6.21.3.7 initial_params

```
InitialPopsParams* Simulation::initial_params  [private]
```

6.21.3.8 life_params

```
LifeParams* Simulation::life_params  [private]
```

6.21.3.9 max_t

```
int Simulation::max_t  [private]
```

6.21.3.10 num_runs

```
int Simulation::num_runs  [private]
```

6.21.3.11 rec_params

```
RecordParams* Simulation::rec_params  [private]
```

6.21.3.12 rel_params

```
ReleaseParams* Simulation::rel_params  [private]
```

6.21.3.13 sites_coords

```
std::vector<Point> Simulation::sites_coords  [private]
```

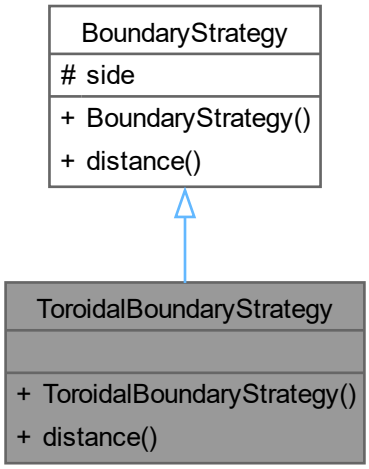
The documentation for this class was generated from the following files:

- Simulation.h
- Simulation.cpp

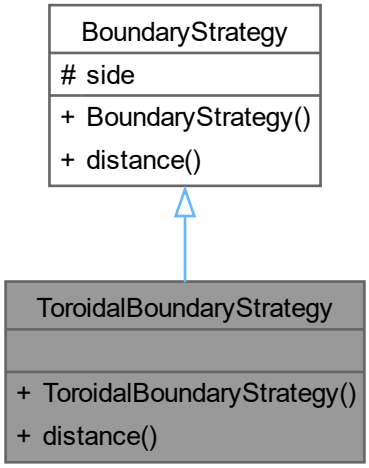
6.22 ToroidalBoundaryStrategy Class Reference

`#include <BoundaryStrategy.h>`

Inheritance diagram for ToroidalBoundaryStrategy:



Collaboration diagram for ToroidalBoundaryStrategy:



Public Member Functions

- ToroidalBoundaryStrategy (double side)
- double distance (const Point &p1, const Point &p2) override

Public Member Functions inherited from BoundaryStrategy

- BoundaryStrategy (double side)

Additional Inherited Members

Protected Attributes inherited from BoundaryStrategy

- double side

6.22.1 Constructor & Destructor Documentation

6.22.1.1 ToroidalBoundaryStrategy()

```
ToroidalBoundaryStrategy::ToroidalBoundaryStrategy (
            double side )  [inline]
```

6.22.2 Member Function Documentation

6.22.2.1 distance()

```
double ToroidalBoundaryStrategy::distance (
            const Point & p1,
            const Point & p2 )  [override], [virtual]
```

Implements BoundaryStrategy.

The documentation for this class was generated from the following files:

- BoundaryStrategy.h
- BoundaryStrategy.cpp

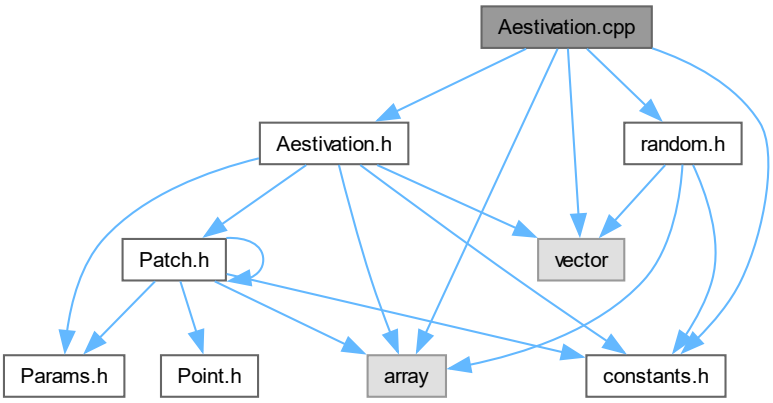
Chapter 7

File Documentation

7.1 Aestivation.cpp File Reference

```
#include <array>
#include <vector>
#include "Aestivation.h"
#include "random.h"
#include "constants.h"
```

Include dependency graph for Aestivation.cpp:

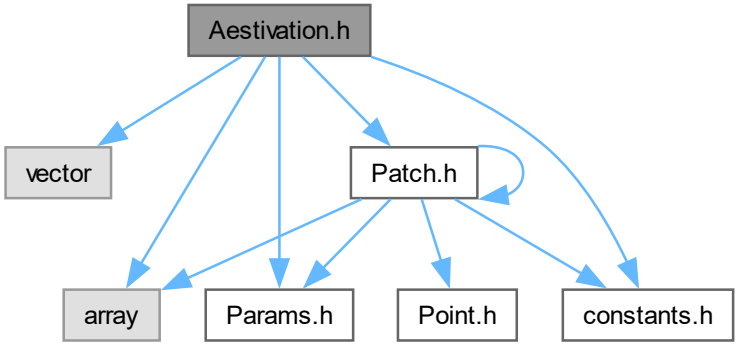


7.2 Aestivation.h File Reference

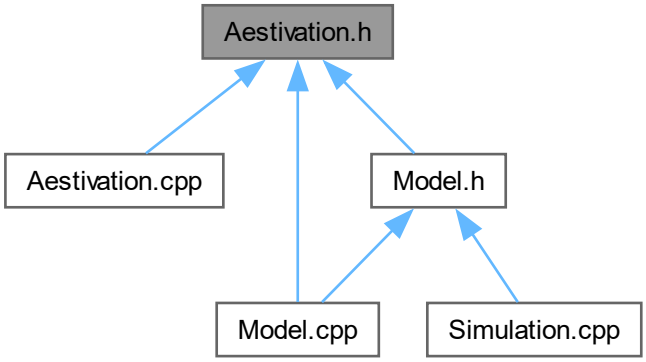
```
#include <vector>
#include <array>
#include "Params.h"
#include "Patch.h"
```

```
#include "constants.h"
```

Include dependency graph for Aestivation.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Aestivation

7.3 Aestivation.h

Go to the documentation of this file.

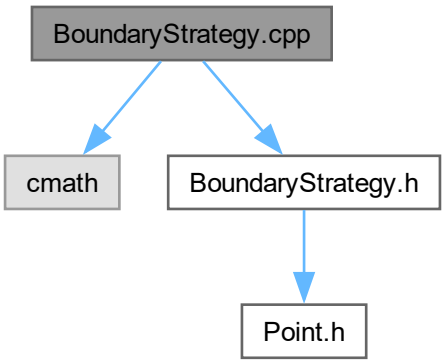
```
00001 #ifndef AESTIVATION_H
00002 #define AESTIVATION_H
00003
00004 #include <vector>
```

```
00005 #include <array>
00006 #include "Params.h"
00007 #include "Patch.h"
00008 #include "constants.h"
00009
00010 using namespace constants;
00011
00012 class Patch;
00013
00014 // Implement aestivative behaviour for the collection of mosquito sites.
00015 class Aestivation {
00016 public:
00017     Aestivation(AestivationParams *params, int sites_size);
00018     void hide(std::vector<Patch*> &sites);
00019     void wake(int day, std::vector<Patch*> &sites);
00020     bool is_hide_time(int day);
00021     bool is_wake_time(int day);
00022
00023 private:
00024     double psi; // aestivation rate
00025     double mu_aes; // aestivation mortality
00026     int t_hide1; // start day of aestivation-entering period (day number of the year), not included
00027     int t_hide2; // end day of aestivation-entering period (day number of the year)
00028     int t_wake1; // start day of aestivation-waking period (day number of the year), not included
00029     int t_wake2; // end day of aestivation-waking period (day number of the year)
00030
00031     // number of mated female mosquitoes F_{ij} with female genotype i and carrying mated male
      genotype j that have gone into
00032     // aestivation from each patch
00033     std::vector<std::array<std::array<long long int, num_gen>, num_gen» aes_F;
00034 };
00035
00036 #endif //AESTIVATION_H
```

7.4 BoundaryStrategy.cpp File Reference

```
#include <cmath>
#include "BoundaryStrategy.h"
```

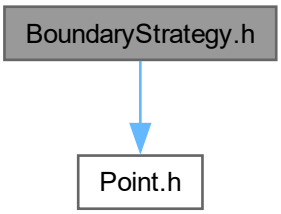
Include dependency graph for BoundaryStrategy.cpp:



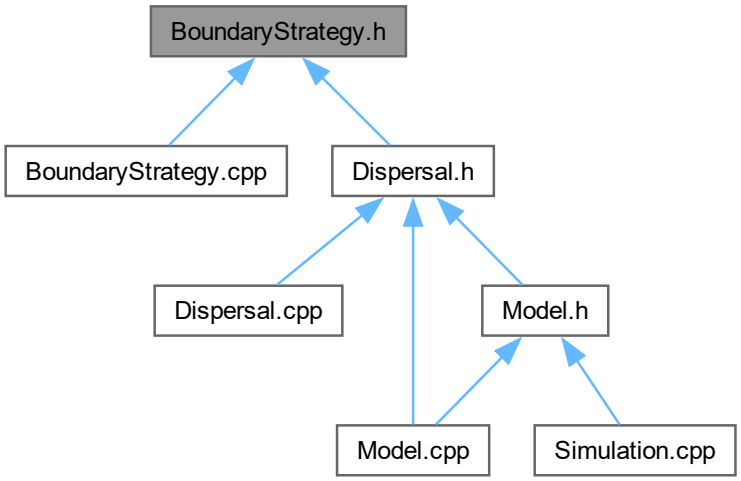
7.5 BoundaryStrategy.h File Reference

```
#include "Point.h"
```

Include dependency graph for BoundaryStrategy.h:



This graph shows which files directly or indirectly include this file:



Classes

- class BoundaryStrategy
- class ToroidalBoundaryStrategy
- class EdgeBoundaryStrategy

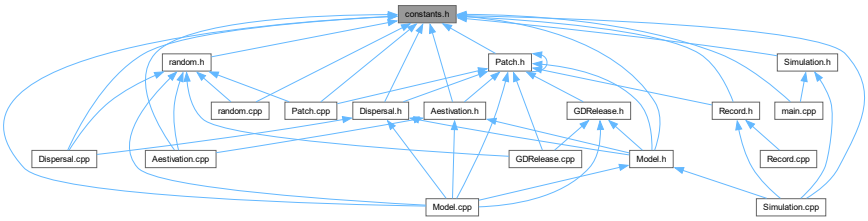
7.6 BoundaryStrategy.h

Go to the documentation of this file.

```
00001 #ifndef BOUNDARYSTRATEGY_H
00002 #define BOUNDARYSTRATEGY_H
00003
00004 #include "Point.h"
00005
00006 class BoundaryStrategy {
00007 public:
00008     BoundaryStrategy(double side): side(side) {};
00009     virtual double distance(const Point& p1, const Point& p2) = 0;
00010
00011 protected:
00012     double side;
00013 };
00014
00015 class ToroidalBoundaryStrategy: public BoundaryStrategy {
00016 public:
00017     ToroidalBoundaryStrategy(double side): BoundaryStrategy(side) {};
00018     double distance(const Point &p1, const Point &p2) override;
00019 };
00020
00021 class EdgeBoundaryStrategy: public BoundaryStrategy {
00022 public:
00023     EdgeBoundaryStrategy(double side): BoundaryStrategy(side) {};
00024     double distance(const Point& p1, const Point& p2) override;
00025 };
00026
00027 #endif //BOUNDARYSTRATEGY_H
```

7.7 constants.h File Reference

This graph shows which files directly or indirectly include this file:



Namespaces

- namespace constants

Enumerations

- enum BoundaryType { Toroid , Edge }
- enum DispersalType { DistanceKernel , Radial }

Variables

- const int constants::max_dev = 20
- const int constants::num_gen = 6

7.7.1 Enumeration Type Documentation

7.7.1.1 BoundaryType

```
enum BoundaryType
```

Enumerator

Toroid	
Edge	

7.7.1.2 DispersalType

```
enum DispersalType
```

Enumerator

DistanceKernel	
Radial	

7.8 constants.h

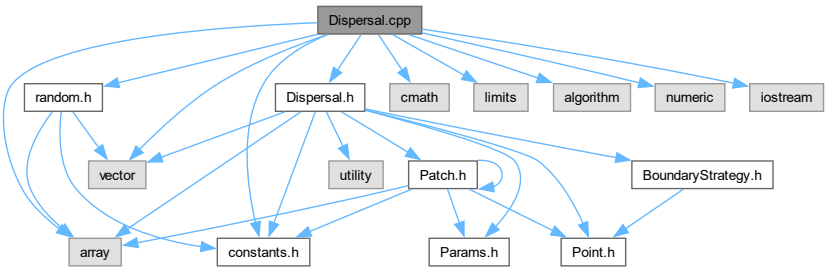
Go to the documentation of this file.

```
00001
00002 #ifndef CONSTANTS_H
00003 #define CONSTANTS_H
00004
00005 namespace constants
00006 {
00007     const int max_dev = 20; // juvenile development time (egg to adult) expressed as days left till
      eclosion (eclosion on day 0)
00008     const int num_gen = 6; // number of different genotypes in the mosquito population
00009 }
00010
00011 enum BoundaryType{Toroid, Edge};
00012 enum DispersalType{DistanceKernel, Radial};
00013
00014 #endif //CONSTANTS_H
```

7.9 Dispersal.cpp File Reference

```
#include <vector>
#include <array>
#include <cmath>
#include <limits>
#include <algorithm>
#include <numeric>
#include "Dispersal.h"
#include "random.h"
#include "constants.h"
#include <iostream>
```

Include dependency graph for Dispersal.cpp:



Variables

- const double PI = 3.14159265
- const double TWOPI = 2 * PI

7.9.1 Variable Documentation

7.9.1.1 PI

```
const double PI = 3.14159265
```

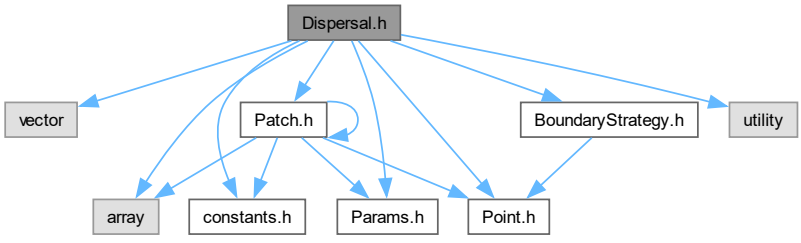
7.9.1.2 TWOPI

```
const double TWOPI = 2 * PI
```

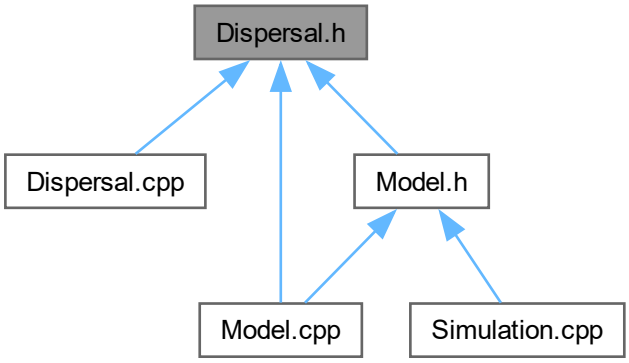
7.10 Dispersal.h File Reference

```
#include <vector>
#include <array>
#include <utility>
#include "constants.h"
#include "Params.h"
#include "Patch.h"
#include "Point.h"
#include "BoundaryStrategy.h"
```

Include dependency graph for Dispersal.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Dispersal
- class DistanceKernelDispersal
- class RadialDispersal

7.11 Dispersal.h

Go to the documentation of this file.

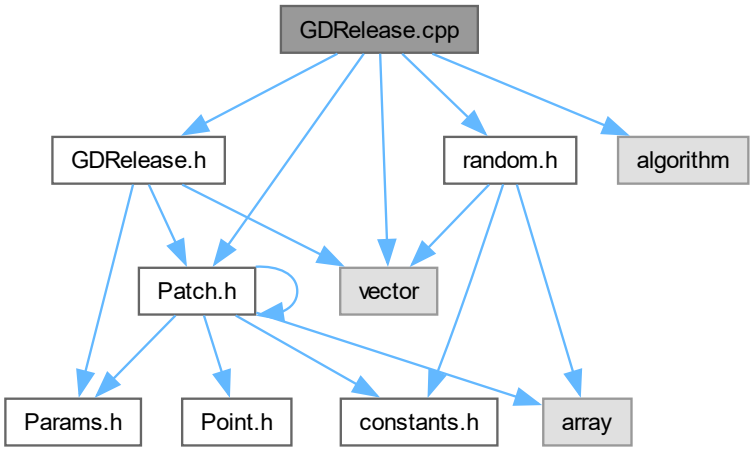
```
00001 #ifndef DISPERSAL_H
00002 #define DISPERSAL_H
00003
00004 #include <vector>
00005 #include <array>
00006 #include <utility>
00007 #include "constants.h"
00008 #include "Params.h"
00009 #include "Patch.h"
00010 #include "Point.h"
00011 #include "BoundaryStrategy.h"
00012
00013 using namespace constants;
00014
00015 class Patch;
00016
00017 // Implements dispersion across all mosquito sites in the collection.
00018 class Dispersal {
00019 public:
00020     Dispersal(DispersalParams* params, BoundaryType boundary, double side);
00021     ~Dispersal();
00022     virtual void set_connecs(std::vector<Patch*> &sites) = 0;
00023     virtual void adults_disperse(std::vector<Patch*> &sites) = 0;
00024
00025 protected:
00026     double disp_rate; // adult dispersal rate
00027     double max_disp; // maximum distance at which two sites are connected (km)
00028
00029     // connected patch indices ordered by each patch in sites, such that the first element contains
      the indices of all the patches
00030     // connected to the first sites patch, second element has all connection indices to the second
      sites patch, etc.
00031     std::vector<std::vector<int» connec_indices;
00032     // connection weights of the connected patches ordered by each patch in sites, such that the first
      element contains the connection
```

```
00033     // weights between the first patch in sites and all the patches connected to it, the second
      element has all connection weights
00034     // between the second sites element and all other patches connected to it, etc.
00035     std::vector<std::vector<double» connec_weights;
00036
00037     BoundaryStrategy* boundary_strategy;
00038
00039     std::vector<std::array<long long int, num_gen» M_dispersing_out(const std::vector<Patch*> &sites);
00040     std::vector<std::array<std::array<long long int, num_gen>, num_gen» F_dispersing_out(const
      std::vector<Patch*> &sites);
00041 };
00042
00043
00044 class DistanceKernelDispersal: public Dispersal {
00045 public:
00046     DistanceKernelDispersal(DispersalParams* params, BoundaryType boundary, double side):
      Dispersal(params, boundary, side) {};
00047     void set_connecs(std::vector<Patch*> &sites) override;
00048     void adults_disperse(std::vector<Patch*> &sites) override;
00049
00050 private:
00051     std::pair<std::vector<std::vector<int», std::vector<std::vector<double»>
      compute_connecs(std::vector<Patch*> &sites);
00052 };
00053
00054 class RadialDispersal: public Dispersal {
00055 public:
00056     RadialDispersal(DispersalParams* params, BoundaryType boundary, double side);
00057     void set_connecs(std::vector<Patch*> &sites) override;
00058     void adults_disperse(std::vector<Patch*> &sites) override;
00059
00060 private:
00061     std::vector<double> connec_weights_sum;
00062
00063     std::pair<std::vector<std::vector<int», std::vector<std::vector<double»>
      compute_connecs(std::vector<Patch*> &sites);
00064     std::pair<std::vector<std::pair<double, double», double> compute_interval_union(const
      std::pair<double, double>& qq,
00065         const std::vector<std::pair<double, double»& input);
00066     double wrap_around(double value, double range);
00067     std::vector<int> get_sorted_positions(const std::vector<double>& numbers);
00068     std::vector<std::vector<double» compute_distances(const std::vector<Patch*> &sites);
00069 };
00070
00071 #endif //DISPERSAL_H
```

7.12 GDRelease.cpp File Reference

```
#include <vector>
#include <algorithm>
#include "GDRelease.h"
#include "Patch.h"
#include "random.h"
```

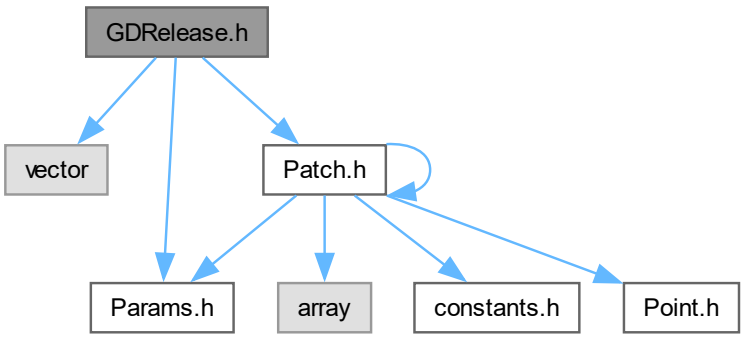
Include dependency graph for GDRelease.cpp:



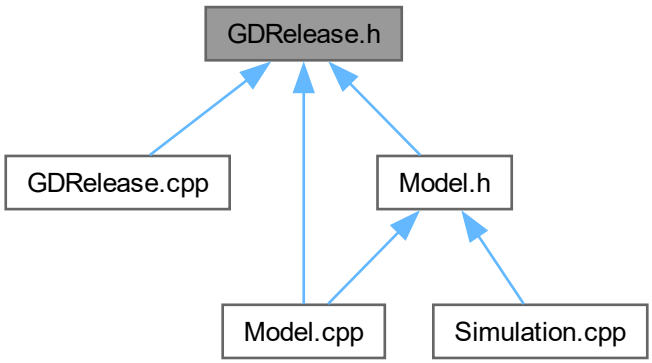
7.13 GDRelease.h File Reference

```
#include <vector>
#include "Params.h"
#include "Patch.h"
```

Include dependency graph for GDRelease.h:



This graph shows which files directly or indirectly include this file:



Classes

- class GDRelease

7.14 GDRelease.h

Go to the documentation of this file.

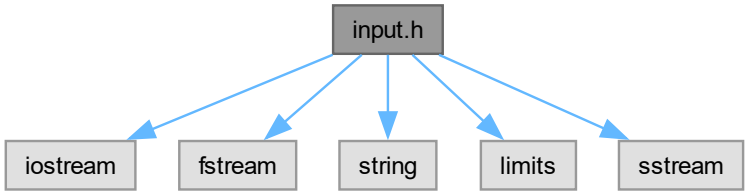
```
00001 #ifndef GDRELEASE_H
00002 #define GDRELEASE_H
00003
00004 #include <vector>
00005 #include "Params.h"
00006 #include "Patch.h"
00007
00008 class Patch;
00009
00010 // Implements gene drive release of mosquitoes into the collection of mosquito sites.
00011 class GDRelease {
00012 public:
00013     GDRelease(ReleaseParams* params);
00014     void release_gene_drive(std::vector<Patch*> &sites);
00015     bool is_release_time(int day);
00016
00017 private:
00018     int driver_start; // time to start releasing drive alleles into the mosquito population
00019     int num_driver_M; // number of drive heterozygous (WD) male mosquitoes per release
00020     int num_driver_sites; // number of gene drive release sites per year
00021
00022     std::vector<Patch*> select_driver_sites(int num_rel_sites, const std::vector<Patch*> &sites);
00023     void put_driver_sites(std::vector<Patch*>& rel_sites, std::vector<Patch*> &sites);
00024 };
00025
00026 #endif //GDRELEASE_H
```

7.15 input.h File Reference

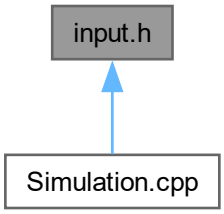
```
#include <iostream>
#include <fstream>
#include <string>
```

```
#include <limits>
#include <sstream>
```

Include dependency graph for input.h:



This graph shows which files directly or indirectly include this file:



Functions

- template<typename T >
  bool check_bounds (const std::string &par_name, T value, T lower_bound, bool inclusive_lower=true, T upper_bound=std::numeric_limits< T >::max(), bool inclusive_upper=true)
- template<typename T >
  bool read_and_validate_type (std::ifstream &file, T &par, const std::string &par_name, const std::string &par_type)
- template<typename T >
  bool read_and_validate_type (std::stringstream &linestream, T &par, const std::string &par_name, const std::string &par_type)

7.15.1 Function Documentation

7.15.1.1 check_bounds()

```
template<typename T >
bool check_bounds (
            const std::string & par_name,
```

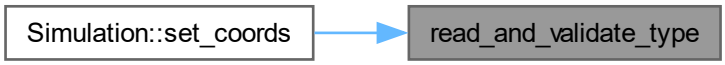
```
            T value,
            T lower_bound,
            bool inclusive_lower = true,
            T upper_bound = std::numeric_limits<T>::max(),
            bool inclusive_upper = true )
```

Here is the caller graph for this function:

7.15.1.2 read_and_validate_type() [1/2]

```
template<typename T >
bool read_and_validate_type (
            std::ifstream & file,
            T & par,
            const std::string & par_name,
            const std::string & par_type )
```

Here is the caller graph for this function:



7.15.1.3 read_and_validate_type() [2/2]

```
template<typename T >
bool read_and_validate_type (
            std::stringstream & linestream,
            T & par,
            const std::string & par_name,
            const std::string & par_type )
```

7.16 input.h

Go to the documentation of this file.

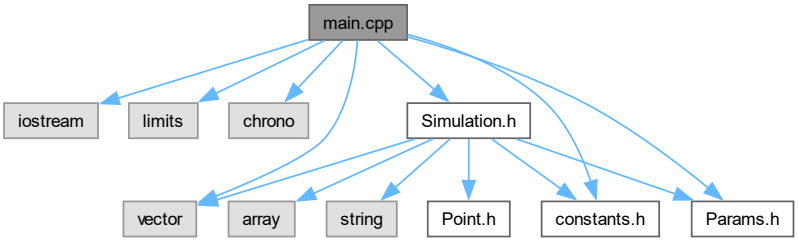
```
00001 #ifndef INPUT_H
00002 #define INPUT_H
00003
00004 #include <iostream>
00005 #include <fstream>
00006 #include <string>
00007 #include <limits>
00008 #include <sstream>
00009
00010 // Checks if a value falls within bounds.
00011 template <typename T>
00012 bool check_bounds(const std::string &par_name, T value, T lower_bound, bool inclusive_lower = true,
00013  T upper_bound = std::numeric_limits<T>::max(), bool inclusive_upper = true)
00014 {
00015     if (lower_bound >= upper_bound) {
00016         std::cerr « "Error: lower_bound must be less than upper_bound." « std::endl;
00017         return false;
00018     }
00019
00020     bool lower_check = inclusive_lower ? value >= lower_bound : value > lower_bound;
00021     bool upper_check = inclusive_upper ? value <= upper_bound : value < upper_bound;
00022
00023     std::string lower_bound_char = inclusive_lower ? "\u2264" : "<";
00024     std::string upper_bound_char = inclusive_upper ? "\u2264" : "<";
00025     if (!lower_check || !upper_check) {
00026         std::cout « "The parameter " « par_name « " is out of bounds. ";
00027         std::cout « par_name « " should be " « lower_bound « " " « lower_bound_char « " " « par_name «
      " ";
00028         std::cout «  upper_bound_char « " " « upper_bound « ". " « std::endl;
00029     }
00030
00031     return lower_check && upper_check;
00032 }
00033
00034 // Reads a value from filestream and assigns it to the parameter variable if the types match.
00035 template <typename T>
00036 bool read_and_validate_type(std::ifstream &file, T &par, const std::string &par_name, const
      std::string &par_type)
00037 {
00038     if (!(file » par)) {
00039         std::cerr « "Error: invalid type for " « par_name « ". Expected " « par_type « "." «
      std::endl;
00040         return false;
00041     }
00042     return true;
00043 }
00044
00045 template <typename T>
00046 bool read_and_validate_type(std::stringstream &linestream, T &par, const std::string &par_name, const
      std::string &par_type)
00047 {
00048     if (!(linestream » par)) {
00049         std::cerr « "Error: invalid type for " « par_name « ". Expected " « par_type « "." «
      std::endl;
00050         return false;
00051     }
00052     return true;
00053 }
00054
00055 #endif //INPUT_H
```

7.17 main.cpp File Reference

```
#include <iostream>
#include <limits>
#include <chrono>
#include <vector>
#include "Simulation.h"
#include "Params.h"
```

```
#include "constants.h"
```

Include dependency graph for main.cpp:



Functions

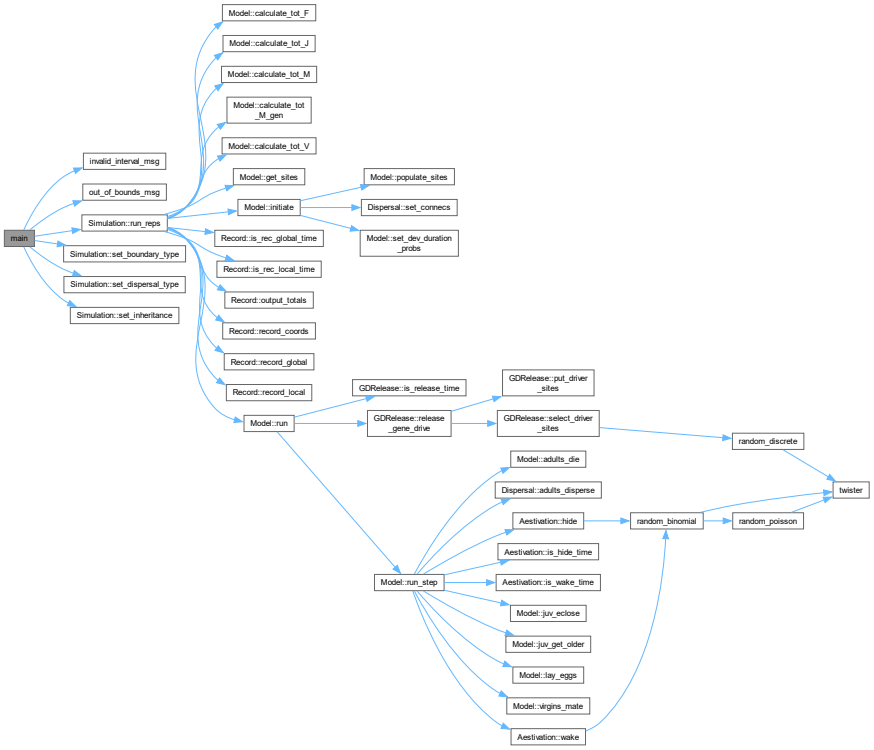
- int main ()

7.17.1 Function Documentation

7.17.1.1 main()

```
int main ( )
```

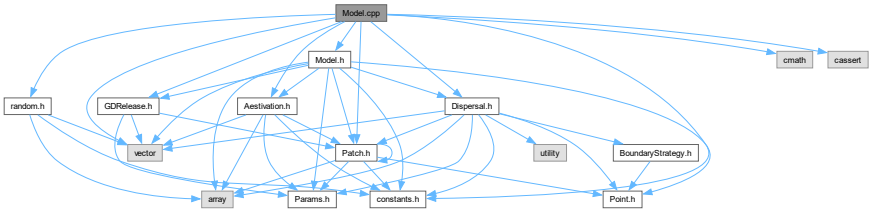
Here is the call graph for this function:



7.18 Model.cpp File Reference

```
#include <vector>
#include <cmath>
#include <cassert>
#include "Model.h"
#include "random.h"
#include "constants.h"
#include "Patch.h"
#include "Dispersal.h"
#include "GDRelease.h"
#include "Aestivation.h"
```

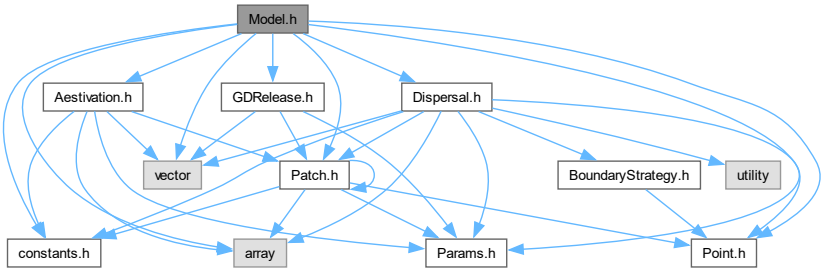
Include dependency graph for Model.cpp:



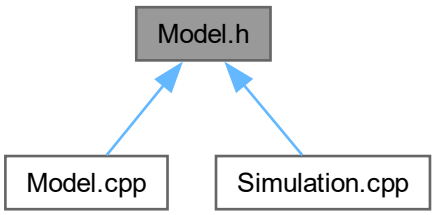
7.19 Model.h File Reference

```
#include <vector>
#include <array>
#include "constants.h"
#include "Params.h"
#include "Patch.h"
#include "Dispersal.h"
#include "Aestivation.h"
#include "GDRelease.h"
#include "Point.h"
```

Include dependency graph for Model.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Model

7.20 Model.h

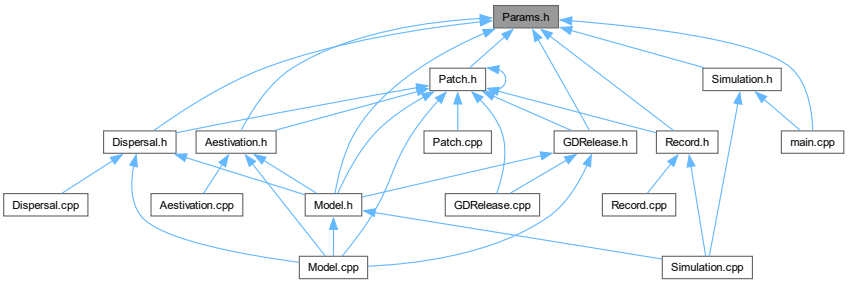
Go to the documentation of this file.

```
00001 #ifndef MODEL_H
00002 #define MODEL_H
00003
00004 #include <vector>
00005 #include <array>
00006 #include "constants.h"
00007 #include "Params.h"
00008 #include "Patch.h"
00009 #include "Dispersal.h"
00010 #include "Aestivation.h"
00011 #include "GDRelease.h"
00012 #include "Point.h"
00013
00014 using namespace constants;
00015
00016 // Runs the model.
00017 class Model {
00018 public:
00019     Model(AreaParams *area, InitialPopsParams *initial, LifeParams *life, AestivationParams *aes,
      DispersalParams *disp,
00020         ReleaseParams *rel, BoundaryType boundary = BoundaryType::Toroid, DispersalType disp_type =
      DispersalType::DistanceKernel,
00021          std::vector<Point> coords = {});
00022     ~Model();
00023     void initiate();
00024     void run(int day, const std::array<std::array<std::array <double, num_gen>, num_gen>, num_gen>
      &inher_fraction);
00025
00026     long long int calculate_tot_J();
00027     long long int calculate_tot_M();
00028     long long int calculate_tot_V();
00029     long long int calculate_tot_F();
00030     std::array<long long int, num_gen> calculate_tot_M_gen();
00031     std::vector<Patch*> get_sites() const;
00032
00033 private:
00034     std::vector<Patch*> sites;
00035     Dispersal* dispersal;
00036     Aestivation* aestivation;
00037     GDRelease* gd_release;
00038
00039     // simulation area parameters
00040     int num_pat; // number of population sites chosen for the simulation
00041     double side; // size of the square simulation area (side x side) (km)
00042
00043     // initial population values - common for all Patches
```

```
00044     InitialPopsParams *initial_pops;
00045
00046     // juvenile development parameters - common for all Patches
00047     int min_dev; // minimum development time for a juvenile (in days)
00048     std::array<double, max_dev+1> dev_duration_probs; // array of probabilities of juvenile
      development duration for a new juvenile
00049     // (index indicates the number of days to develop or, equivalently, the age class the new juvenile
      starts at)
00050
00051     // initiation methods
00052     void populate_sites();
00053     void set_dev_duration_probs(int min_time, int max_time);
00054
00055     // life-processes - interface with Patch
00056     void run_step(int day, const std::array<std::array<std::array <double, num_gen>, num_gen>,
      num_gen> &inher_fraction);
00057     void juv_get_older();
00058     void adults_die();
00059     void virgins_mate();
00060     void lay_eggs(const std::array<std::array<std::array <double, num_gen>, num_gen>, num_gen>
      &inher_fraction);
00061     void juv_eclose();
00062 };
00063
00064 #endif //MODEL_H
```

7.21 Params.h File Reference

This graph shows which files directly or indirectly include this file:



Classes

- struct ProgressionParams
- struct AreaParams
- struct LifeParams
- struct InheritanceParams
- struct ReleaseParams
- struct DispersalParams
- struct AestivationParams
- struct InitialPopsParams
- struct RecordParams

7.22 Params.h

Go to the documentation of this file.

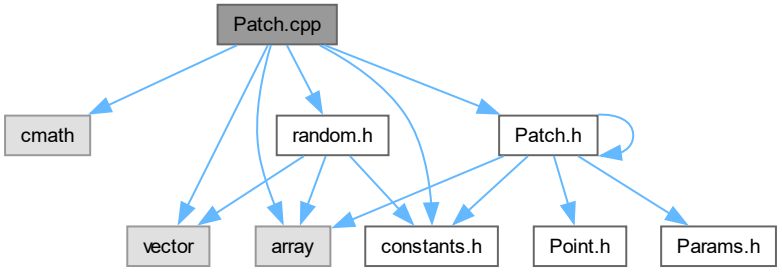
```
00001 #ifndef PARAMS_H
00002 #define PARAMS_H
00003
00004 // ** These parameters should not be modified after being passed to the Simulation or Model **
00005
00006 // Simulation progression parameters
00007 struct ProgressionParams {
00008     int num_runs = 1; // number of simulation replicates to run
00009     int max_t = 1000; // maximum simulated time (in days)
00010 };
00011
00012 // Model area parameters
00013 struct AreaParams {
00014     int num_pat = 50; // number of population sites chosen for the simulation
00015     double side = 1.0; // size of the square simulation area (side x side) (km)
00016 };
00017
00018 // Model life-process parameters
00019 struct LifeParams {
00020     double mu_j = 0.05; // juvenile density independent mortality rate per day
00021     double mu_a = 0.125; // adult mortality rate per day
00022     double beta = 100.0; // parameter that controls mating rate
00023     double theta = 9.0; // average egg laying rate of wildtype females (eggs per day)
00024     double alpha0 = 100000.0; // baseline contribution to carrying capacity
00025     double mean_dev = 15.0; // mean juvenile development time (in days)
00026     int min_dev = 10; // minimum development time for a juvenile (in days)
00027 };
00028
00029 // Gene drive inheritance parameters
00030 struct InheritanceParams {
00031     double gamma = 0.025; // rate of r2 allele formation from W/D meiosis
00032     double xi = 0.2; // somatic Cas9 expression fitness cost
00033     double e = 0.95; // homing rate in females
00034 };
00035
00036 // Gene drive release model parameters
00037 struct ReleaseParams {
00038     int driver_start = 200; // time to start releasing drive alleles into the mosquito population
00039     int num_driver_M = 1000; // number of drive heterozygous (WD) male mosquitoes per release
00040     int num_driver_sites = 5; // number of gene drive release sites per year
00041 };
00042
00043 // Dispersal model parameters
00044 struct DispersalParams {
00045     double disp_rate = 0.01; // adult dispersal rate
00046     double max_disp = 0.2; // maximum distance at which two sites are connected (km)
00047 };
00048
00049 // Aestivation model parameters
00050 struct AestivationParams {
00051     double psi = 0.0; // aestivation rate
00052     double mu_aes = 0.0; // aestivation mortality
00053     int t_hide1 = 0; // start day of aestivation-entering period (day number of the year), not
      included
00054     int t_hide2 = 0; // end day of aestivation-entering period (day number of the year)
00055     int t_wake1 = 0; // start day of aestivation-waking period (day number of the year), not included
00056     int t_wake2 = 0; // end day of aestivation-waking period (day number of the year)
00057 };
00058
00059 // Initial population values for the model
00060 struct InitialPopsParams {
00061     int initial_WJ = 10000; // array of number of initial juvenile mosquitoes with wild homozygous
      (WW) genotype for each age group
00062     int initial_WM = 50000; // number of initial adult male mosquitoes with wild homozygous (WW)
      genotype
00063     int initial_WV = 10000; // number of initial adult unmated female (virgin) mosquitoes with wild
      homozygous (WW) genotype
00064     int initial_WF = 40000; // number of initial adult mated female mosquitoes with wild homozygous
      (WW) genotype
00065 };
00066
00067 // Data-recording parameters
00068 struct RecordParams {
00069     // recording window and intervals
00070     int rec_start = 0; // start time for the data recording window (in days) (non-inclusive)
00071     int rec_end = 1000; // end time for the data recording window (in days) (inclusive)
00072     int rec_interval_global = 1; // time interval for global data recording/output
00073     int rec_interval_local = 200; // time interval at which to collect/record local data (in days)
00074     int rec_sites_freq = 1; // fraction of sites to collect local data for (1 is all sites, 10 is 1 in
      10 etc)
00075
00076     // output filename labels
```

```
00077     int set_label = 1; // 'set of runs' index label for output files
00078 };
00079
00080 #endif //PARAMS_H
```

7.23 Patch.cpp File Reference

```
#include <cmath>
#include <array>
#include <vector>
#include "Patch.h"
#include "random.h"
#include "constants.h"
```

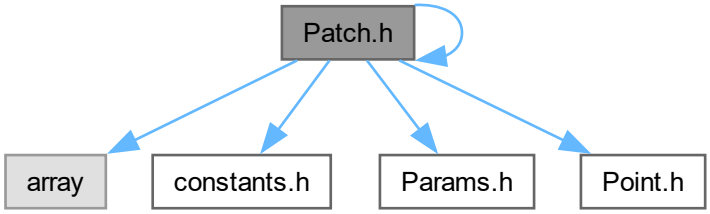
Include dependency graph for Patch.cpp:



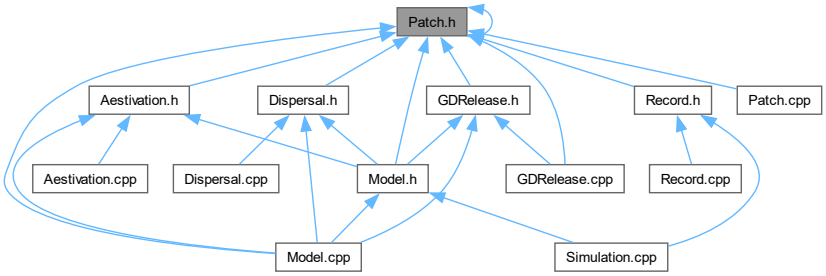
7.24 Patch.h File Reference

```
#include <array>
#include "Patch.h"
#include "constants.h"
#include "Params.h"
#include "Point.h"
```

Include dependency graph for Patch.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Patch

7.25 Patch.h

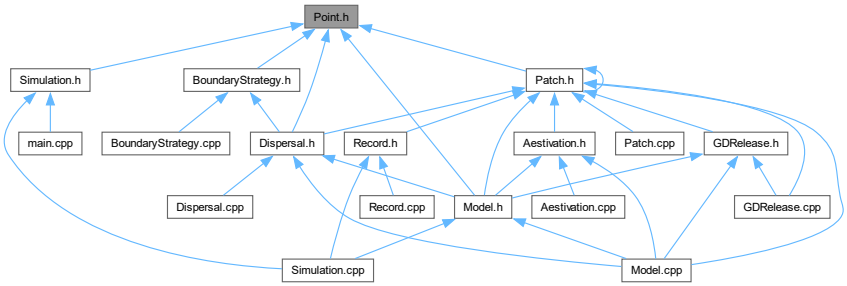
Go to the documentation of this file.

```
00001 #ifndef PATCH_H
00002 #define PATCH_H
00003
00004 #include <array>
00005 #include "Patch.h"
00006 #include "constants.h"
00007 #include "Params.h"
00008 #include "Point.h"
00009
00010 using namespace constants;
00011
00012 // Contains the information of a local mosquito population
00013 class Patch {
00014 public:
00015     Patch(LifeParams* par, double side);
00016     Patch(LifeParams* par, Point point);
00017     void populate(int initial_WJ, int initial_WM, int initial_WV, int initial_WF);
00018
00019     Point get_coords() const;
00020     std::array<long long int, num_gen> get_M() const;
00021     std::array<std::array<long long int, num_gen>, num_gen> get_F() const;
00022
00023     long long int calculate_tot_J();
00024     long long int calculate_tot_M();
00025     long long int calculate_tot_V();
00026     long long int calculate_tot_F();
00027
00028     // life-processes for the local site
00029     void juv_get_older(int max_dev);
00030     void adults_die();
00031     void virgins_mate();
00032     void lay_eggs(const std::array<std::array<std::array <double, num_gen>, num_gen>, num_gen> &f,
00033      const std::array<double, max_dev+1> &dev_duration_probs);
00034     void juv_eclose();
00035     void update_comp();
00036     void update_mate();
00037
00038     // interface to Dispersal
00039     void M_disperse_out(const std::array<long long int, num_gen> &m_out);
00040     void F_disperse_out(const std::array<std::array<long long int, num_gen>, num_gen> &f_out);
00041     void M_disperse_in(int gen, long long int m_in);
00042     void F_disperse_in(int f_gen, int m_gen, long long int f_disp);
00043
00044     // interface to Aestivation
00045     void F_hide(const std::array<std::array<long long int, num_gen>, num_gen> &f_try);
00046     void F_wake(const std::array<std::array<long long int, num_gen>, num_gen> &f_wake);
00047
00048     // interface to GDRelease
```

```
00049     void add_driver_M(int num_driver_M);
00050
00051 private:
00052     LifeParams* params;
00053
00054     Point coords; // (x, y) coordinates of the site
00055     // number of juvenile mosquitoes with each genotype and in each age group.
00056     // age ordered from oldest (0 days left to eclosion) to youngest (max_dev - 1 days left)
00057     std::array<std::array<long long int, max_dev+1>, num_gen> J;
00058     std::array<long long int, num_gen> M; // number of male mosquitoes with each genotype
00059     std::array<long long int, num_gen> V; // number of unmated female (virgin) mosquitoes with each
      genotype
00060     // number of mated female mosquitoes F_{ij} with female genotype i and carrying mated male
      genotype j
00061     std::array<std::array<long long int, num_gen>, num_gen> F;
00062
00063     long double comp; // survival probability per juvenile per day (both density-dependent and
      independent factors)
00064     long double mate_rate; // probability of an unmated (virgin) female mating on a given day
00065 };
00066
00067 #endif //PATCH_H
```

7.26 Point.h File Reference

This graph shows which files directly or indirectly include this file:



Classes

- struct Point

7.27 Point.h

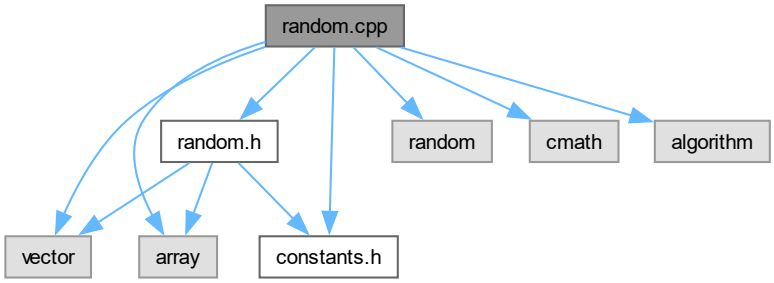
Go to the documentation of this file.

```
00001 #ifndef POINT_H
00002 #define POINT_H
00003
00004 // Represents a 2D point.
00005 struct Point {
00006     double x = 0;
00007     double y = 0;
00008 };
00009
00010 #endif //POINT_H
```

7.28 random.cpp File Reference

```
#include <vector>
#include <array>
#include <random>
#include <cmath>
#include <algorithm>
#include "random.h"
#include "constants.h"
```

Include dependency graph for random.cpp:



Functions

- std::mt19937 twister (1)
- double random_real ()
- int random_discrete (int a, int b)
- long long int random_poisson (double lambda)
- long long int random_binomial (long long int n, double p)
- std::vector< long long int > random_multinomial (long long int n, const std::vector< double > &probs)
- std::vector< long long int > random_multinomial (long long int n, const std::array< long long int, num_gen > &probs)
- std::vector< long long int > random_multinomial (long long int n, const std::array< double, max_dev+1 > &probs)

Variables

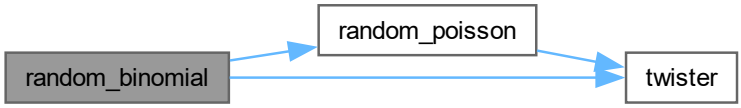
- std::random_device rd

7.28.1 Function Documentation

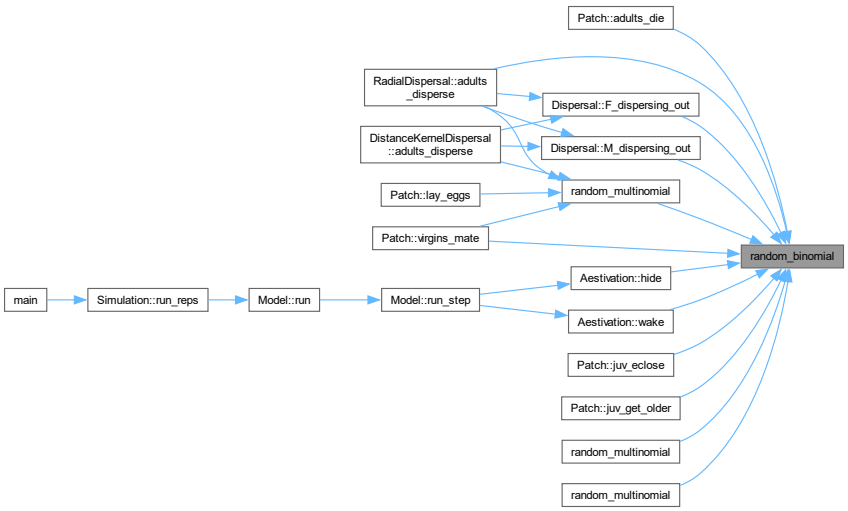
7.28.1.1 random_binomial()

```
long long int random_binomial (
            long long int n,
            double p )
```

Here is the call graph for this function:



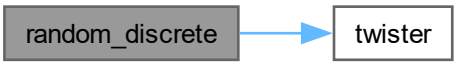
Here is the caller graph for this function:



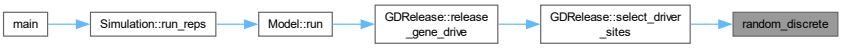
7.28.1.2 random_discrete()

```
int random_discrete (
            int a,
            int b )
```

Here is the call graph for this function:



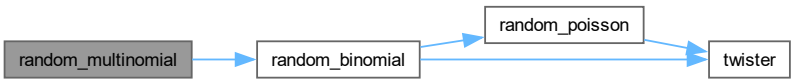
Here is the caller graph for this function:



7.28.1.3 random_multinomial() [1/3]

```
std::vector< long long int > random_multinomial (
            long long int n,
            const std::array< double, max_dev+1 > & probs )
```

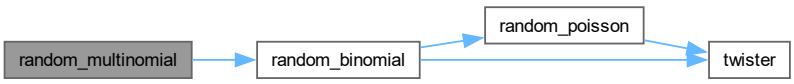
Here is the call graph for this function:



7.28.1.4 random_multinomial() [2/3]

```
std::vector< long long int > random_multinomial (
            long long int n,
            const std::array< long long int, num_gen > & probs )
```

Here is the call graph for this function:

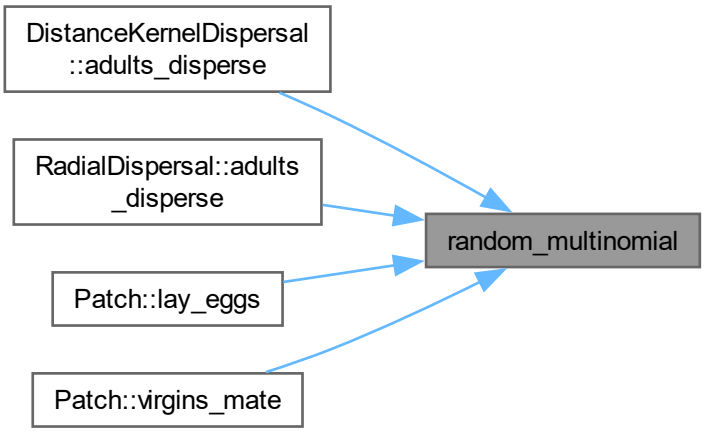


7.28.1.5 random_multinomial() [3/3]

```
std::vector< long long int > random_multinomial (
            long long int n,
            const std::vector< double > & probs )
```

Here is the call graph for this function:

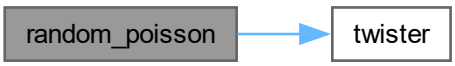
Here is the caller graph for this function:



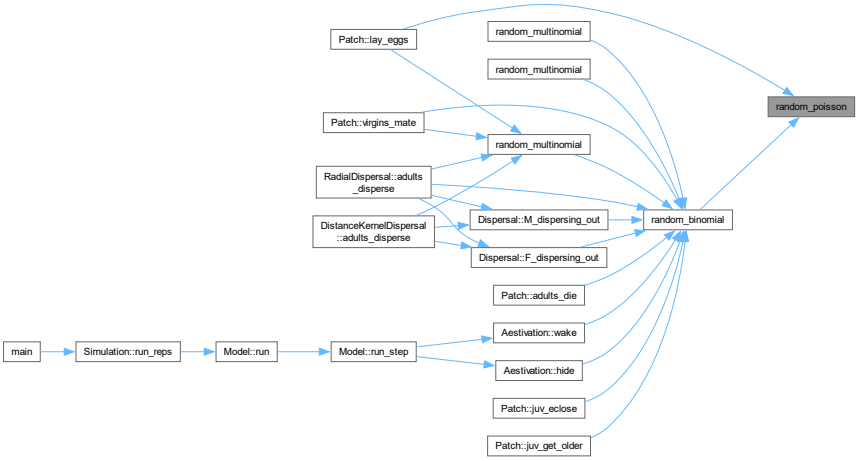
7.28.1.6 random_poisson()

```
long long int random_poisson (
            double lambda )
```

Here is the call graph for this function:



Here is the caller graph for this function:

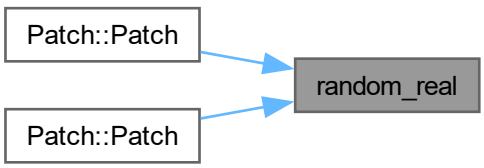


7.28.1.7 random_real()

```
double random_real ( )
```

Here is the call graph for this function:

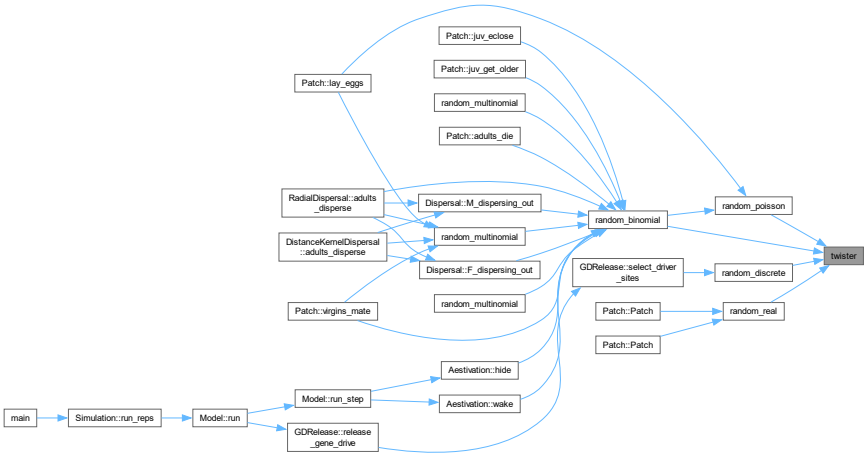
Here is the caller graph for this function:



7.28.1.8 twister()

```
std::mt19937 twister (
            1  )
```

Here is the caller graph for this function:



7.28.2 Variable Documentation

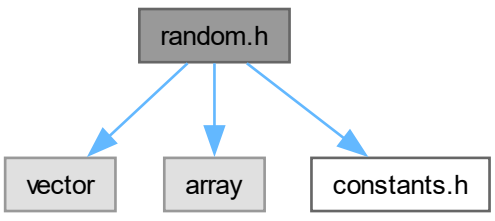
7.28.2.1 rd

```
std::random_device rd
```

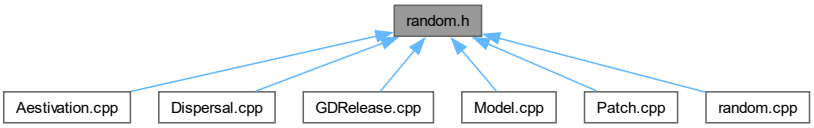
7.29 random.h File Reference

```
#include <vector>
#include <array>
#include "constants.h"
```

Include dependency graph for random.h:



This graph shows which files directly or indirectly include this file:



Functions

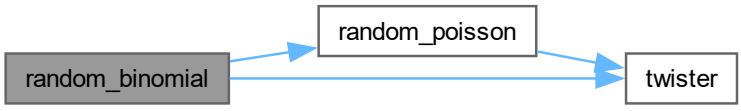
- double random_real ()
- int random_discrete (int a, int b)
- long long int random_poisson (double lambda)
- long long int random_binomial (long long int n, double p)
- std::vector< long long int > random_multinomial (long long int n, const std::vector< double > &probs)
- std::vector< long long int > random_multinomial (long long int n, const std::array< long long int, num_gen > &probs)
- std::vector< long long int > random_multinomial (long long int n, const std::array< double, max_dev+1 > &probs)

7.29.1 Function Documentation

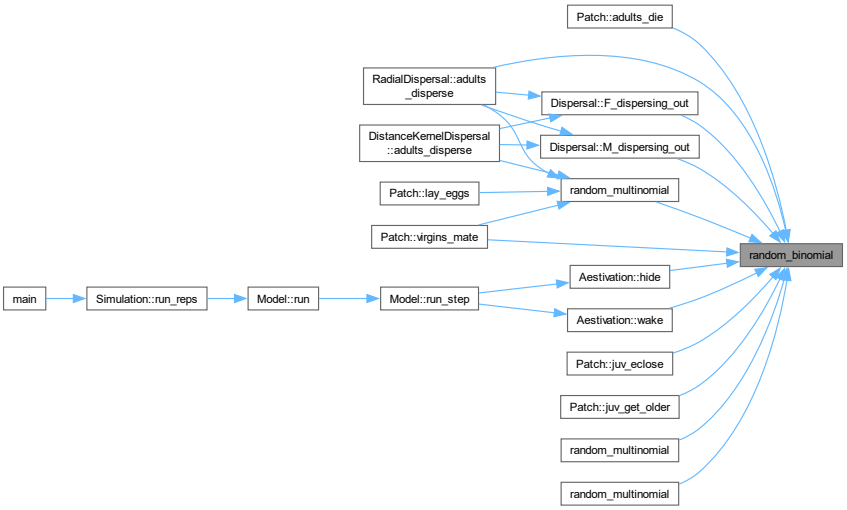
7.29.1.1 random_binomial()

```
long long int random_binomial (
            long long int n,
            double p )
```

Here is the call graph for this function:



Here is the caller graph for this function:

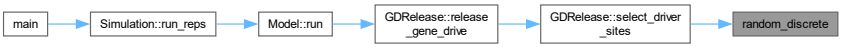


7.29.1.2 random_discrete()

```
int random_discrete (
            int a,
            int b )
```

Here is the call graph for this function:

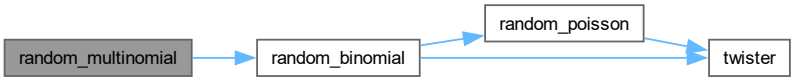
Here is the caller graph for this function:



7.29.1.3 random_multinomial() [1/3]

```
std::vector< long long int > random_multinomial (
            long long int n,
            const std::array< double, max_dev+1 > & probs )
```

Here is the call graph for this function:



7.29.1.4 random_multinomial() [2/3]

```
std::vector< long long int > random_multinomial (
            long long int n,
            const std::array< long long int, num_gen > & probs )
```

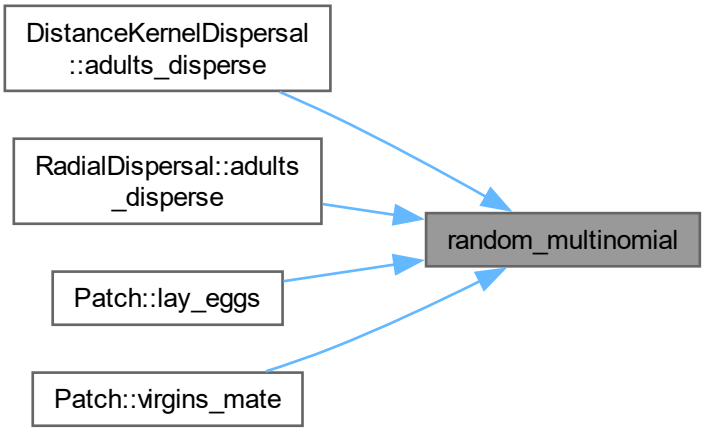
Here is the call graph for this function:

7.29.1.5 random_multinomial() [3/3]

```
std::vector< long long int > random_multinomial (
            long long int n,
            const std::vector< double > & probs )
```

Here is the call graph for this function:

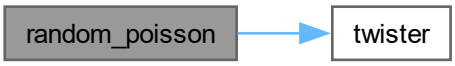
Here is the caller graph for this function:



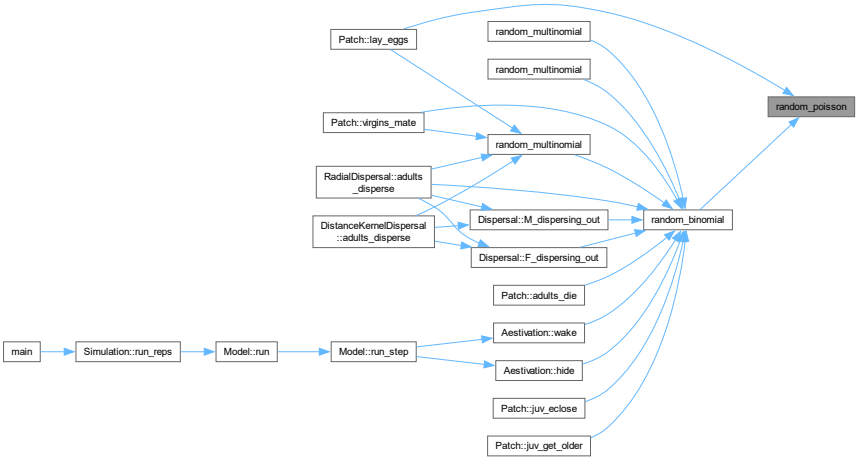
7.29.1.6 random_poisson()

```
long long int random_poisson (
             double lambda )
```

Here is the call graph for this function:



Here is the caller graph for this function:

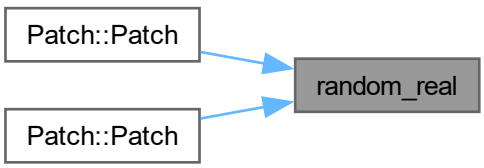


7.29.1.7 random_real()

```
double random_real ( )
```

Here is the call graph for this function:

Here is the caller graph for this function:



7.30 random.h

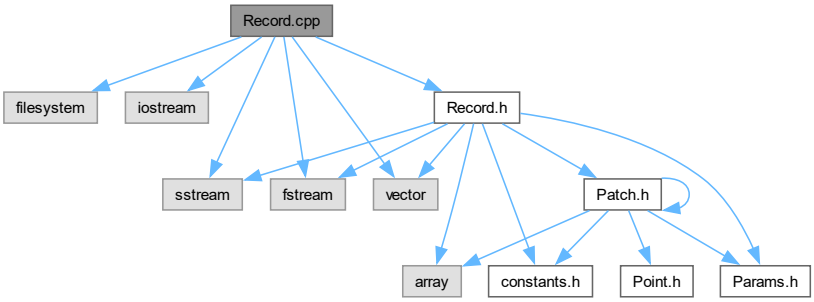
Go to the documentation of this file.

```
00001 #include <vector>
00002 #include <array>
00003 #include "constants.h"
00004
00005 using namespace constants;
00006
00007 // Random number generator functions
00008
00009 double random_real();
00010 int random_discrete(int a, int b);
00011 long long int random_poisson(double lambda);
00012 long long int random_binomial(long long int n, double p);
00013 std::vector<long long int> random_multinomial(long long int n, const std::vector<double>& probs);
00014 std::vector<long long int> random_multinomial(long long int n, const std::array<long long int,
      num_gen>& probs);
00015 std::vector<long long int> random_multinomial(long long int n, const std::array<double, max_dev+1>&
      probs);
```

7.31 Record.cpp File Reference

```
#include <filesystem>
#include <iostream>
#include <sstream>
#include <fstream>
#include <vector>
#include "Record.h"
```

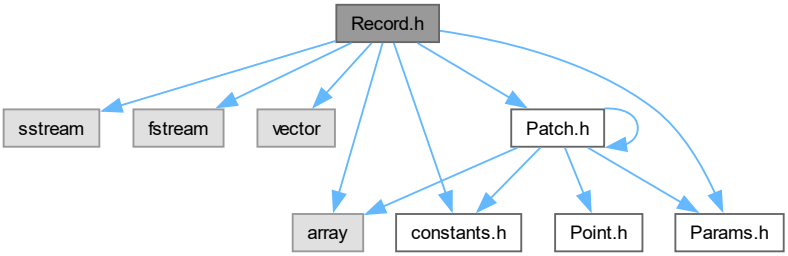
Include dependency graph for Record.cpp:



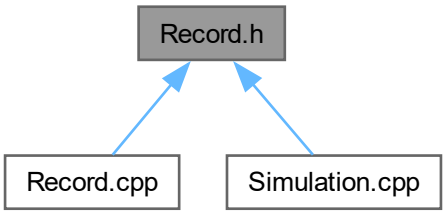
7.32 Record.h File Reference

```
#include <sstream>
#include <fstream>
#include <vector>
#include <array>
#include "constants.h"
#include "Patch.h"
```

`#include "Params.h"`
Include dependency graph for Record.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Record

7.33 Record.h

Go to the documentation of this file.

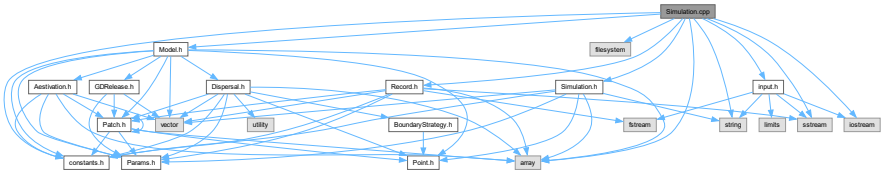
```
00001 #ifndef RECORD_H
00002 #define RECORD_H
00003
00004 #include <sstream>
00005 #include <fstream>
00006 #include <vector>
00007 #include <array>
00008 #include "constants.h"
00009 #include "Patch.h"
00010 #include "Params.h"
00011
00012 using namespace constants;
00013
00014 // Records model data.
00015 class Record {
00016 public:
00017     Record(RecordParams *rec_params, int rep);
00018     ~Record();
```

```
00019     void record_coords(const std::vector<Patch*> &sites);
00020     void record_global(int day, const std::array<long long int, num_gen> &tot_M_gen);
00021     void output_totals(int day, long long int tot_J, long long int tot_M, long long int tot_V, long
      long int tot_F);
00022     void record_local(int day, const std::vector<Patch*> &sites);
00023
00024     bool is_rec_local_time(int day);
00025     bool is_rec_global_time(int day);
00026
00027 private:
00028     // recording window and intervals
00029     int rec_start; // start time for the data recording window (in days) (non-inclusive)
00030     int rec_end; // end time for the data recording window (in days) (inclusive)
00031     int rec_interval_global; // time interval for global data recording/output
00032     int rec_interval_local; // time interval at which to collect/record local data (in days)
00033     int rec_sites_freq; // fraction of sites to collect local data for (1 is all sites, 10 is 1 in 10
      etc)
00034
00035     // output filename labels
00036     int set_label; // 'set of repetitions' index label for output files
00037     int rep_label; // 'repetition' index label in given set of repetitions for output files
00038
00039     std::ostringstream os1, os2, os3; // filenames
00040     std::ofstream local_data, global_data, coord_list; // file objects
00041 };
00042
00043 #endif //RECORD_H
```

7.34 Simulation.cpp File Reference

```
#include <array>
#include <iostream>
#include <filesystem>
#include <sstream>
#include <string>
#include "Simulation.h"
#include "constants.h"
#include "Model.h"
#include "Record.h"
#include "input.h"
```

Include dependency graph for Simulation.cpp:



Functions

- void out_of_bounds_msg (const std::string &par)
- void invalid_interval_msg (const std::string &param1, const std::string &param2)

7.34.1 Function Documentation

7.34.1.1 invalid_interval_msg()

```
void invalid_interval_msg (
            const std::string & param1,
            const std::string & param2 )
```

Here is the caller graph for this function:

7.34.1.2 out_of_bounds_msg()

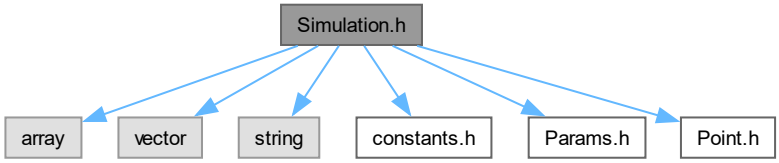
```
void out_of_bounds_msg (
            const std::string & par )
```

Here is the caller graph for this function:

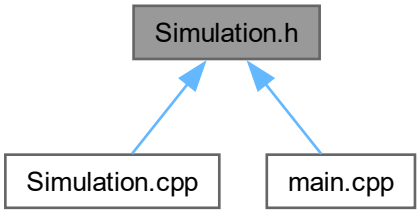
7.35 Simulation.h File Reference

```
#include <array>
#include <vector>
#include <string>
#include "constants.h"
#include "Params.h"
#include "Point.h"
```

Include dependency graph for Simulation.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Simulation

Functions

- void out_of_bounds_msg (const std::string &par)
- void invalid_interval_msg (const std::string &param1, const std::string &param2)

7.35.1 Function Documentation

7.35.1.1 invalid_interval_msg()

```
void invalid_interval_msg (
            const std::string & param1,
            const std::string & param2 )
```

Here is the caller graph for this function:

7.35.1.2 out_of_bounds_msg()

```
void out_of_bounds_msg (
            const std::string & par )
```

Here is the caller graph for this function:

7.36 Simulation.h

Go to the documentation of this file.

```
00001 #ifndef SIMULATION_H
00002 #define SIMULATION_H
00003
00004 #include <array>
00005 #include <vector>
00006 #include <string> // for error messages
00007 #include "constants.h"
00008 #include "Params.h"
00009 #include "Point.h"
00010
00011 using namespace constants;
00012
00013 void out_of_bounds_msg(const std::string& par);
00014 void invalid_interval_msg(const std::string& param1, const std::string& param2);
00015
00016 // Sets up and controls the flow of the simulation.
00017 class Simulation {
00018 public:
00019     Simulation(ProgressionParams &prog, AreaParams &area, LifeParams &life, ReleaseParams &rel,
      DispersalParams &disp,
00020      AestivationParams &aes, InitialPopsParams &initial, RecordParams &rec);
00021     void set_coords(const std::string& coords_file);
00022     void set_boundary_type(BoundaryType boundary);
00023     void set_dispersal_type(DispersalType disp);
00024     void set_inheritance(InheritanceParams inher_params);
00025     void run_reps();
00026
00027 private:
00028     int num_runs; // number of simulation replicates to run
00029     int max_t; // maximum simulated time (in days)
00030
00031     AreaParams *area_params; // model area parameters
00032     LifeParams *life_params; // model life-process parameters
00033     ReleaseParams *rel_params; // gene drive release model parameters
00034     DispersalParams *disp_params; // dispersal model parameters
00035     AestivationParams *aes_params; // aestivation model parameters
00036     InitialPopsParams *initial_params; // initial population values
00037     RecordParams *rec_params; // data-recording parameters
00038
00039     // additional parameter options
00040     std::vector<Point> sites_coords; // 2D coordinates for the sites on the simulated square
00041     BoundaryType boundary_type;
00042     DispersalType disp_type;
00043
00044     // inheritance
00045     // f_ijk is the fraction of genotype k offspring from mother with genotype i mated to father with
      genotype j
00046     std::array<std::array<std::array <double, num_gen>, num_gen>, num_gen> inher_fraction;
00047 };
00048
00049 #endif //SIMULATION_H
```

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