



# **Same Risk Area Case-study for Kattegat and Øresund**

## Appendix 3: Connectivity analysis–Additional results

DTU Aqua report no. 335c-2018

Flemming Thorbjørn Hansen and Asbjørn Christensen

Title: Same-Risk-Area Case-study for Kattegat and Øresund. Appendix 3: Connectivity analysis–Additional results

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Cover: Example from the SRAMM-tool of hydrographic regions identified for *Didemnum vexillum* based on 3 years larval dispersal simulation.

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# 1 Introduction

This appendix 3 is an appendix to the report: "SRA Case Study for Kattegat and Øresund". The appendix presents result from the connectivity analyses carried out for 23 marine invasive species for the Kattegat and Øresund region. The additional results presented here are supplementary to the results presented in the main report and appendix 2. These supplementary results include:

- Hydrographic regions delineation for each species for each year 2005, 2010 and 2012, based on larval dispersal simulations using 200 000 agents as the initial number of agents per simulation. These are included to show how connectivity may vary between years.
- Hydrographic regions delineation for each species for each year 2005, 2010 and 2012, based on larval dispersal simulations using 50 000 agents as the initial number of agents per simulation. These are included to evaluate how robust the connectivity analyses are to the number of agents included in the larval dispersal modelling.
- Hydrographic regions delineation for each species for the year 2005 based on larval dispersal simulations using 200,000 agents as the initial number of agents per simulation, and assuming a more shallow drift depth interval of 0 - 15 m, compared to the depth range of 0 - 40 m applied in the other larval dispersal simulations. These are included to evaluate how assumptions on drift depth may affect the results.

All hydrographic regions delineations are done assuming a multiple generations dispersal (or stepping stone dispersal) using the number of expected generations during a 5 year period and a between generations survival rate of 10 % per generation.

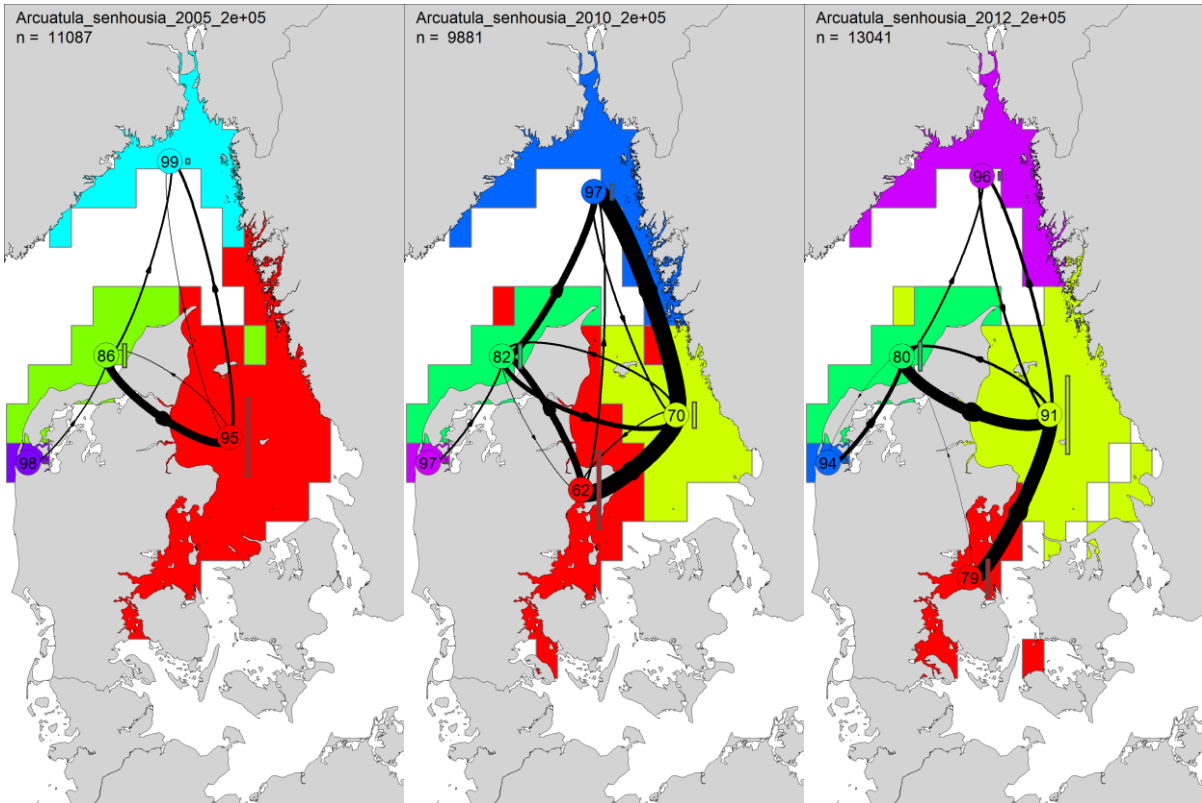
In addition to the hydrographic regions delineations, the appendix include downstream and upstream dispersal probability maps for each species for 7 of the major harbours of Kattegat and Øresund: Frederikshavn, Grenå, Gothenburg, Varberg, Helsingør, Helsingborg and Copenhagen. Dispersal probability maps are presented for both single generation dispersal and multiple generation dispersal within a 5-year period.

For details on the applied methodology and on how to read and interpret the hydrographic regions maps and dispersal probability maps, see the main report and/or appendix 2.

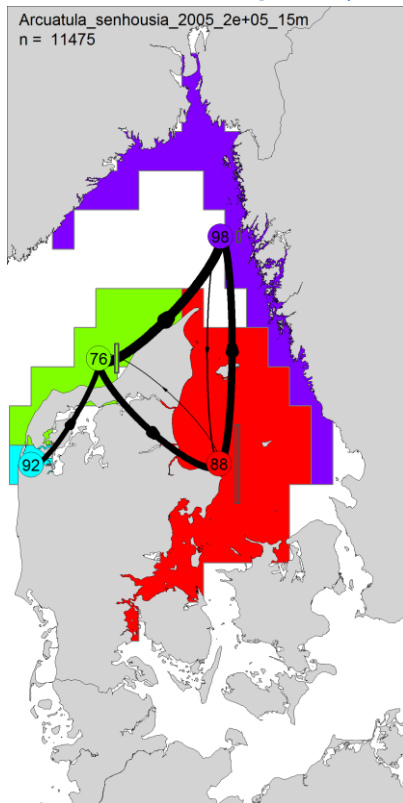
## 2 Arcuatula senhousia

### 2.1 Hydrographic regions

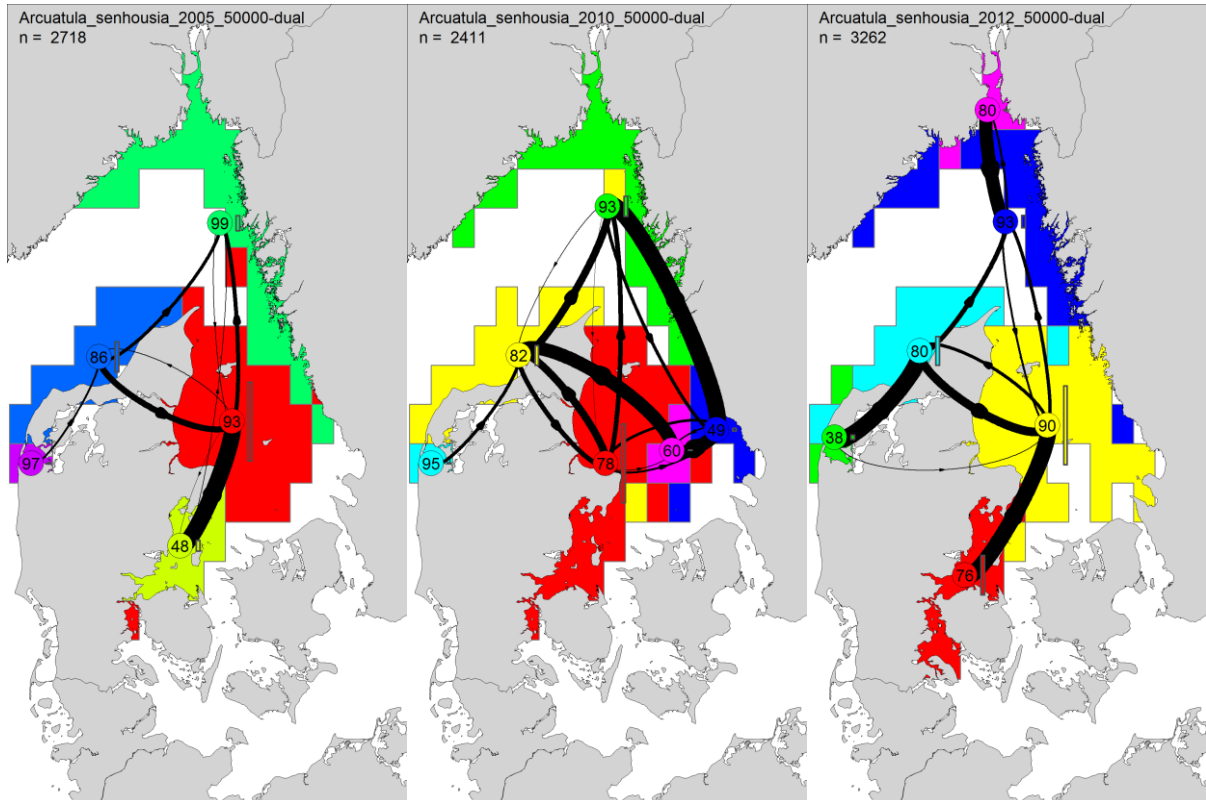
#### 2.1.1 200 000 agents



### 2.1.2 200 000 agents (0-15 m)

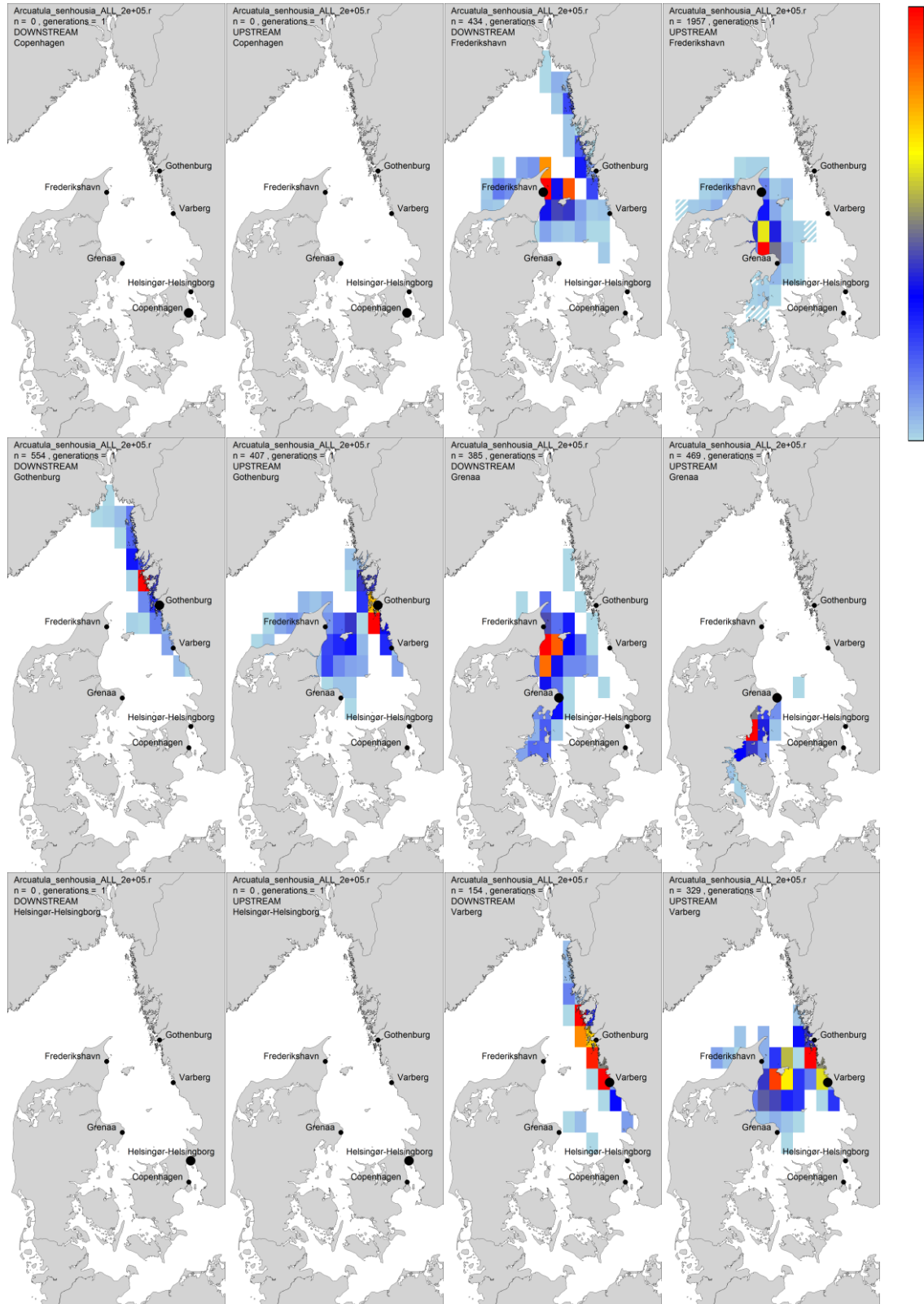


### 2.1.3 50 000 agents



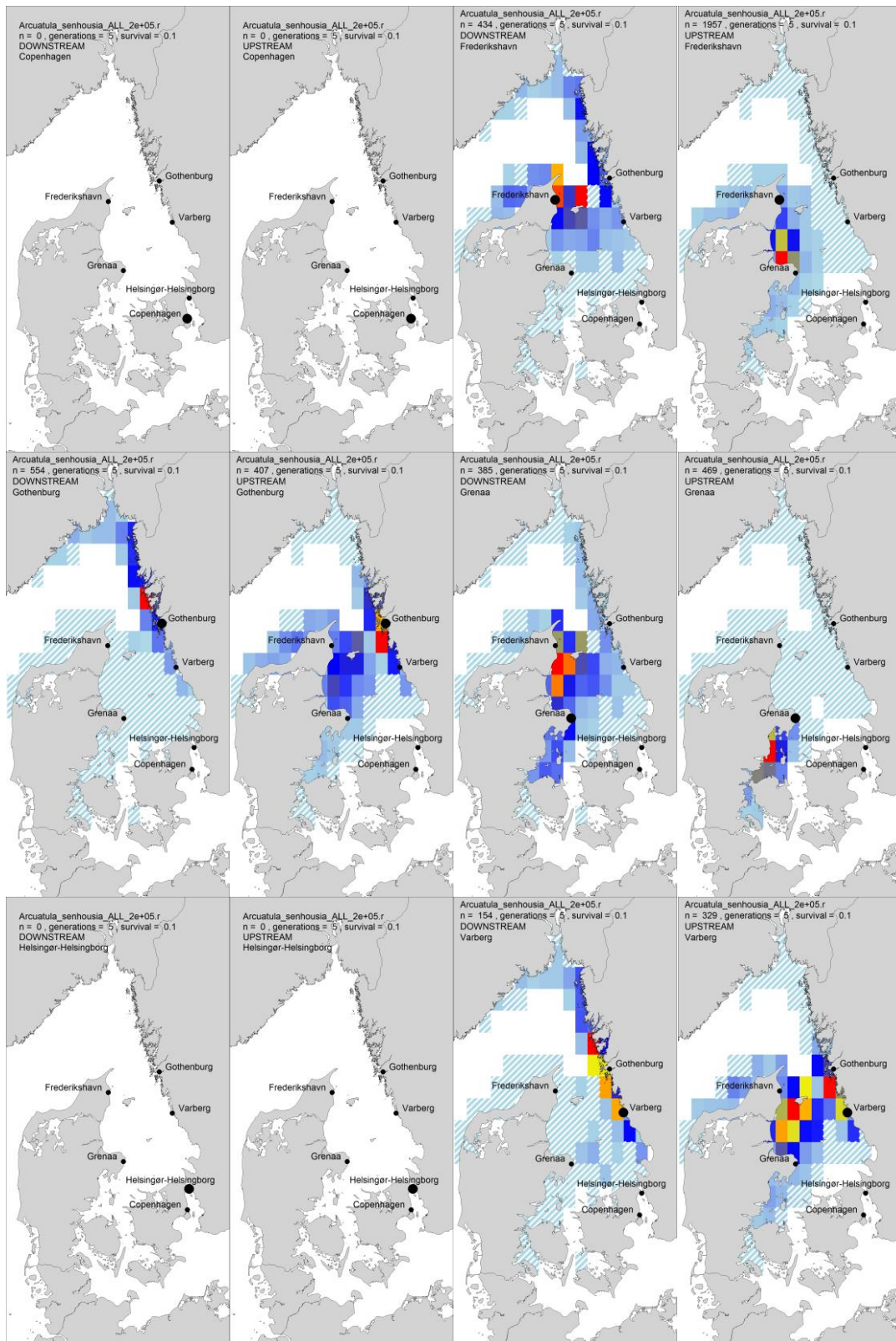
## 2.2 Dispersal probability plots

### 2.2.1 Single generation





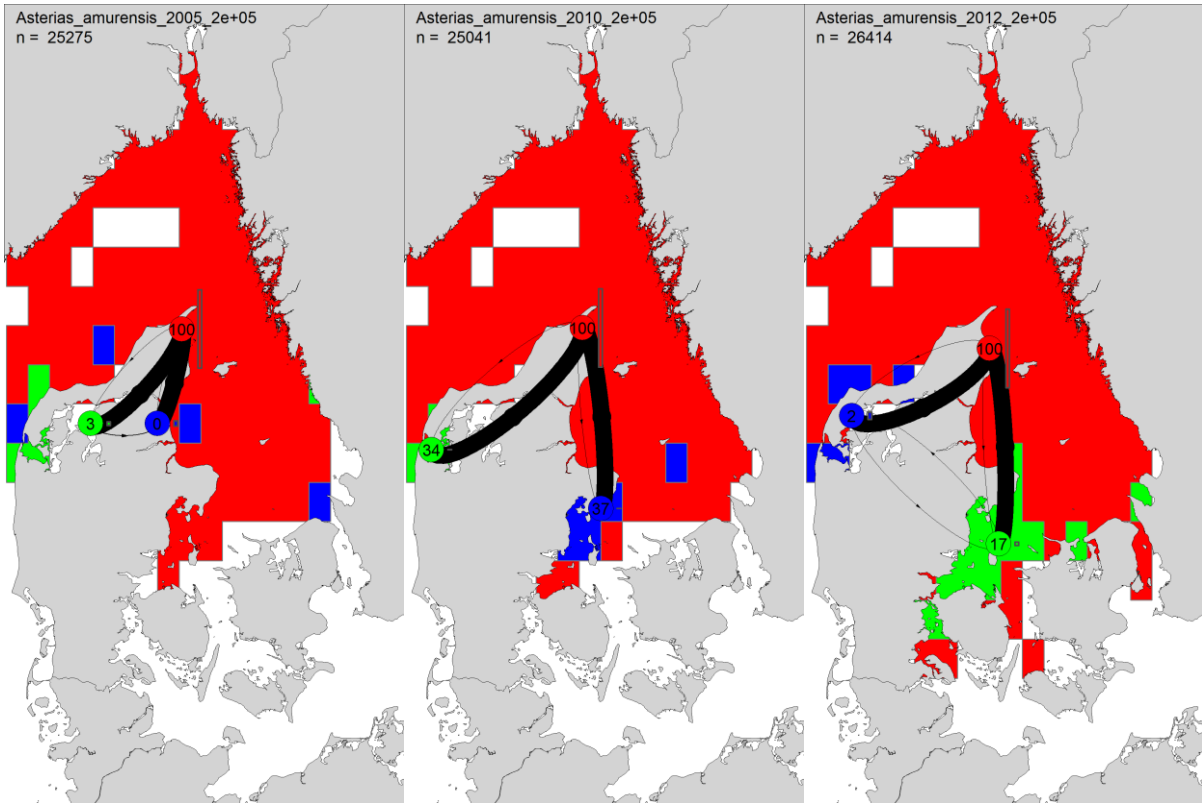
## 2.2.2 Multiple generations



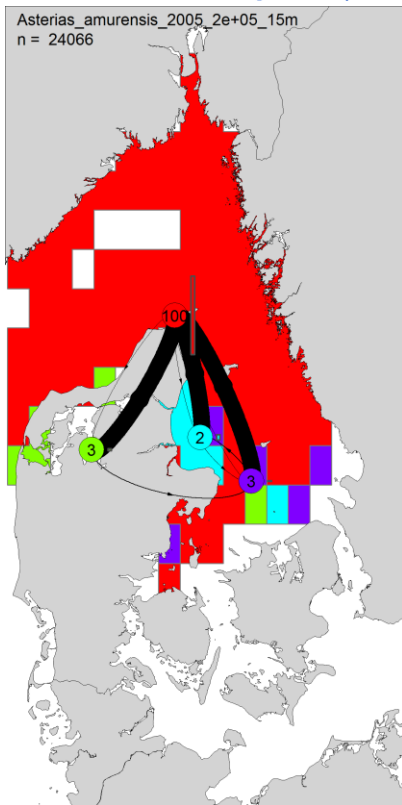
## 3 Asterias amurensis

### 3.1 Hydrographic regions

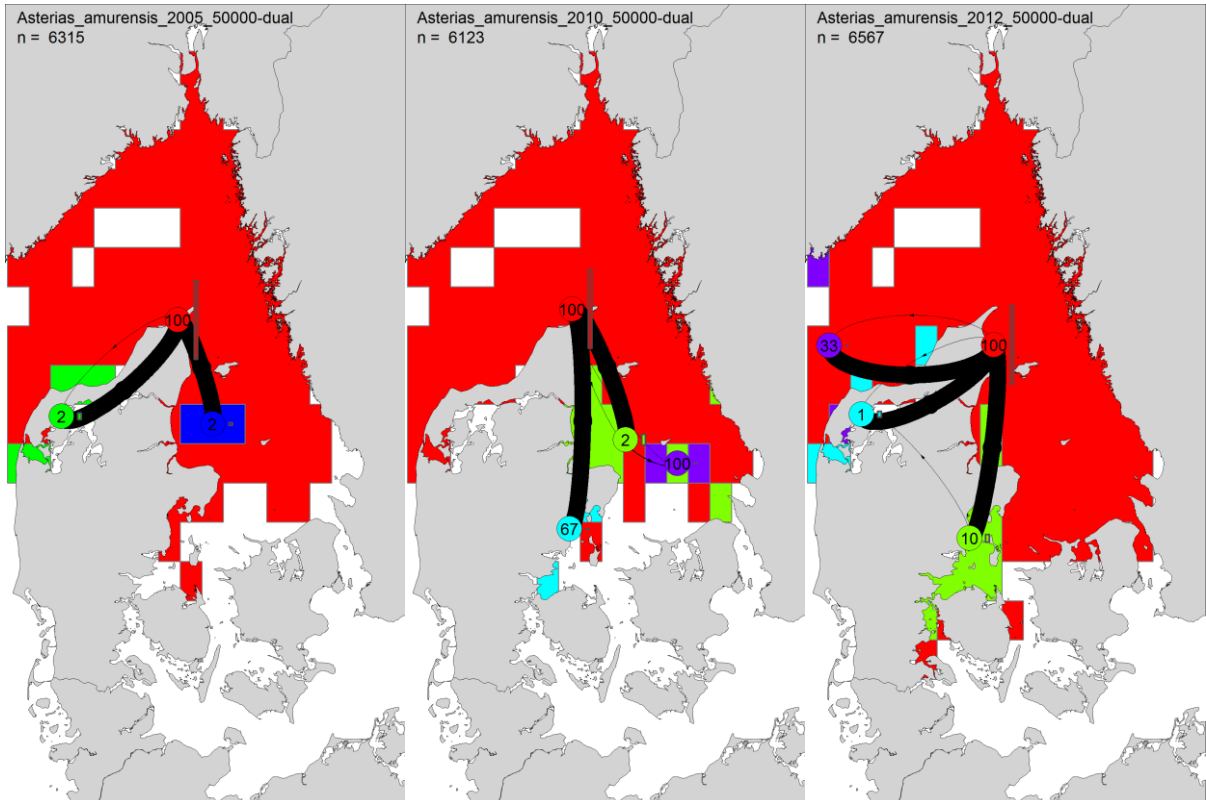
#### 3.1.1 200 000 agents



### 3.1.2 200 000 agents (0-15 m)

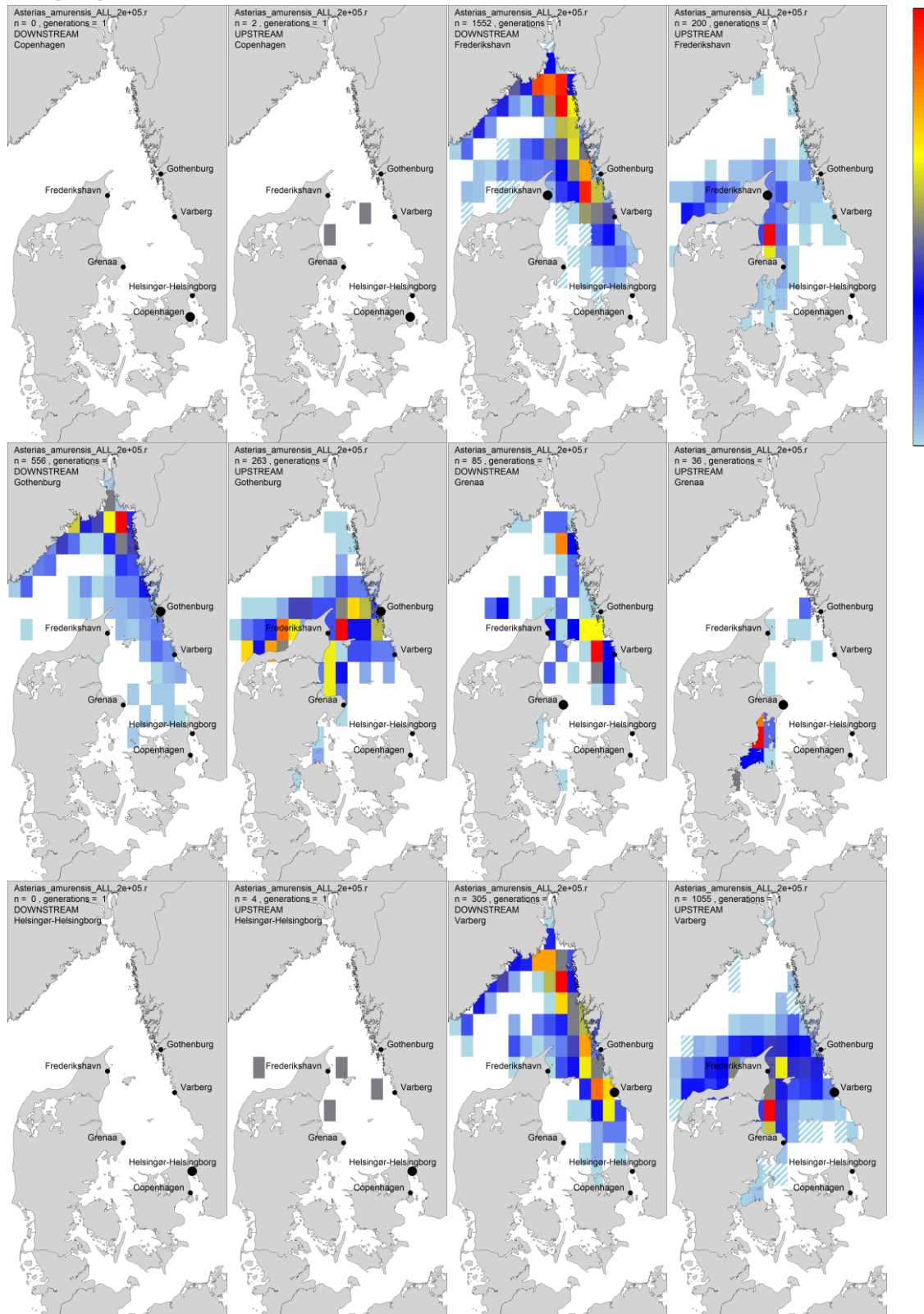


### 3.1.3 50 000 agents

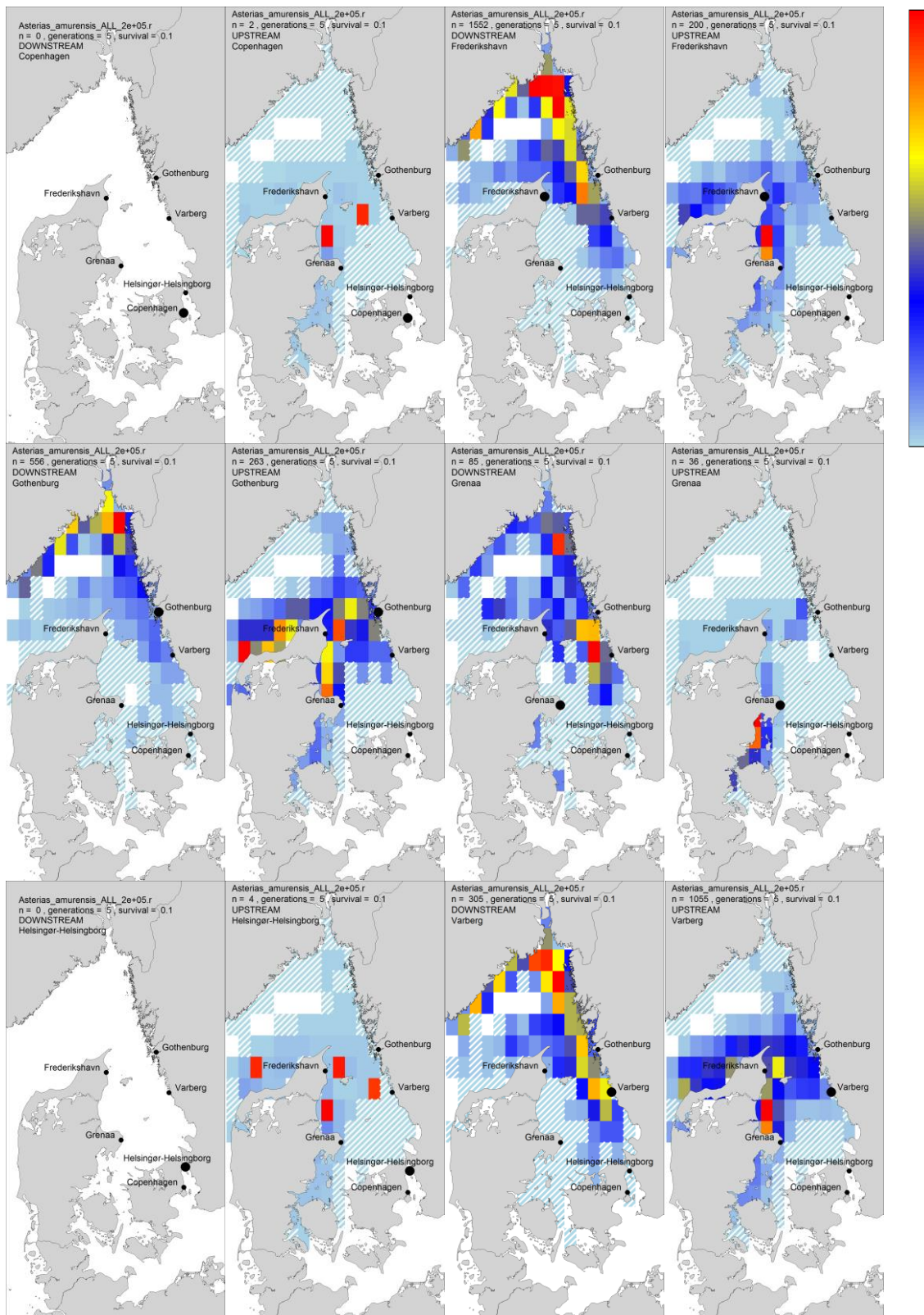


## 3.2 Dispersal probability plots

### 3.2.1 Single generation



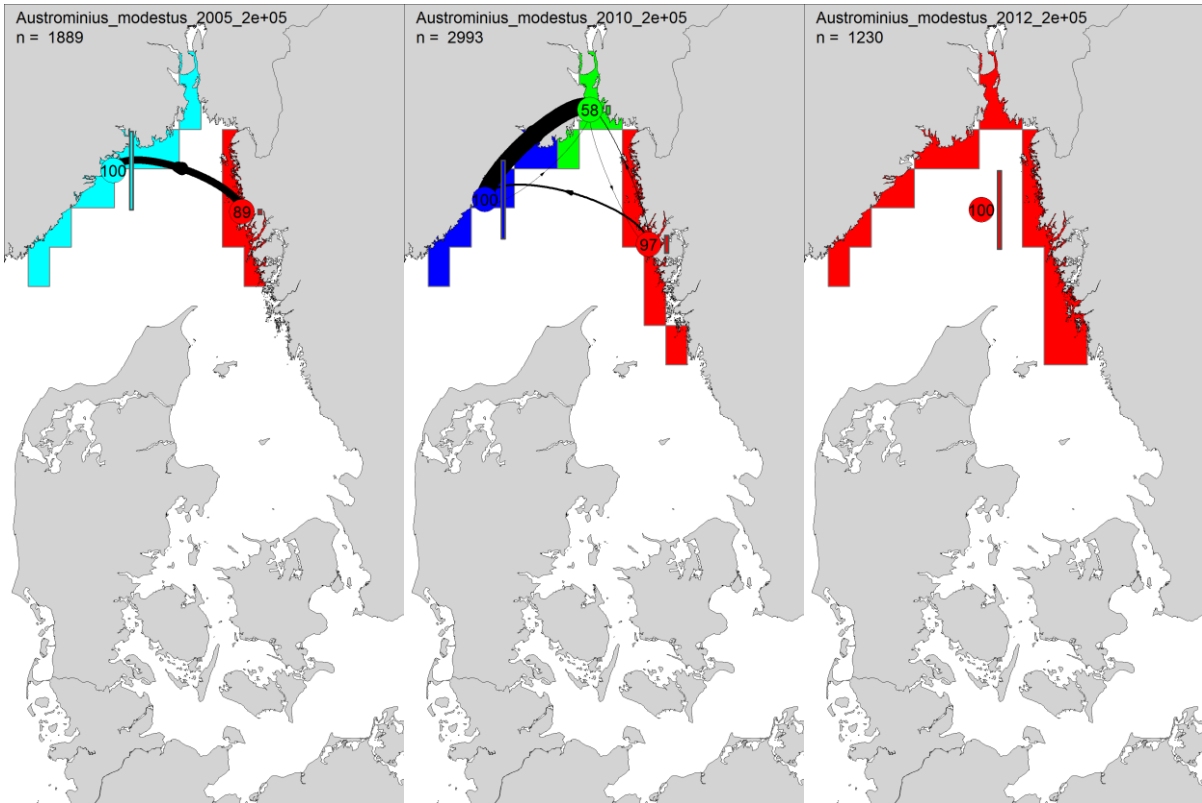
### 3.2.2 Multiple generations



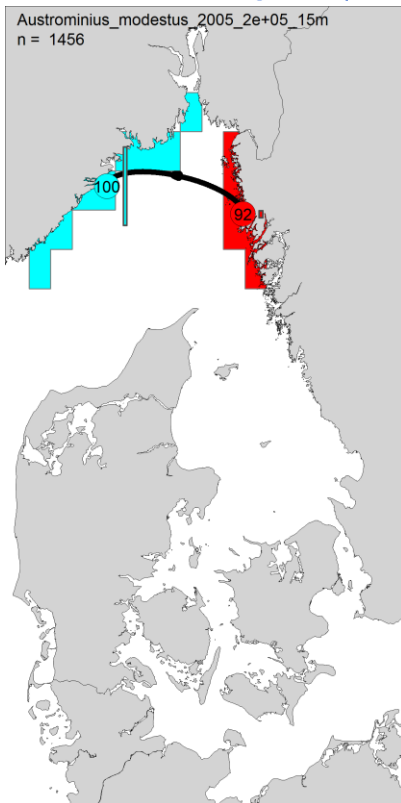
## 4 Austrominius modestus

### 4.1 Hydrographic regions

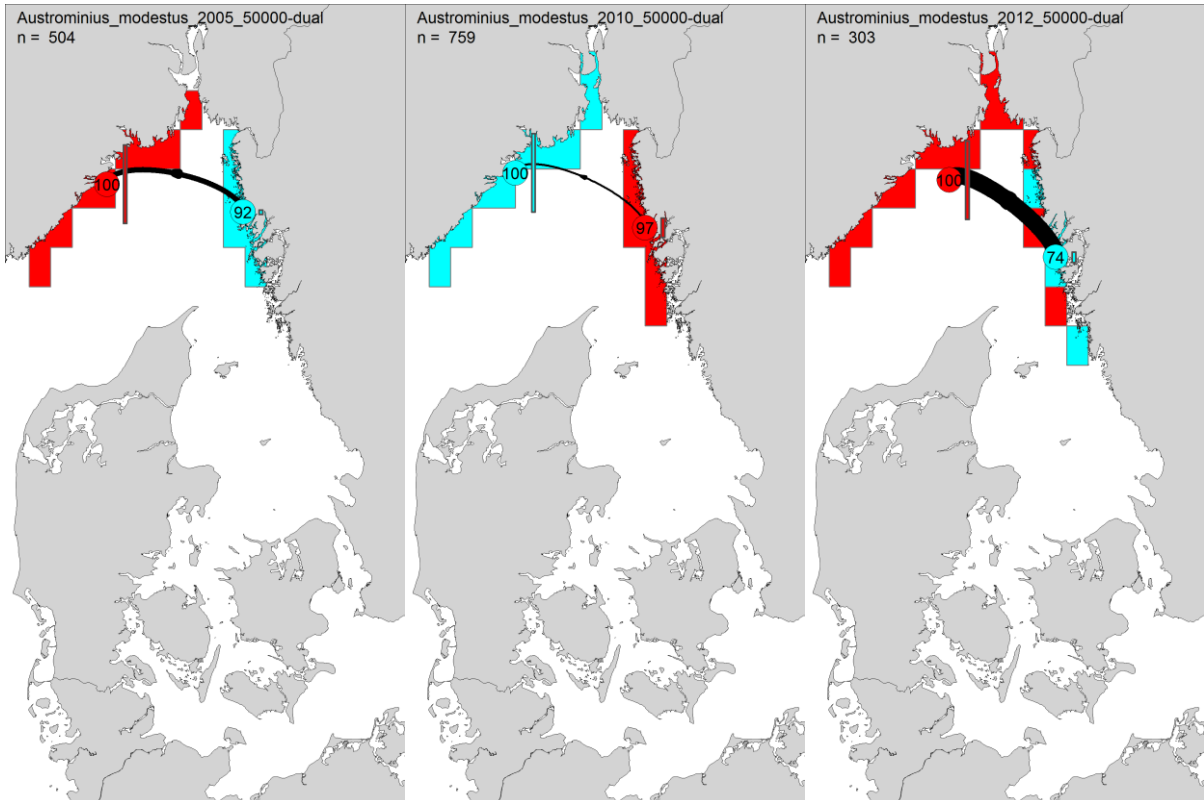
#### 4.1.1 200 000 agents



### 4.1.2 200 000 agents (0-15 m)

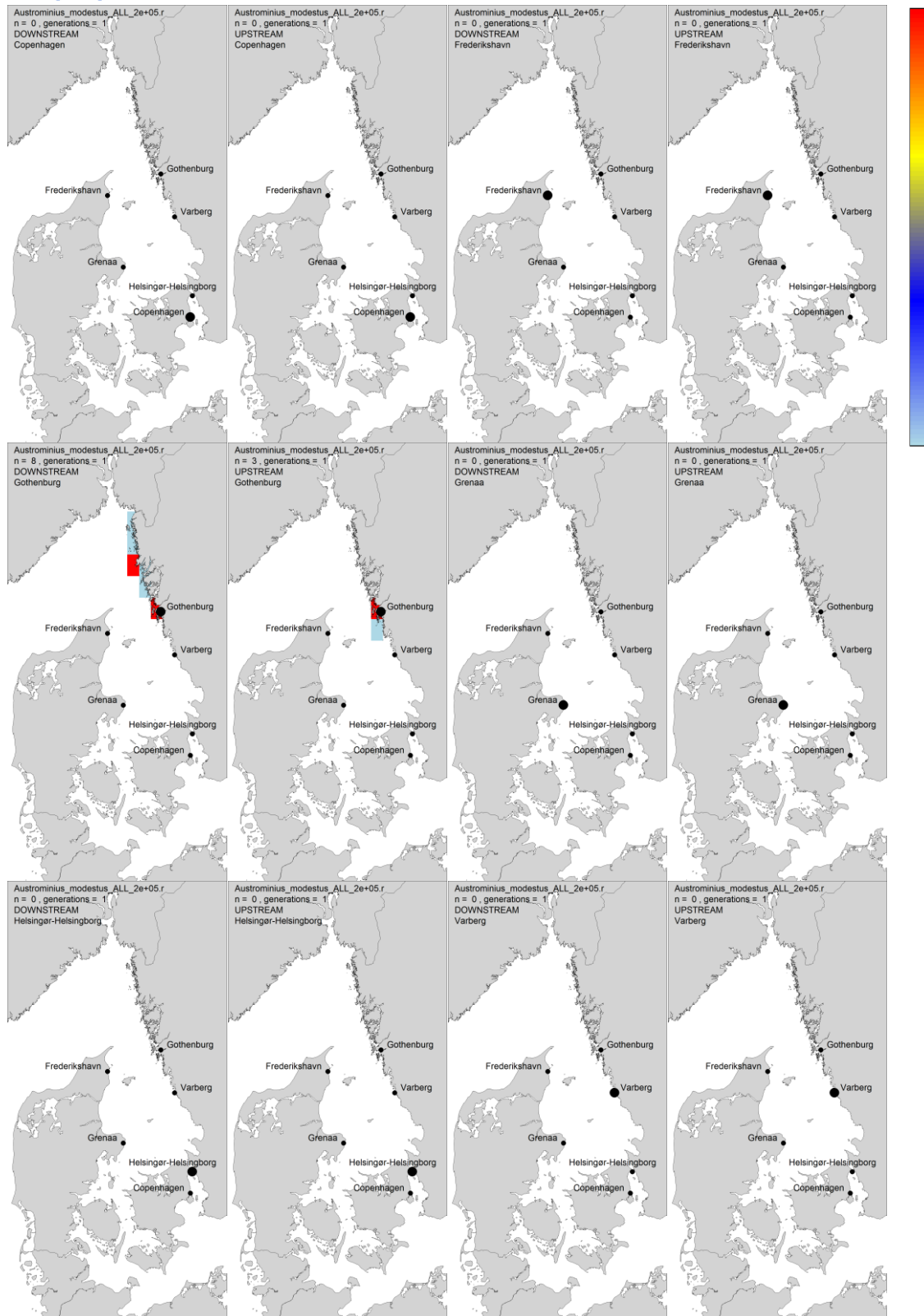


### 4.1.3 50 000 agents



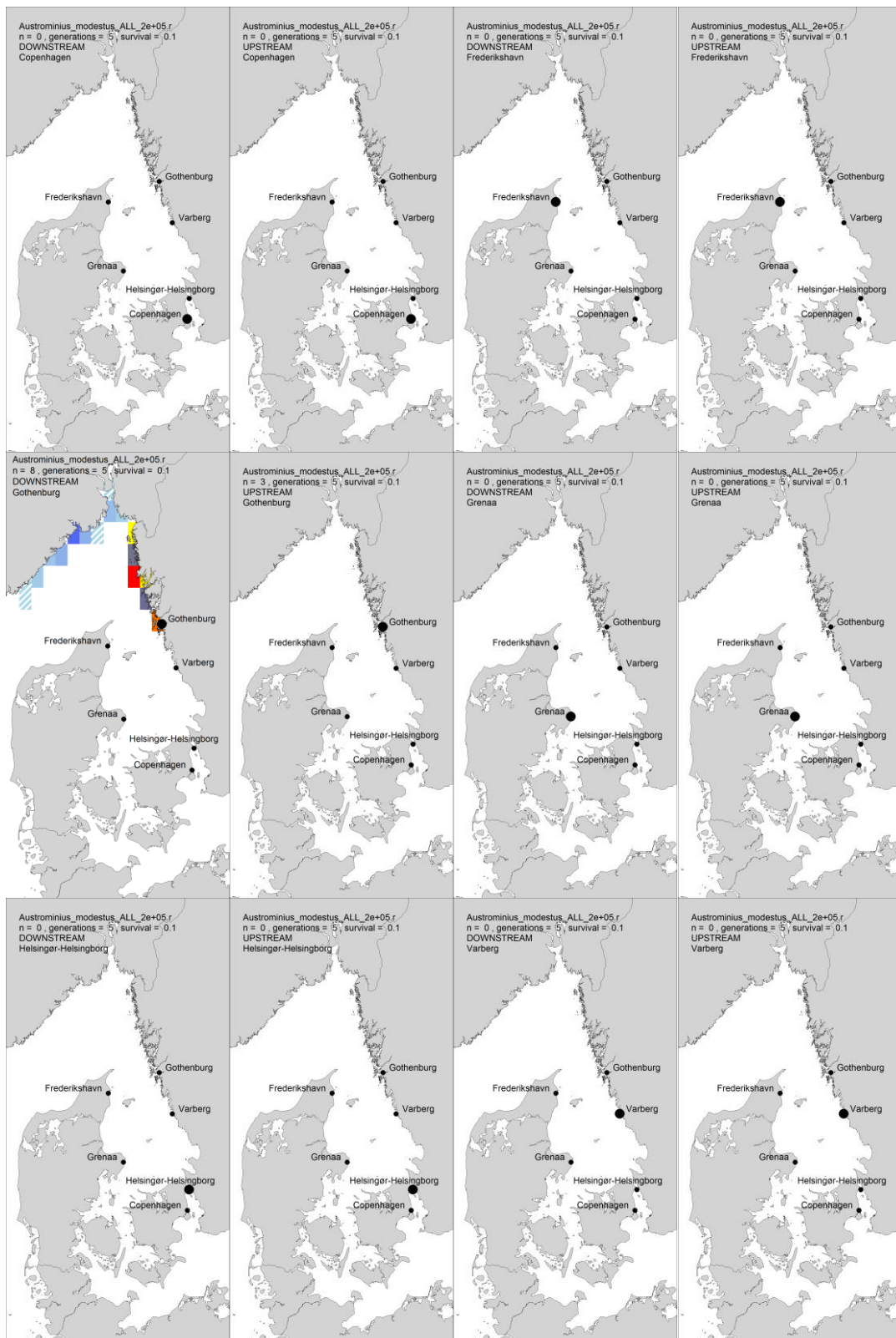
## 4.2 Dispersal probability plots

### 4.2.1 Single generation





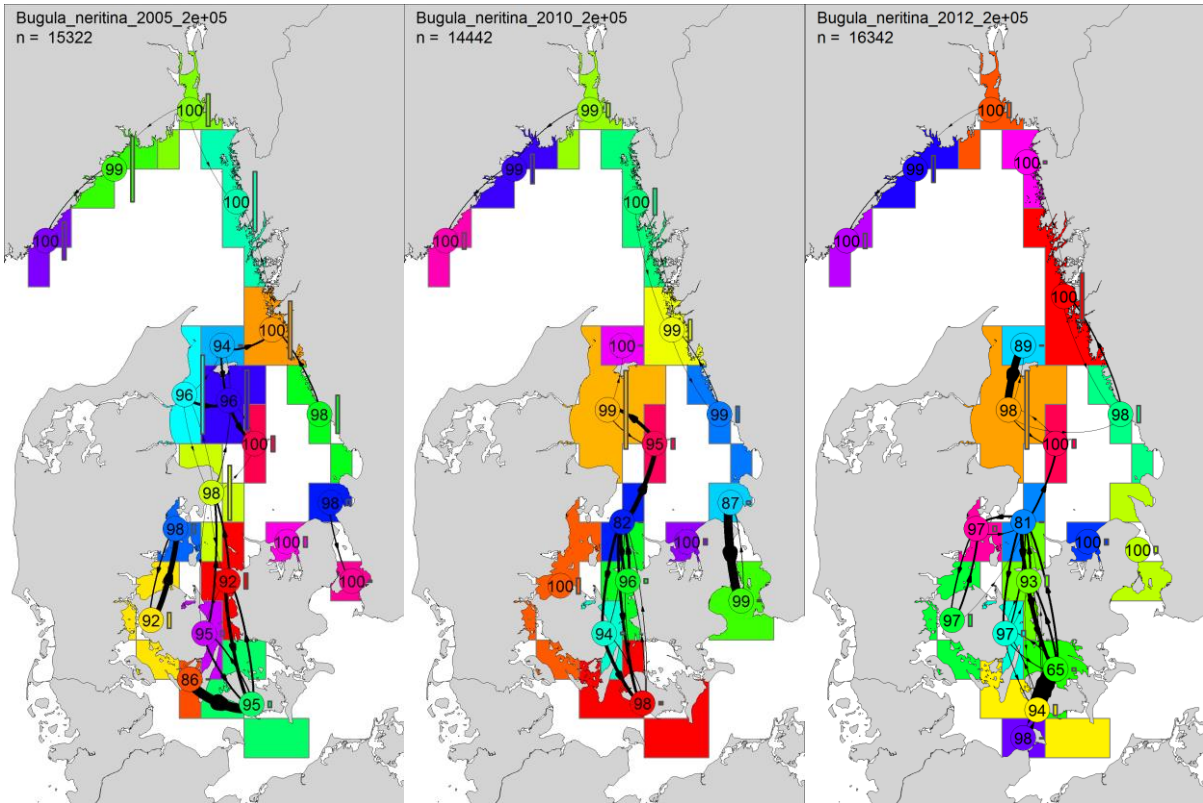
## 4.2.2 Multiple generations



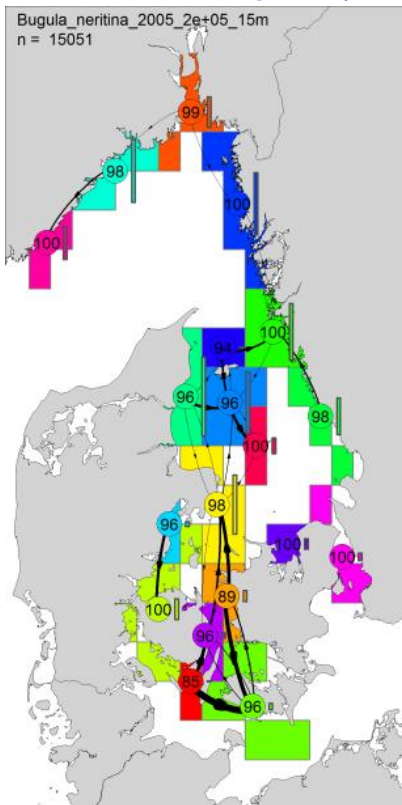
# 5 Bugula neritina

## 5.1 Hydrographic regions

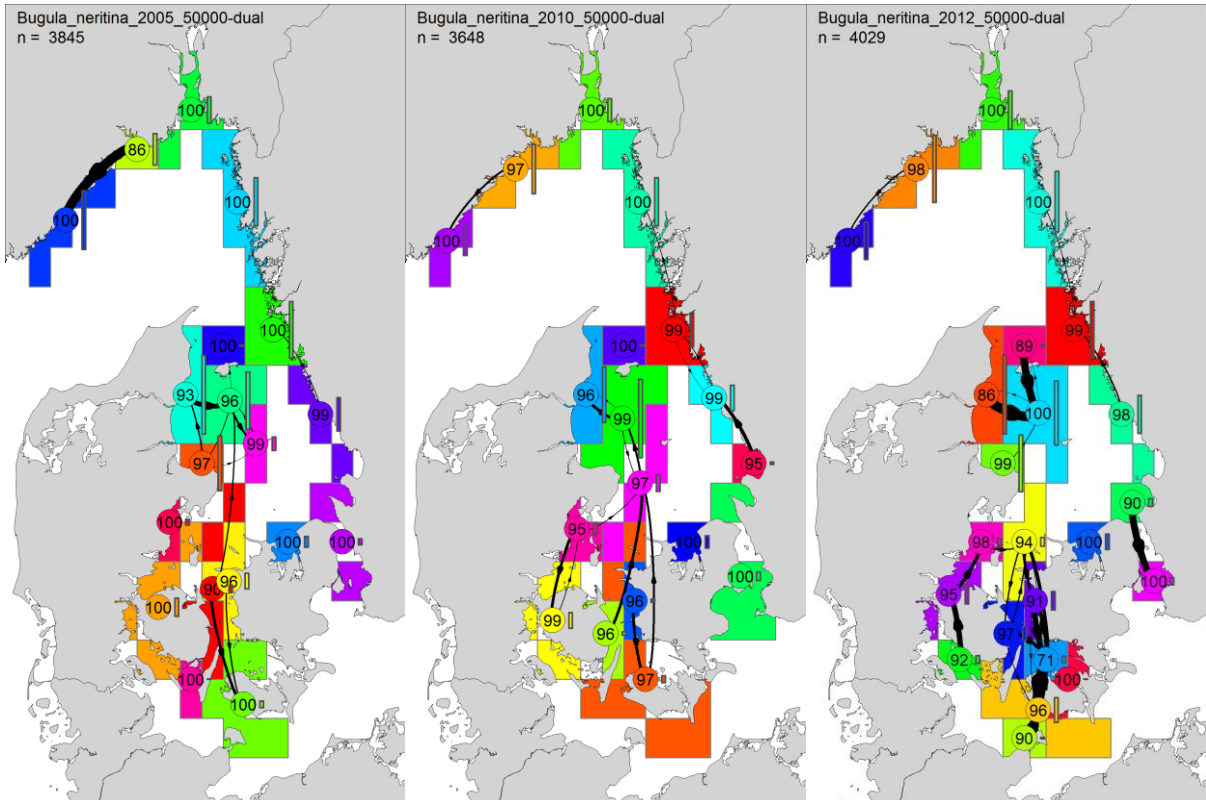
### 5.1.1 200 000 agents



### 5.1.2 200 000 agents (0-15 m)

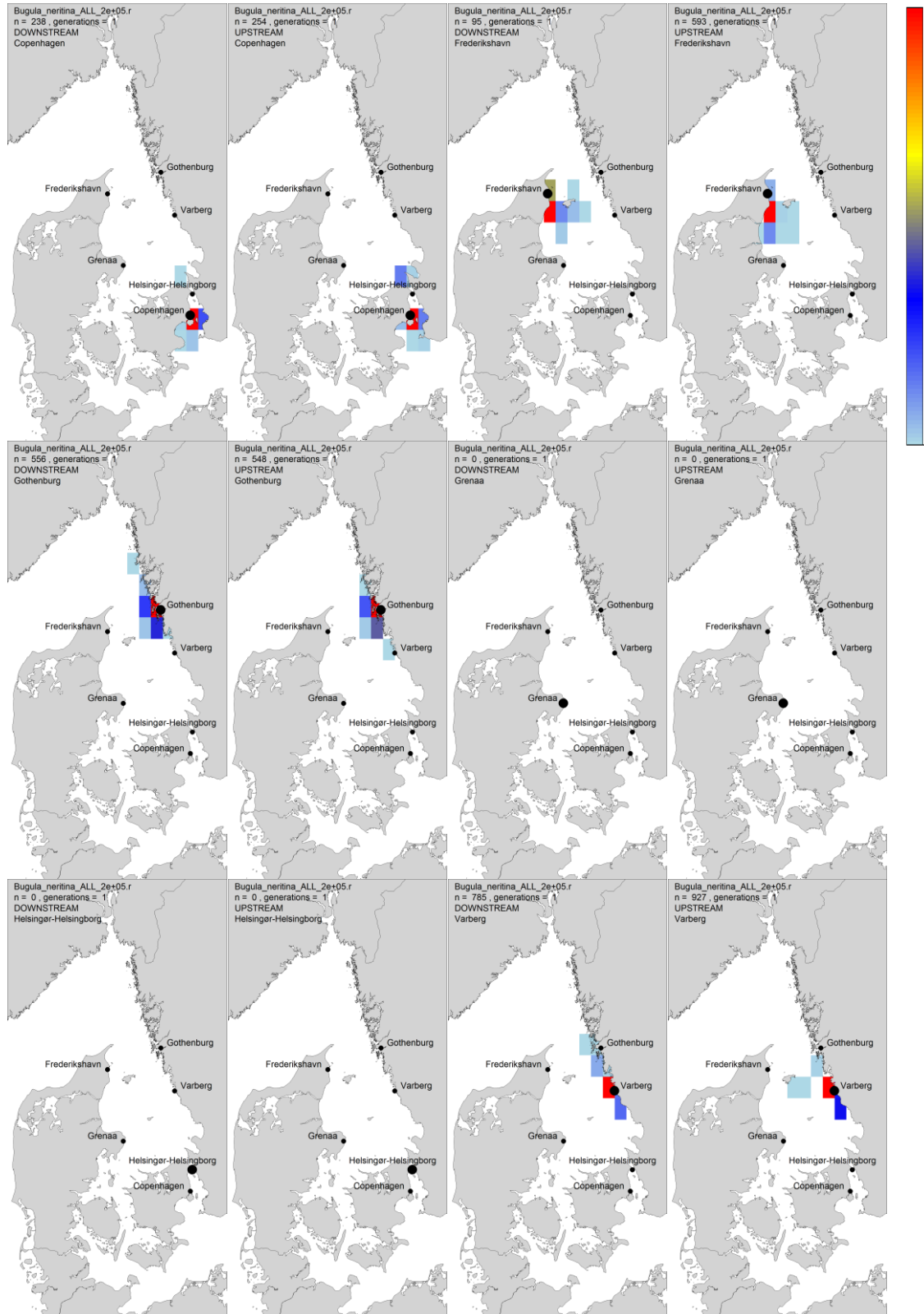


### 5.1.3 50 000 agents

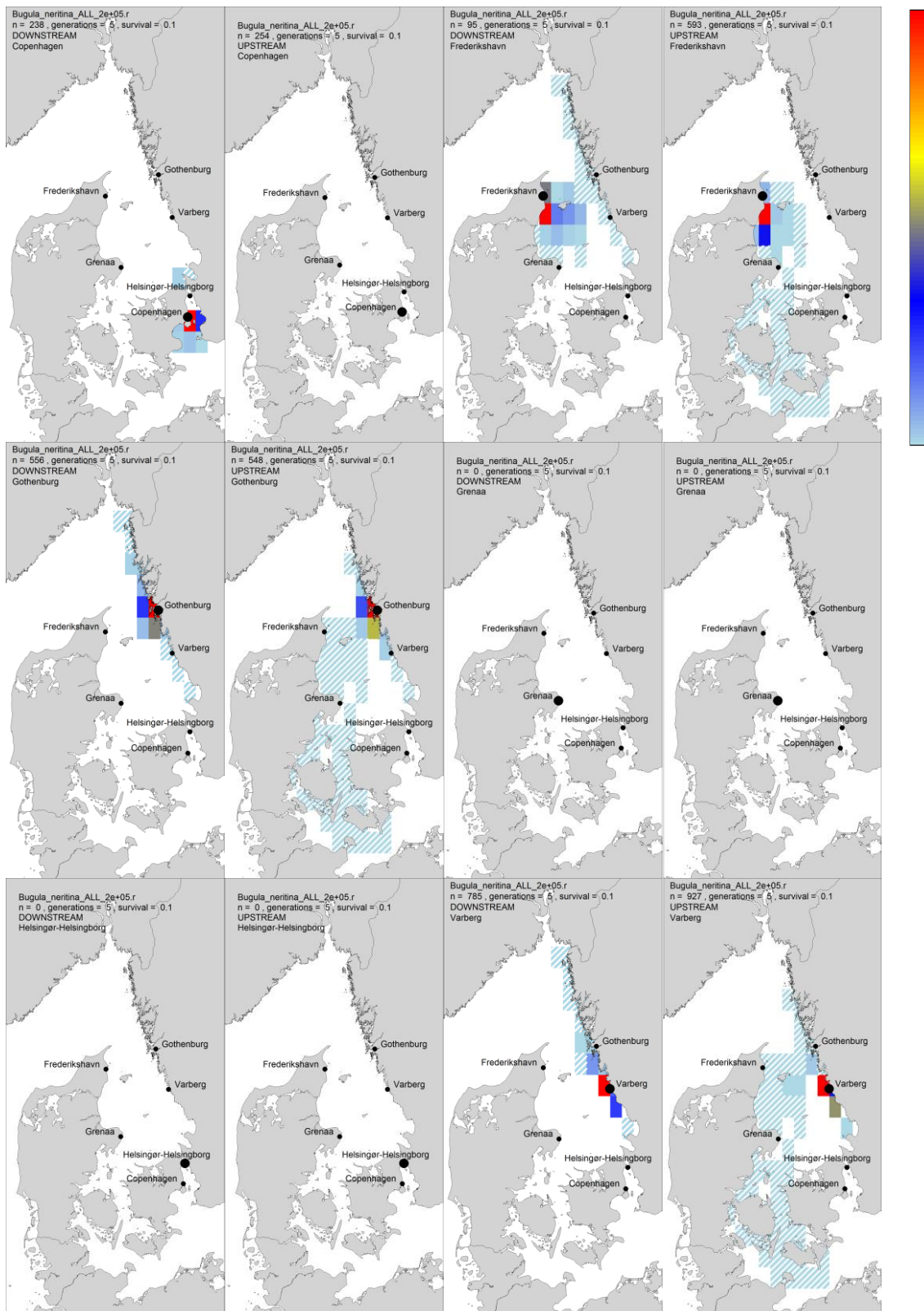


## 5.2 Dispersal probability plots

### 5.2.1 Single generation

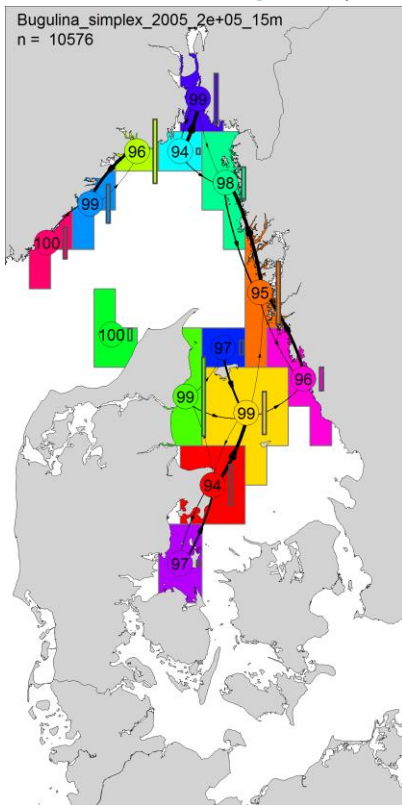


## 5.2.2 Multiple generations

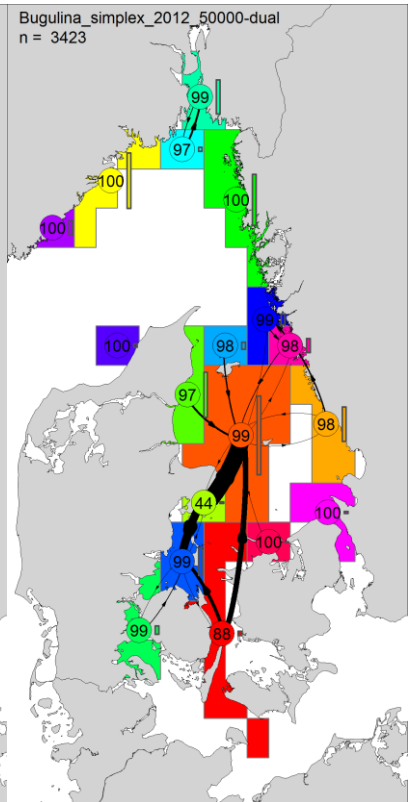
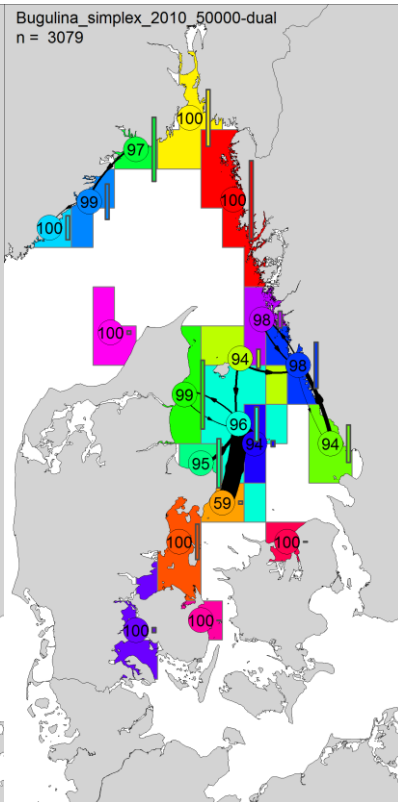
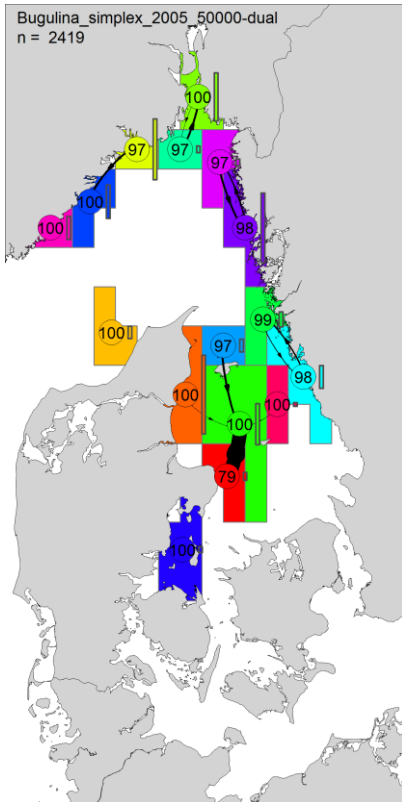




### 6.1.2 200 000 agents (0-15 m)

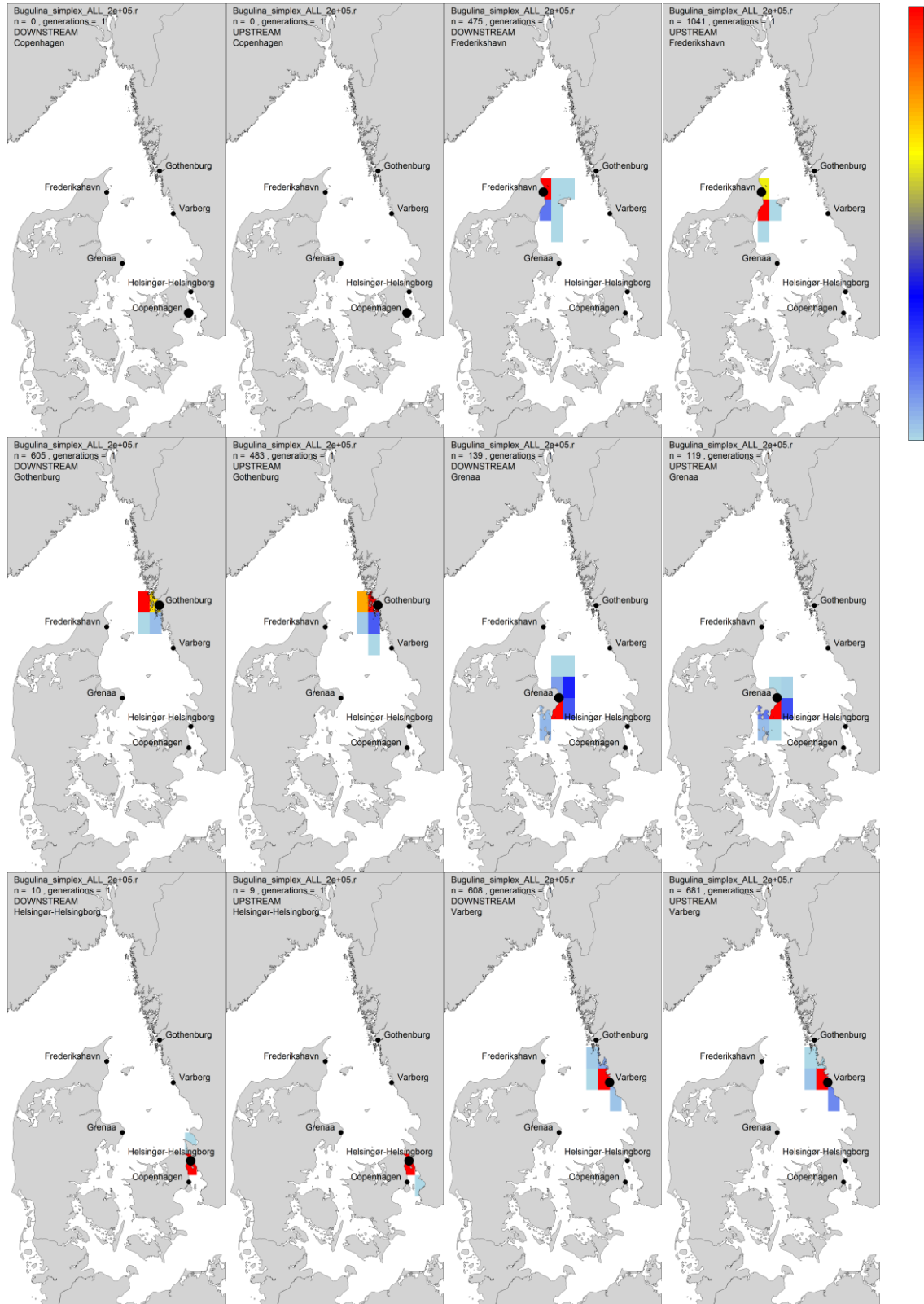


### 6.1.3 50 000 agents



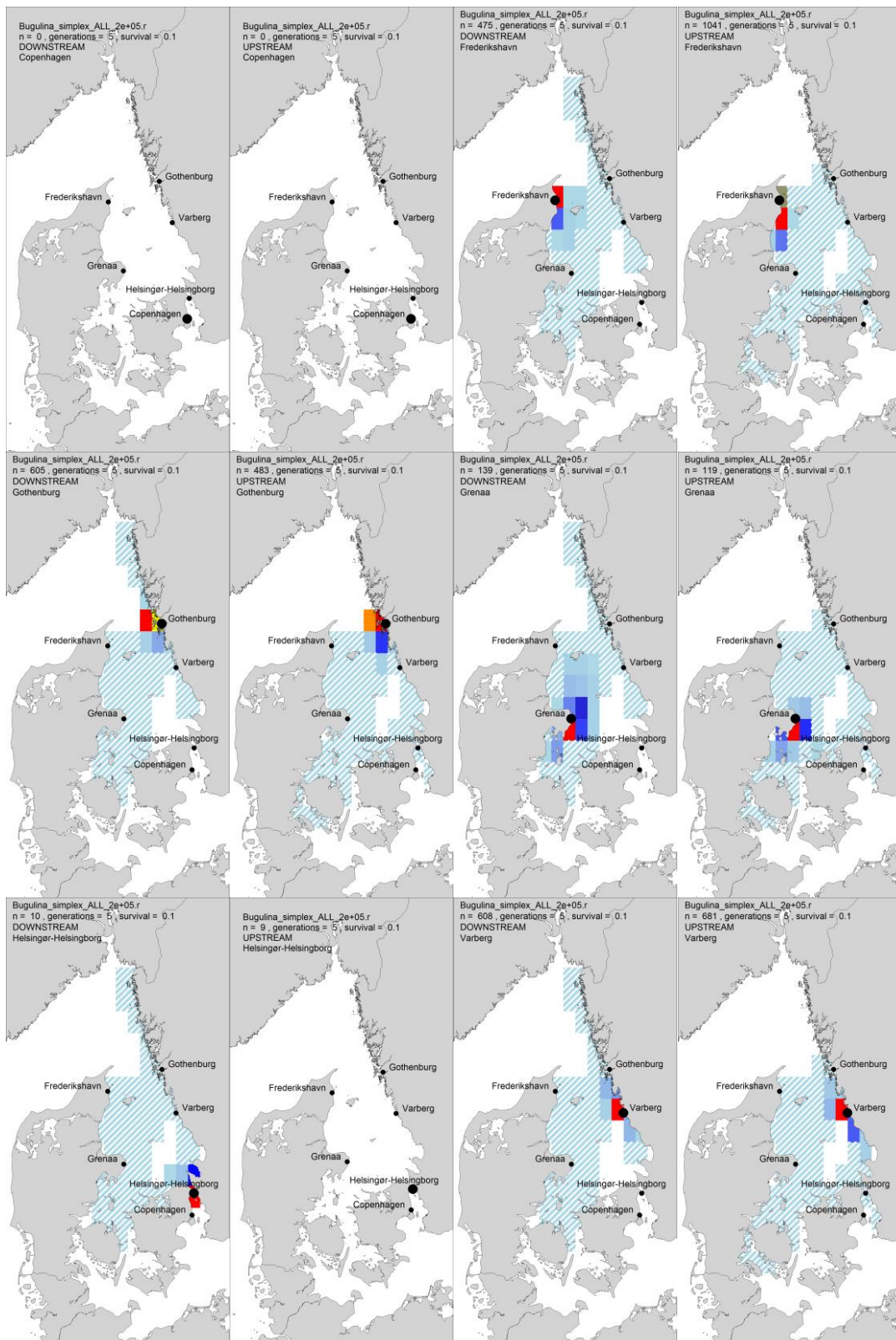
## 6.2 Dispersal probability plots

### 6.2.1 Single generation





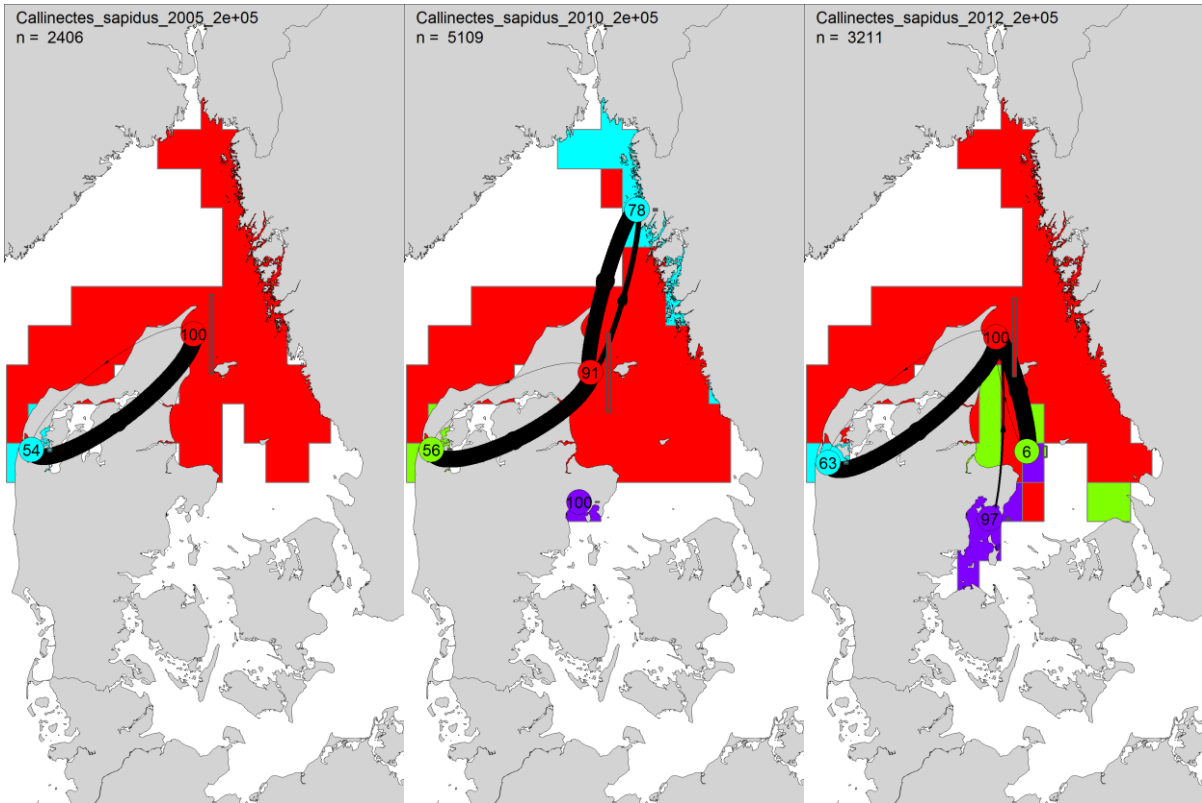
## 6.2.2 Multiple generations



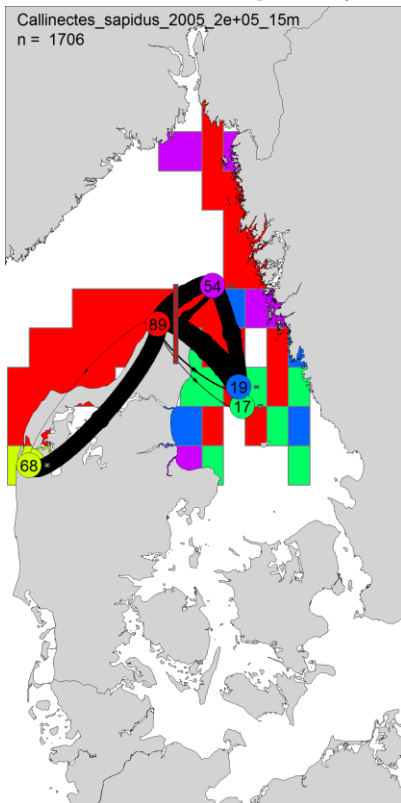
# 7 Callinectes sapidus

## 7.1 Hydrographic regions

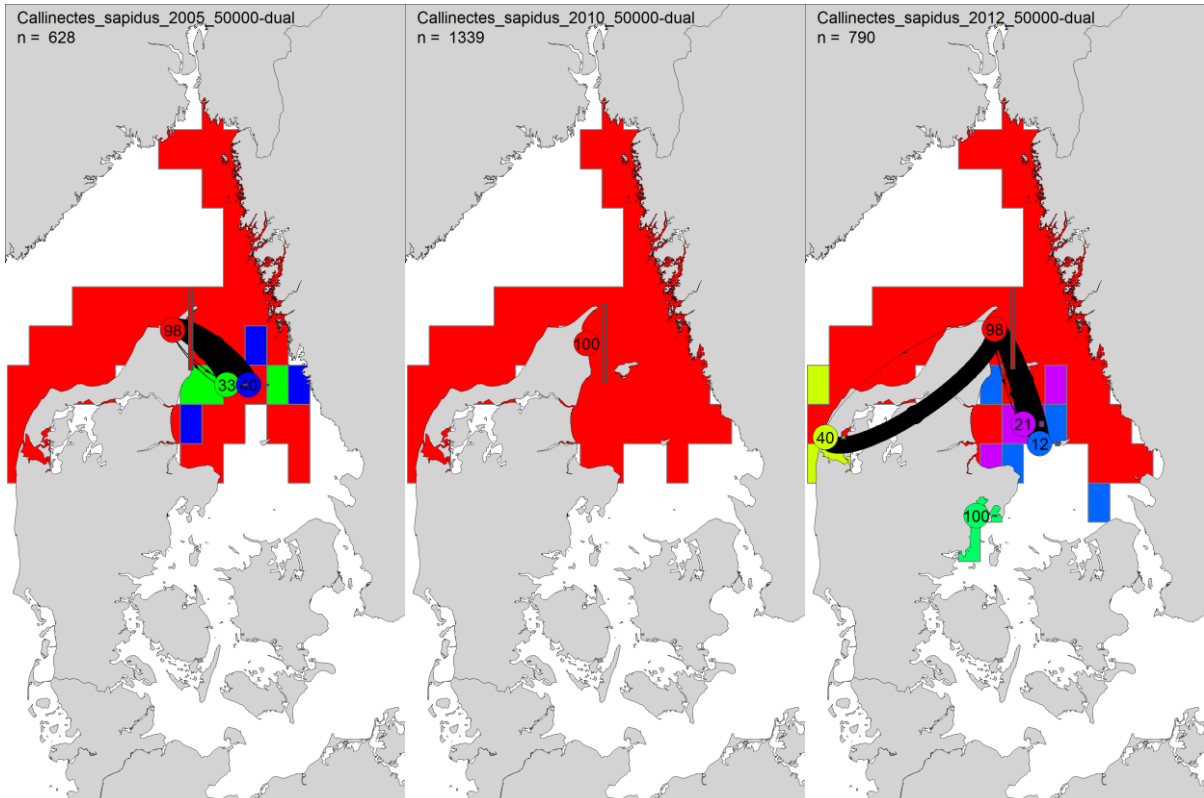
### 7.1.1 200 000 agents



### 7.1.2 200 000 agents (0-15 m)

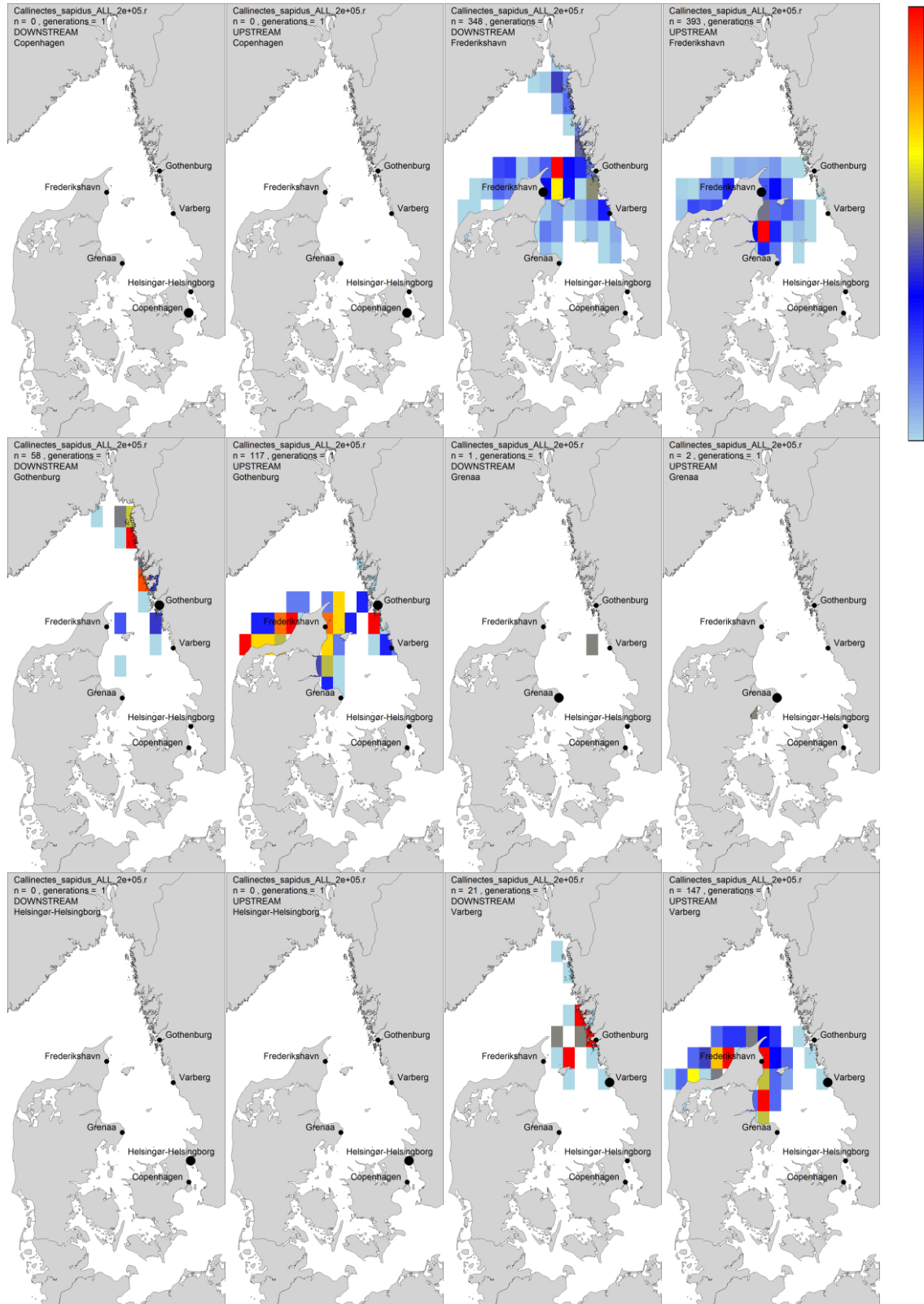


### 7.1.3 50 000 agents

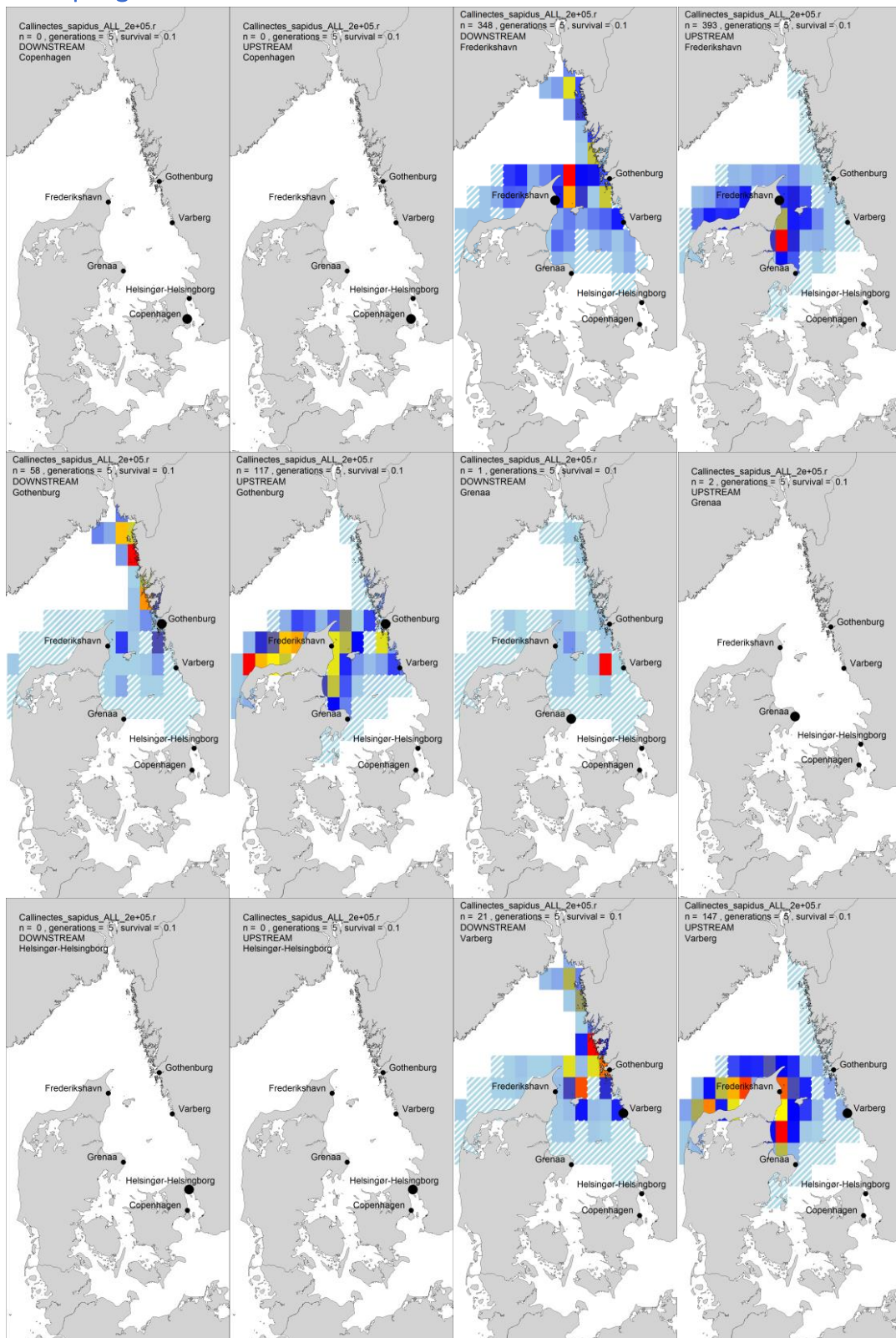


## 7.2 Dispersal probability plots

### 7.2.1 Single generation



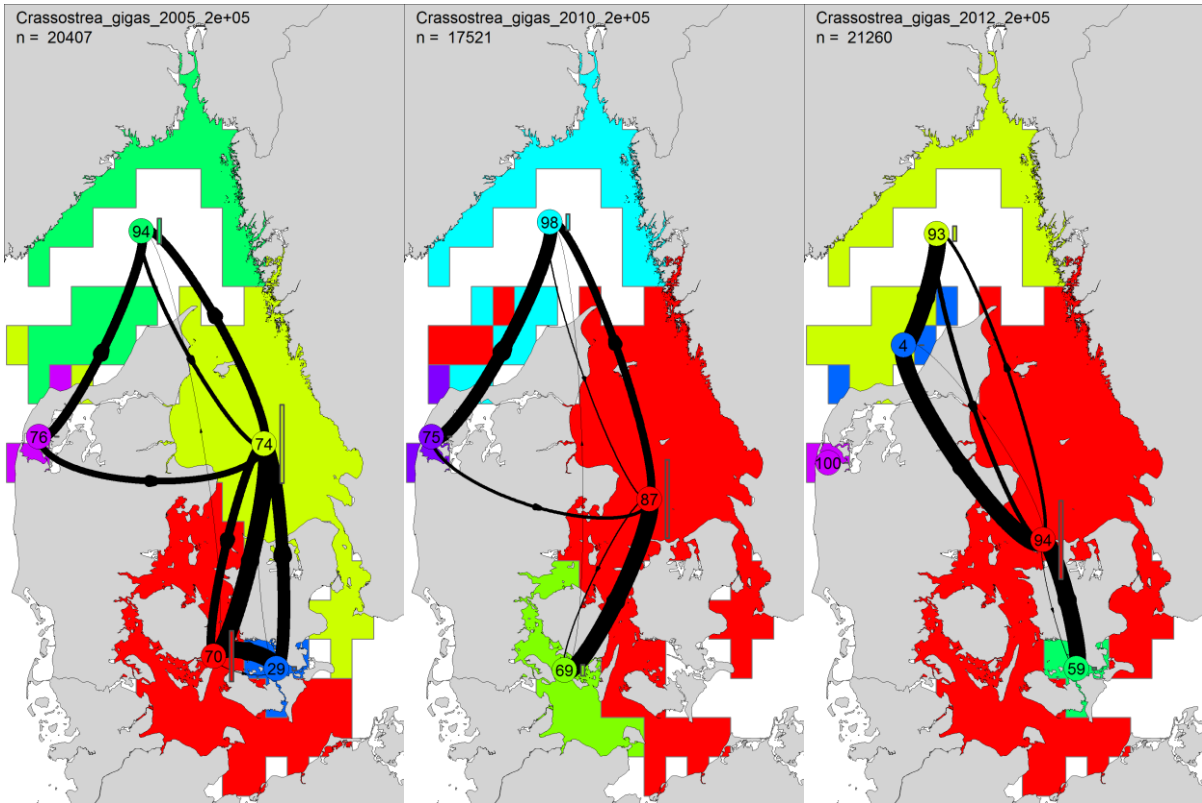
## 7.2.2 Multiple generations



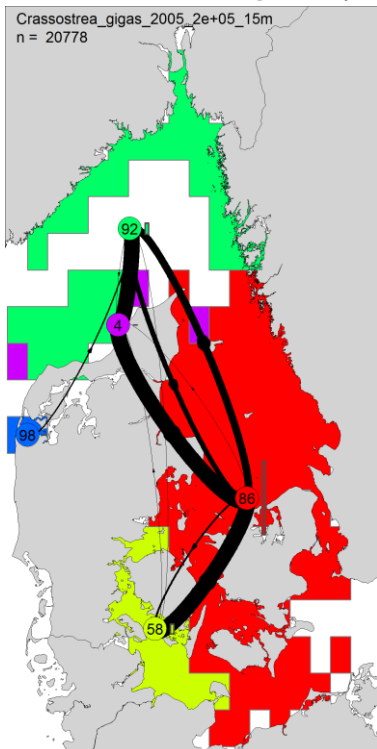
# 8 Crassostrea gigas

## 8.1 Hydrographic regions

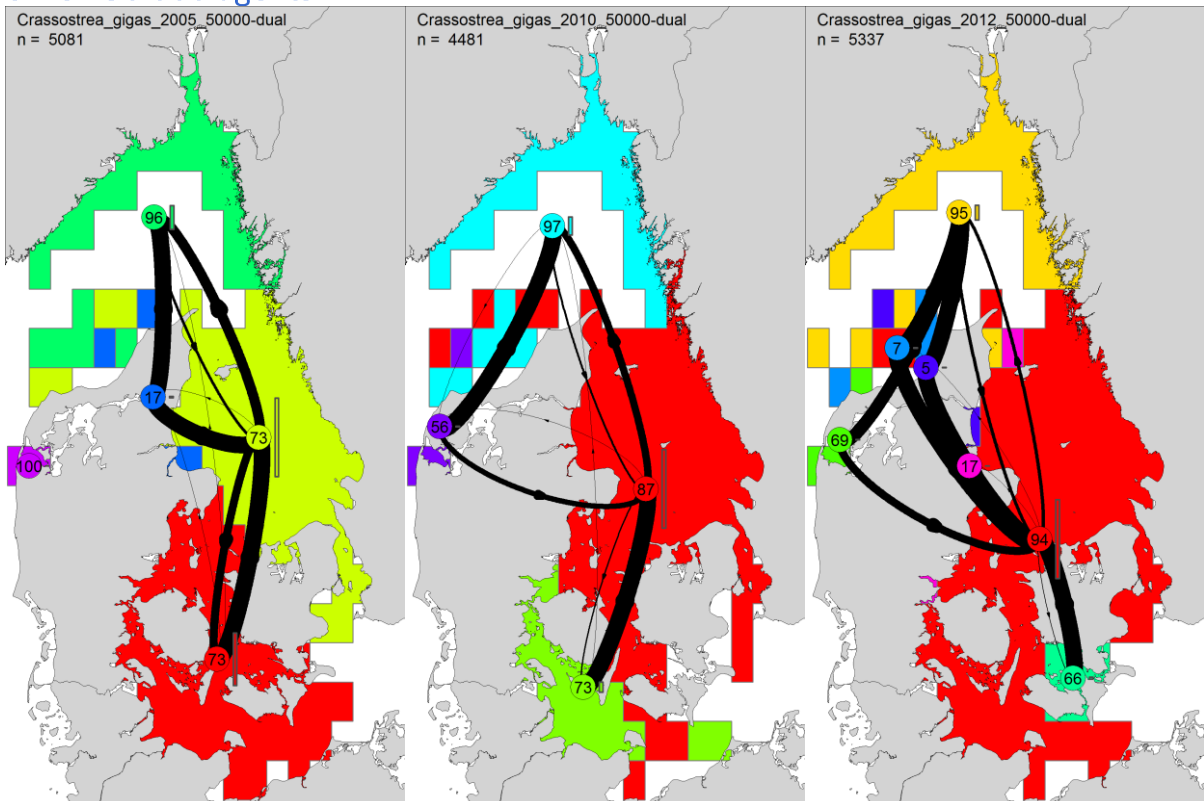
### 8.1.1 200 000 agents



### 8.1.2 200 000 agents (0-15 m)

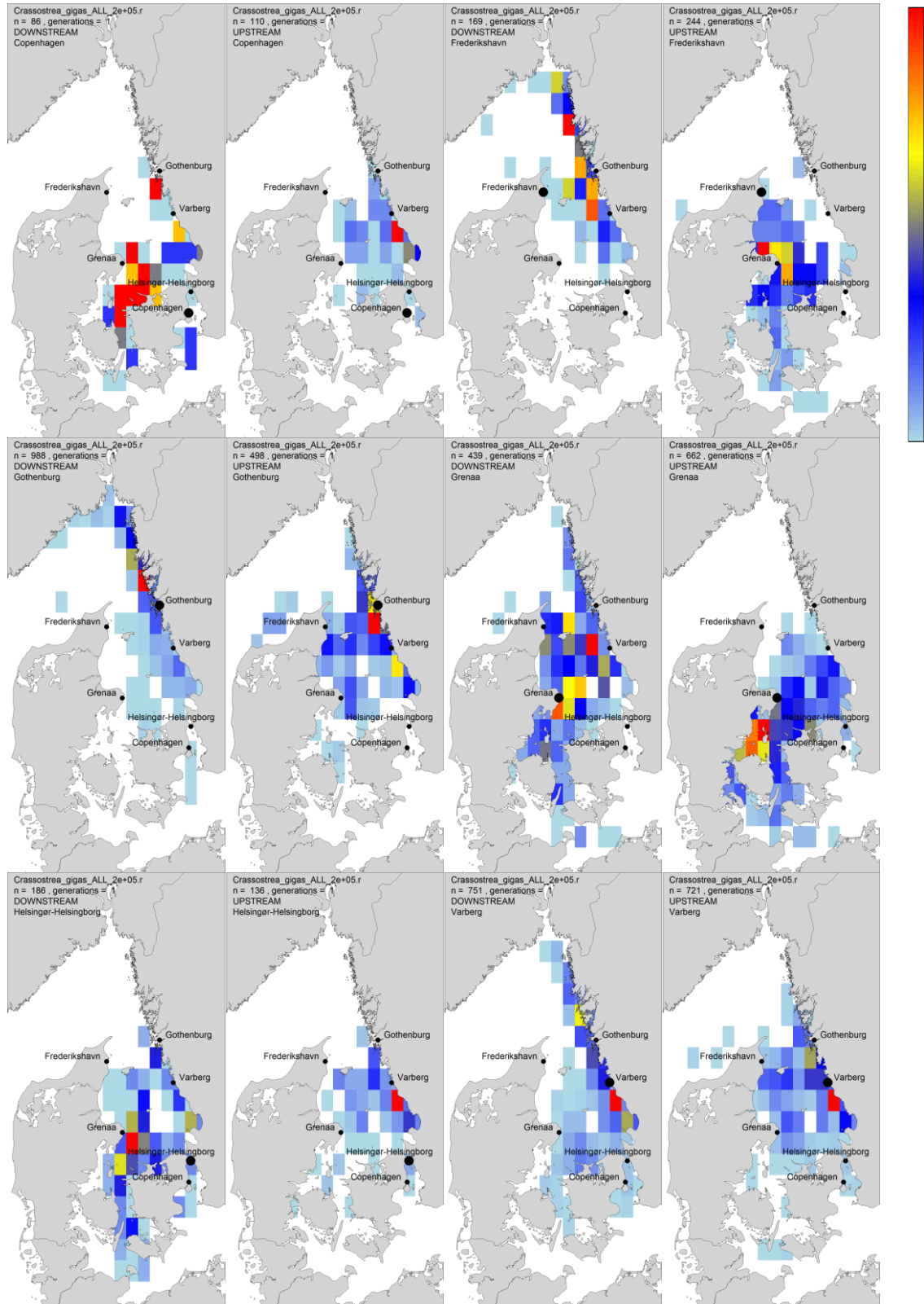


### 8.1.3 50 000 agents



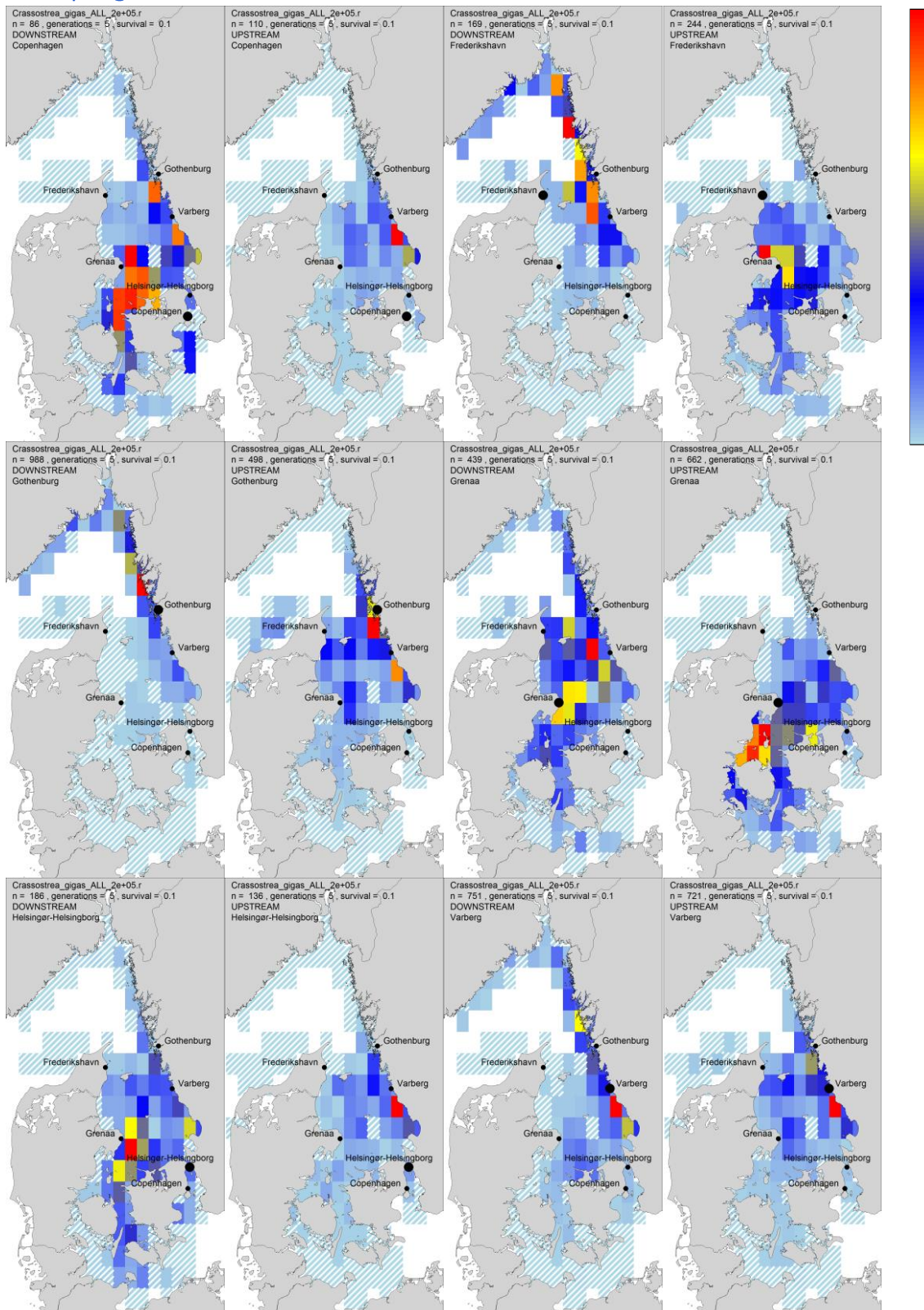
## 8.2 Dispersal probability plots

### 8.2.1 Single generation





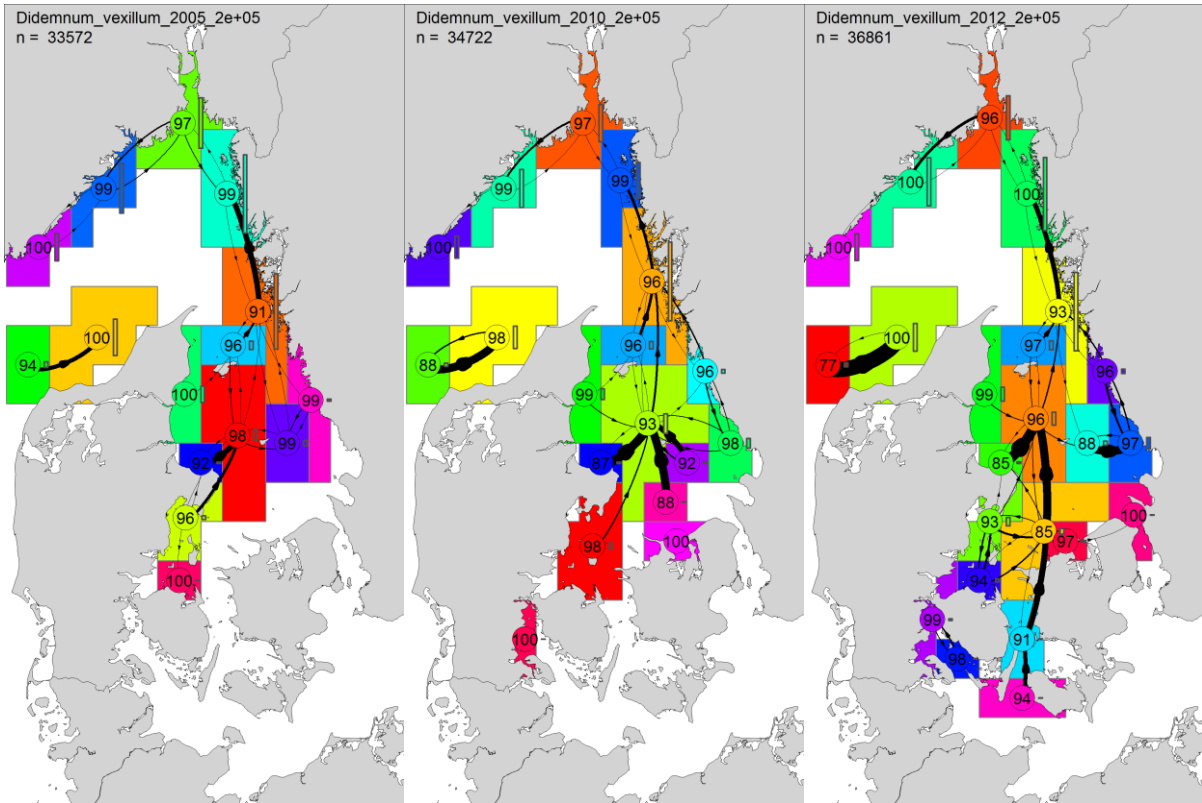
## 8.2.2 Multiple generations



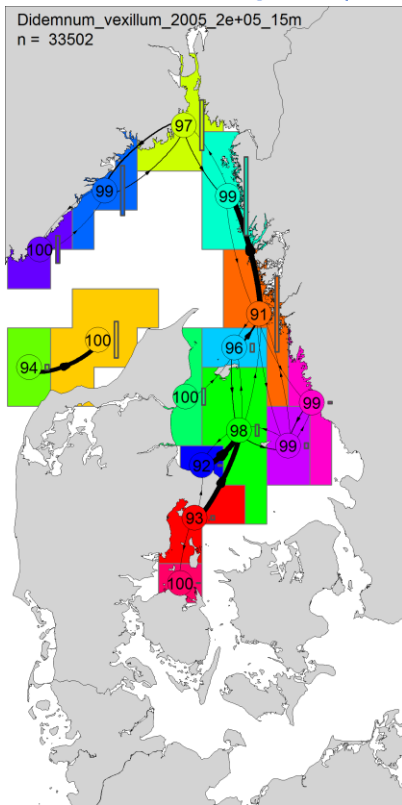
# 9 Didemnum vexillum

## 9.1 Hydrographic regions

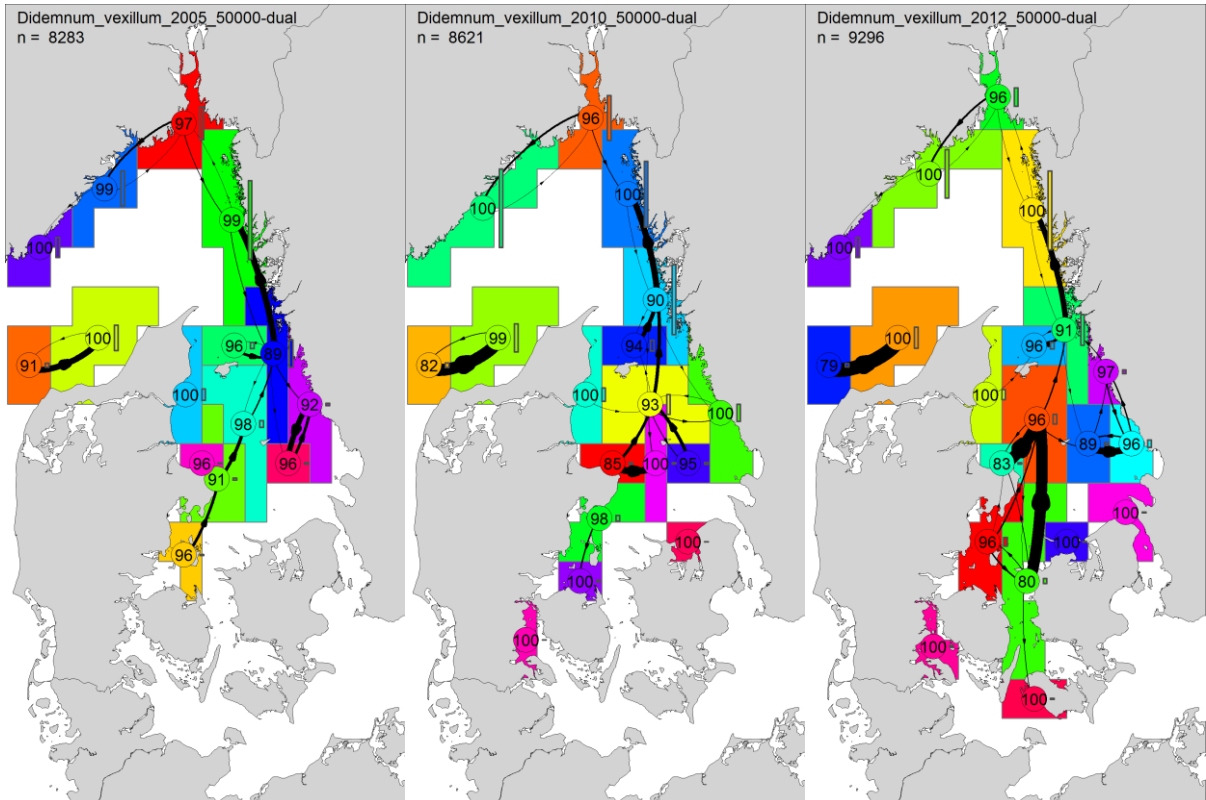
### 9.1.1 200 000 agents



### 9.1.2 200 000 agents (0-15 m)

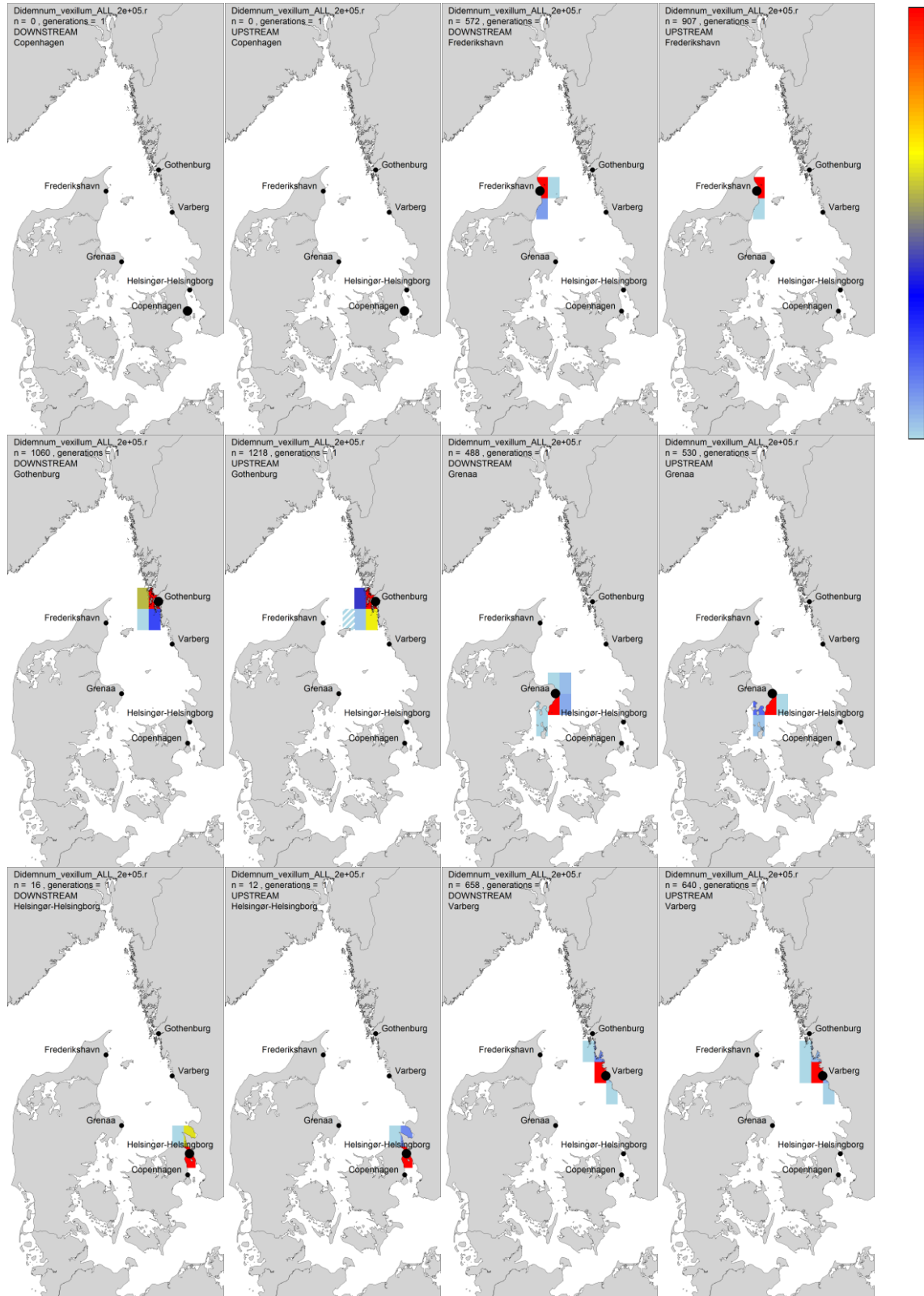


### 9.1.3 50 000 agents

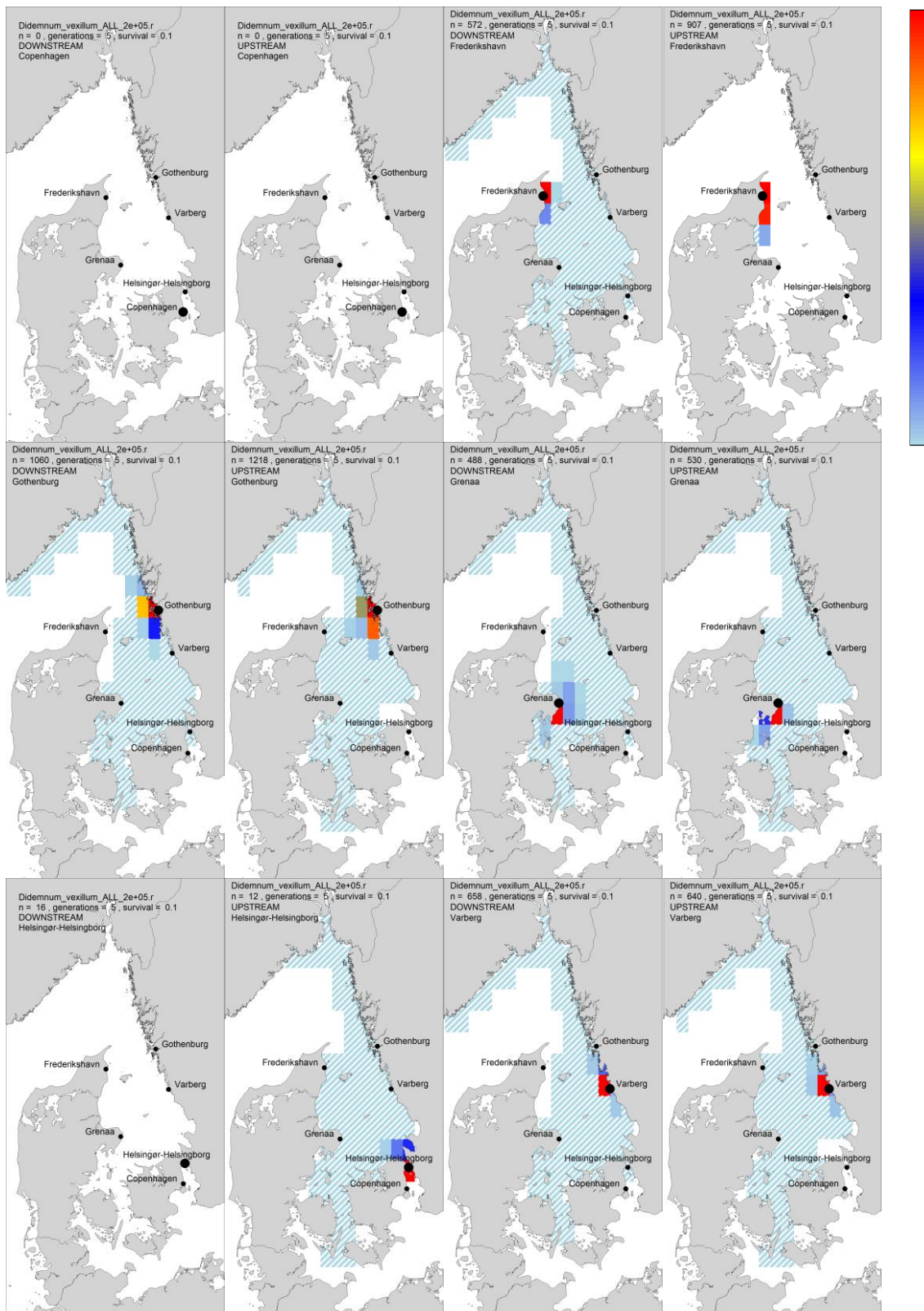


## 9.2 Dispersal probability plots

### 9.2.1 Single generation



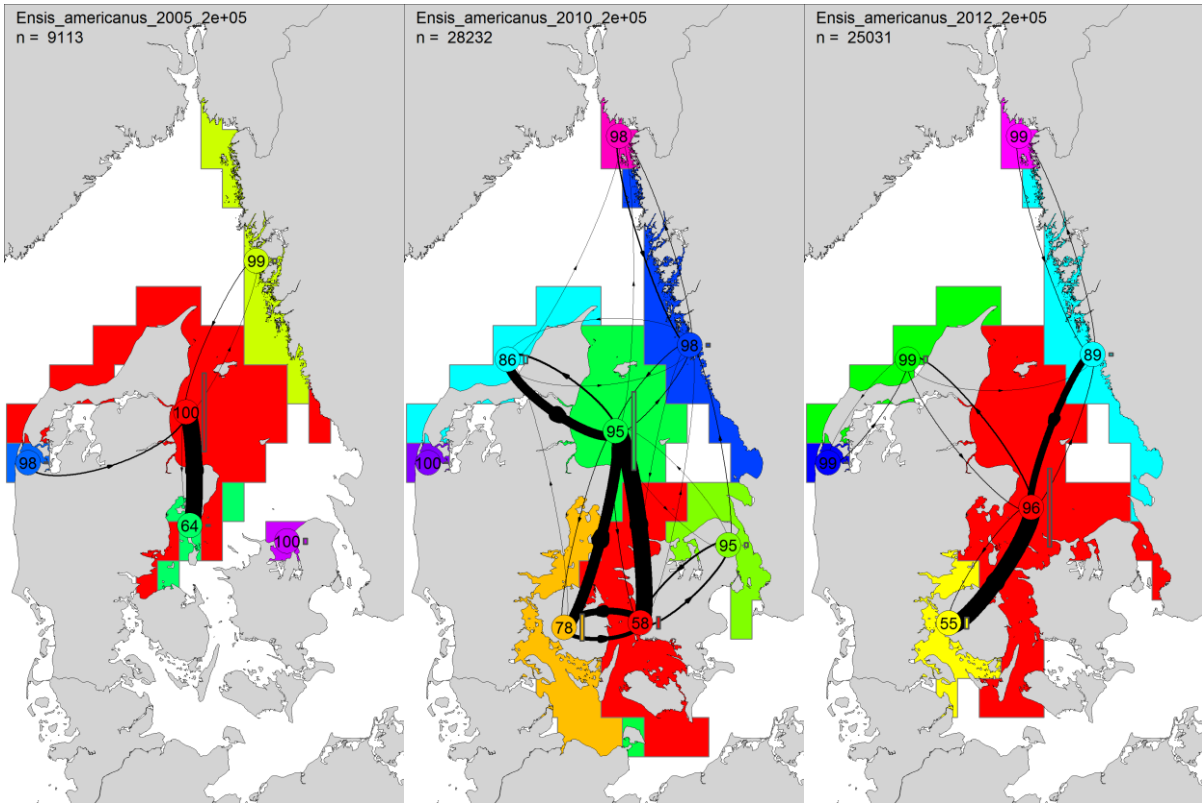
## 9.2.2 Multiple generations



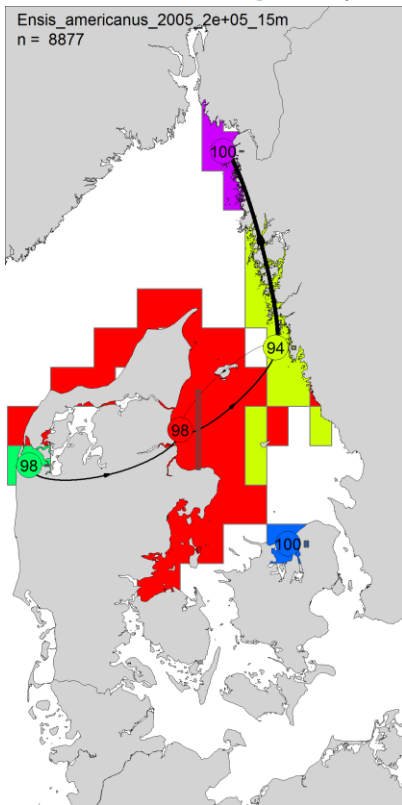
# 10 Ensis directus

## 10.1 Hydrographic regions

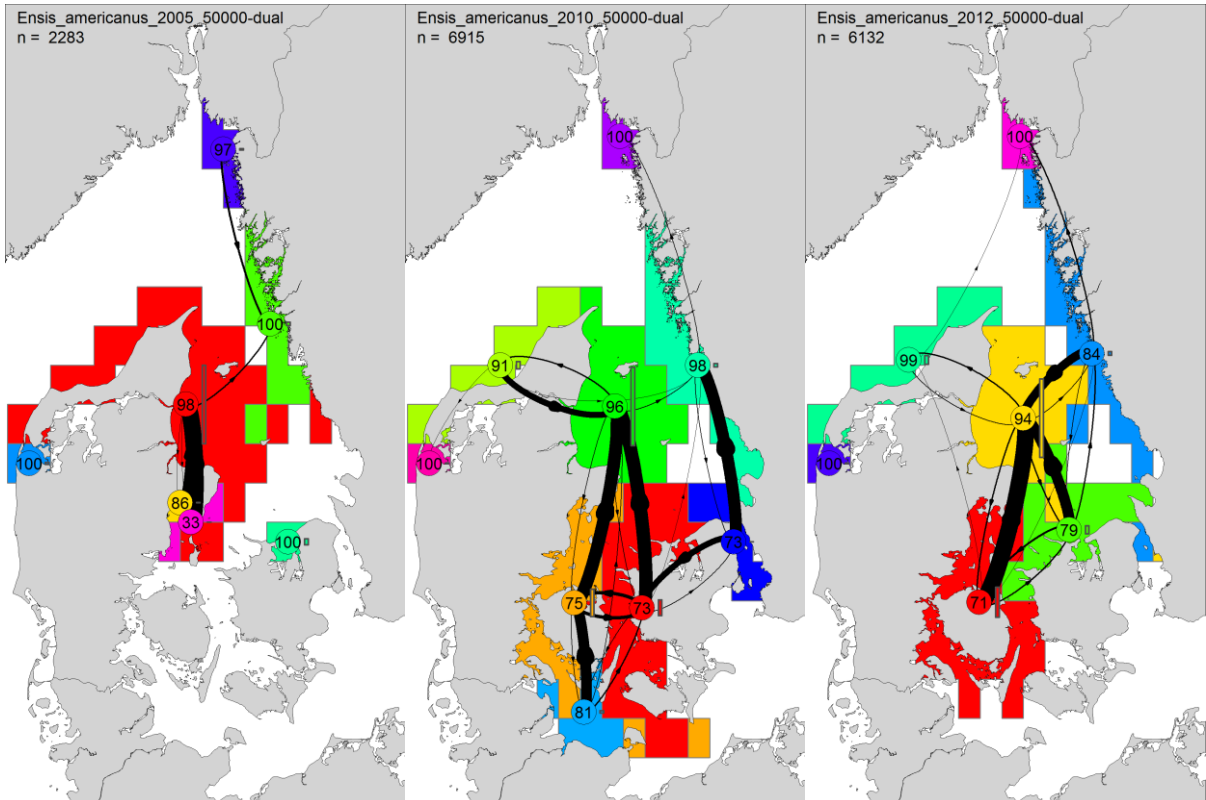
### 10.1.1 200 000 agents



### 10.1.2 200 000 agents (0-15 m)

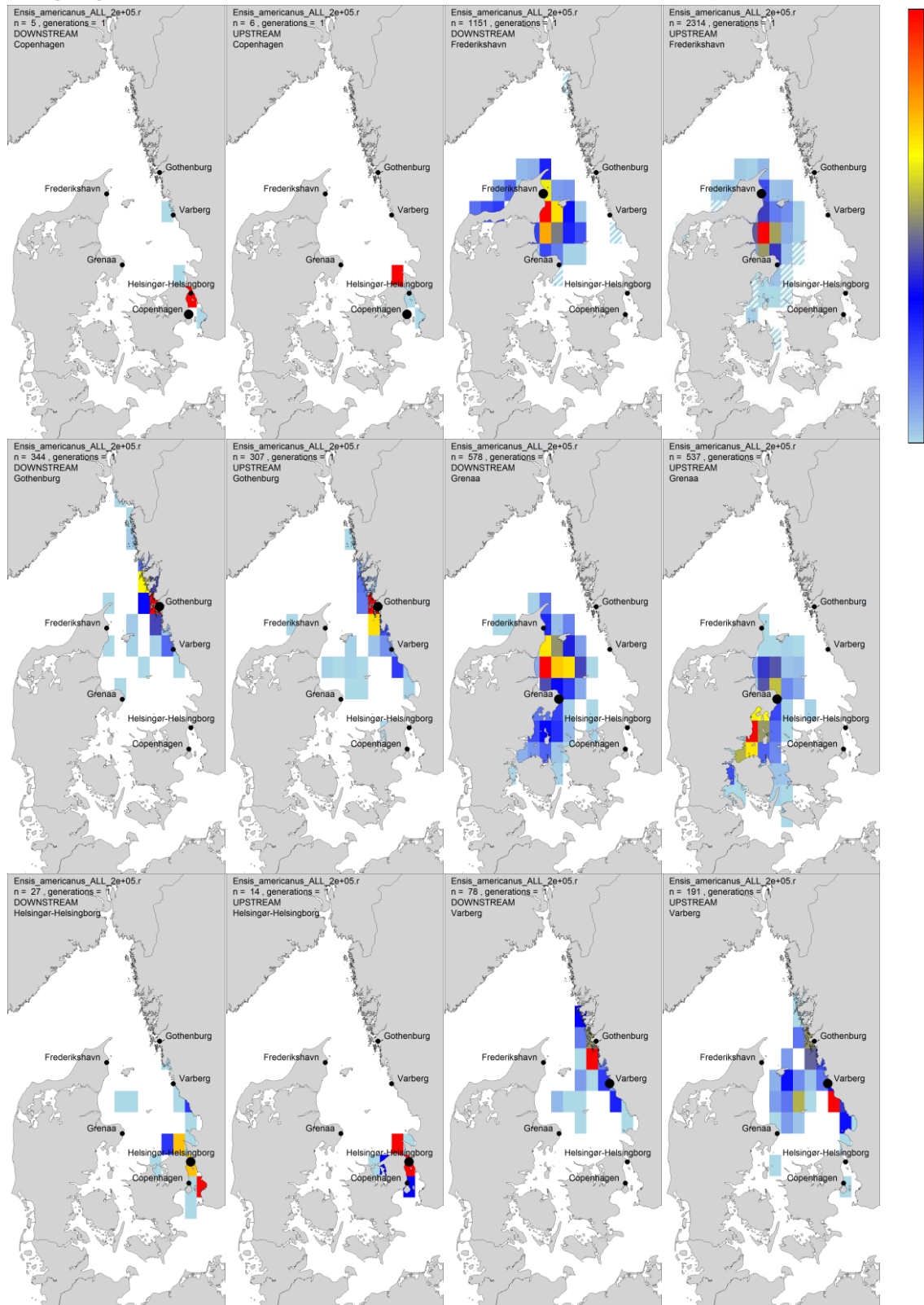


### 10.1.3 50 000 agents



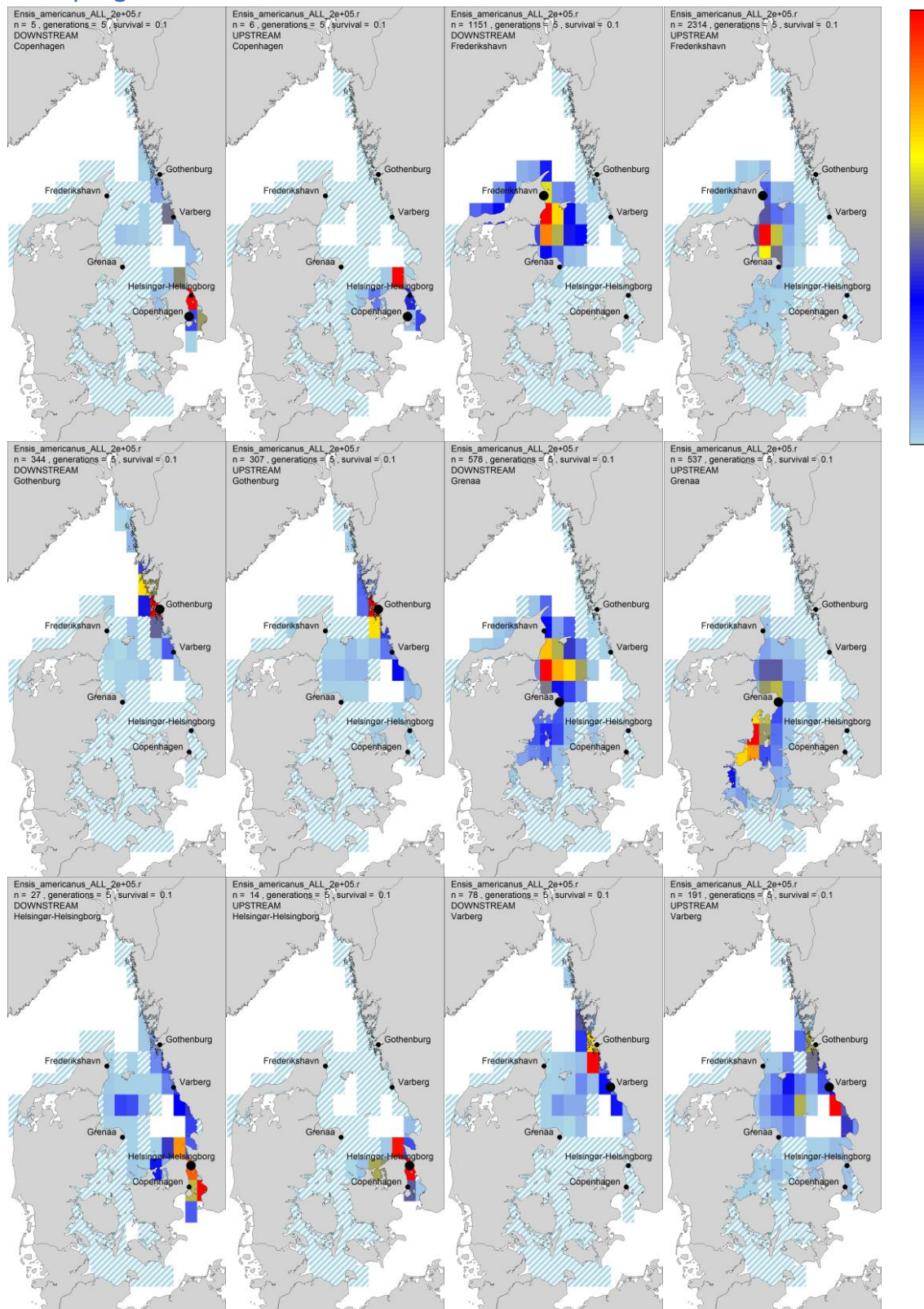
## 10.2 Dispersal probability plots

### 10.2.1 Single generation





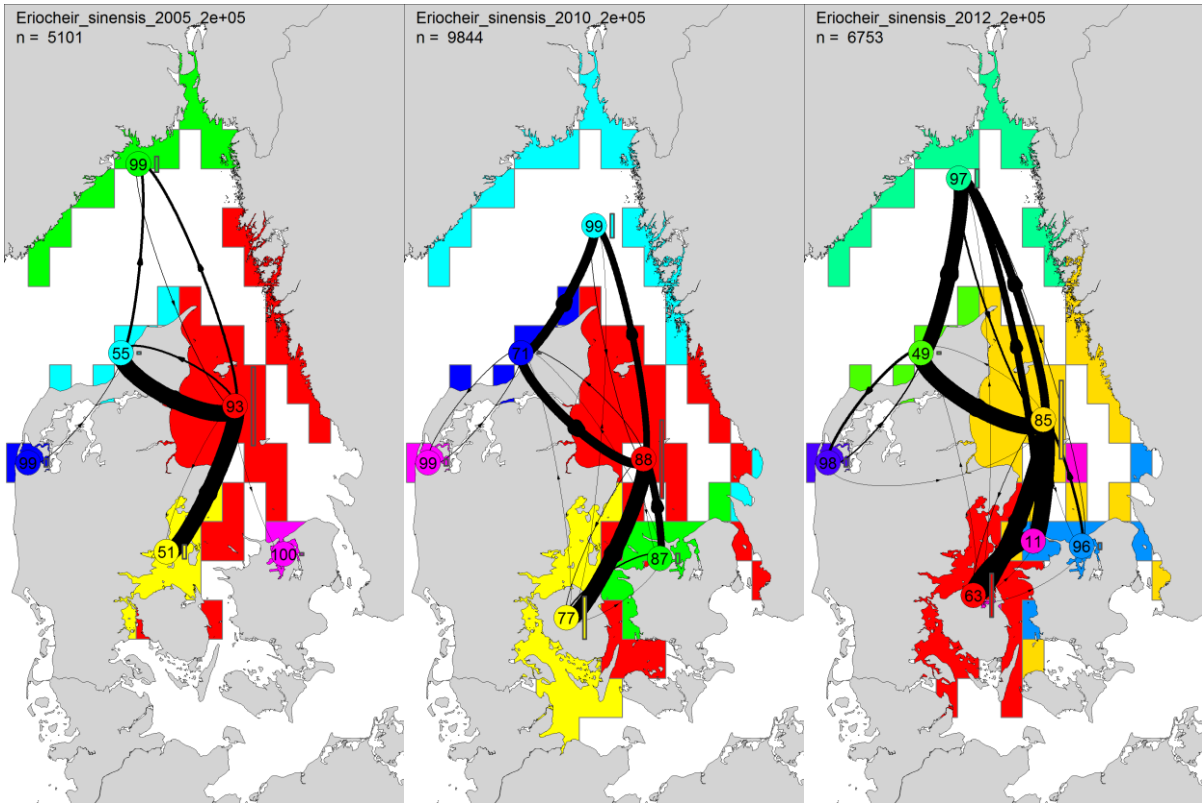
## 10.2.2 Multiple generations



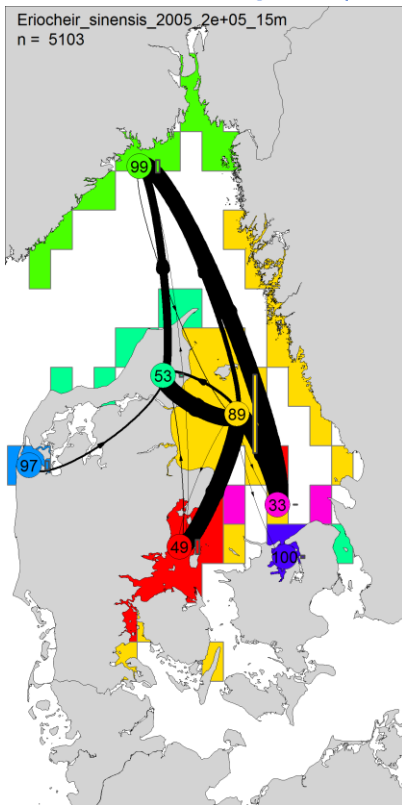
# 11 Eriocheir sinensis

## 11.1 Hydrographic regions

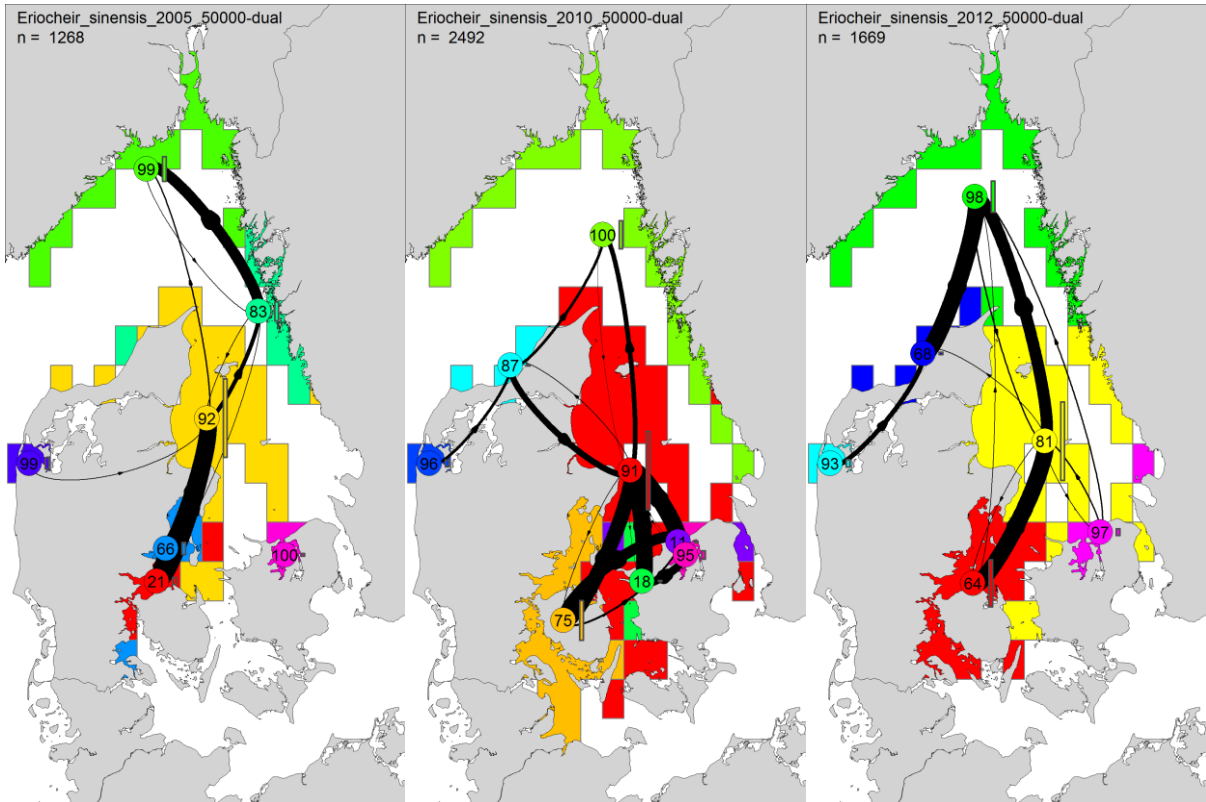
### 11.1.1 200 000 agents



### 11.1.2 200 000 agents (0-15 m)

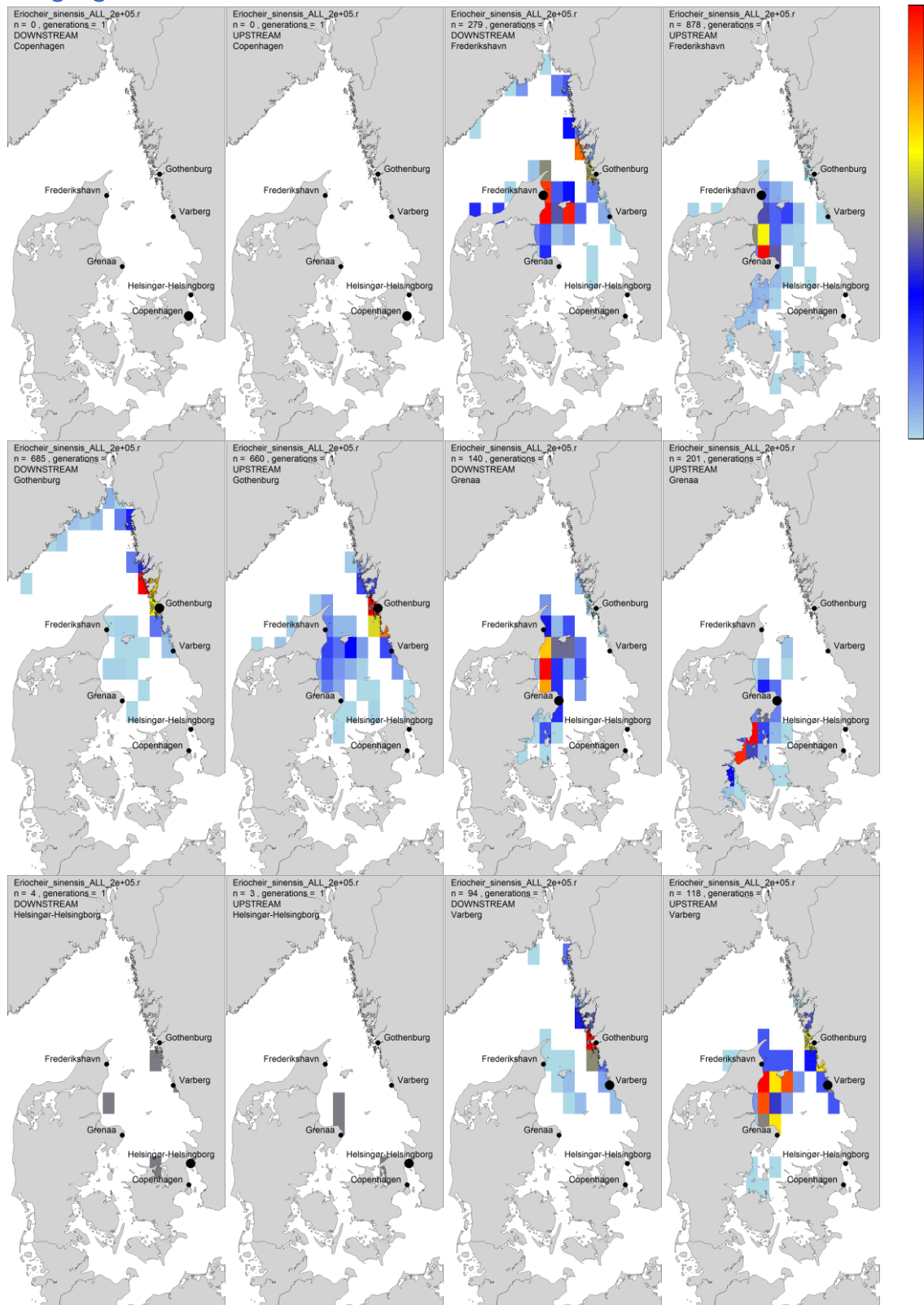


### 11.1.3 50 000 agents

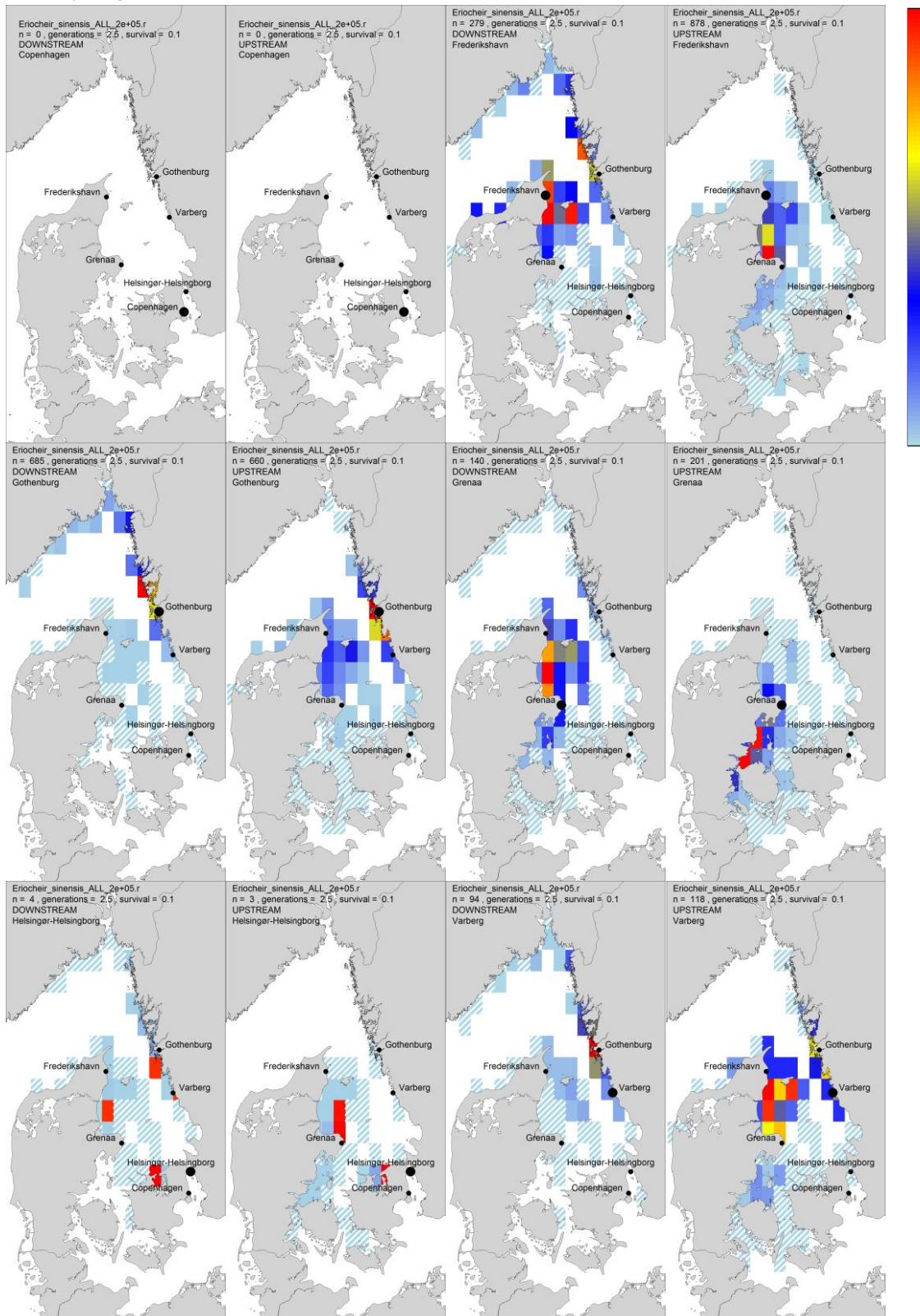


## 11.2 Dispersal probability plots

### 11.2.1 Single generation



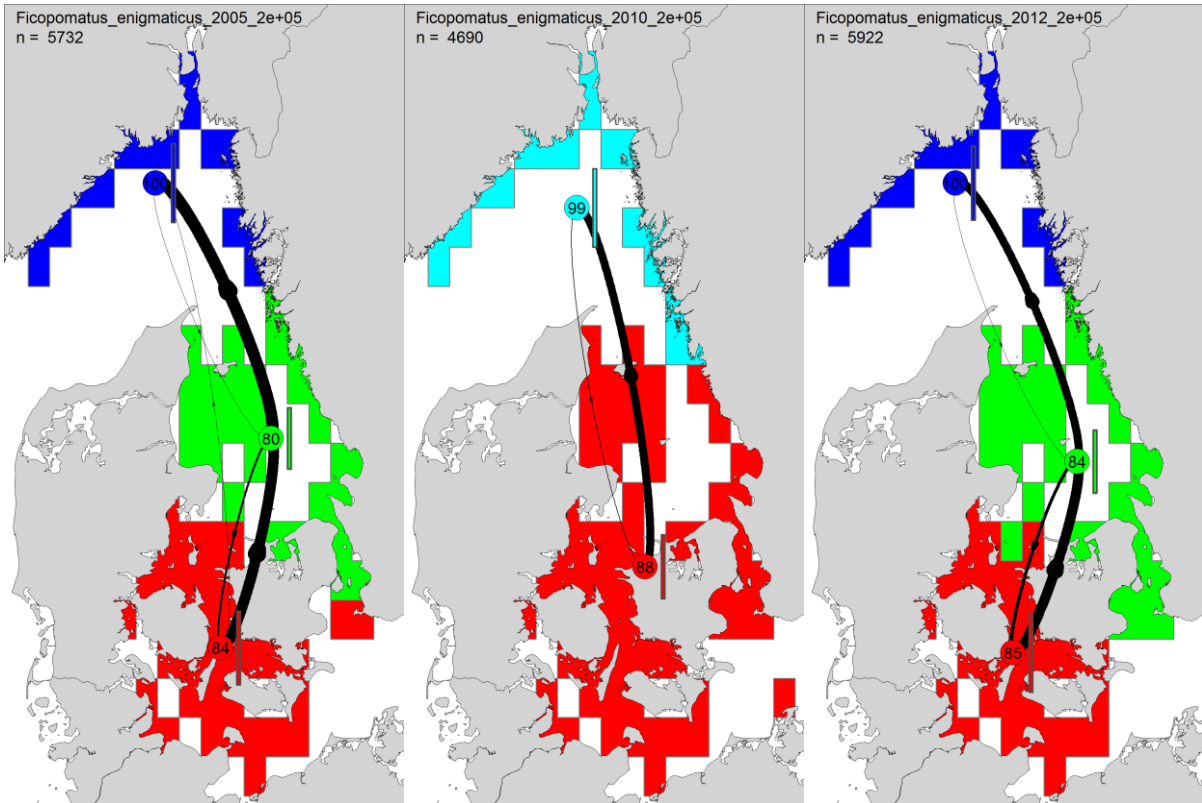
## 11.2.2 Multiple generations



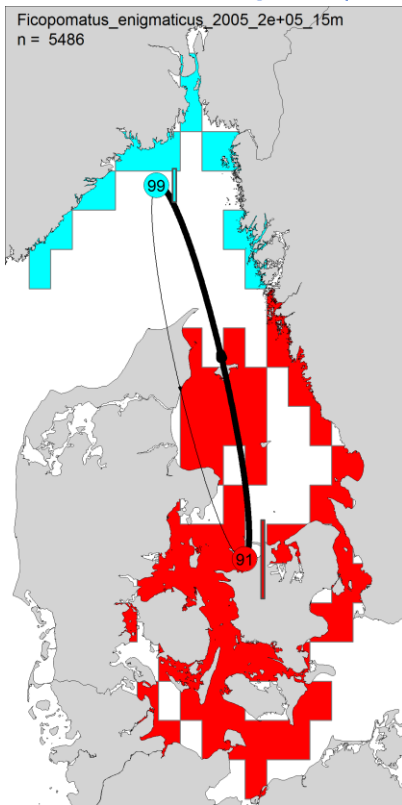
# 12 Ficopomatus enigmaticus

## 12.1 Hydrographic regions

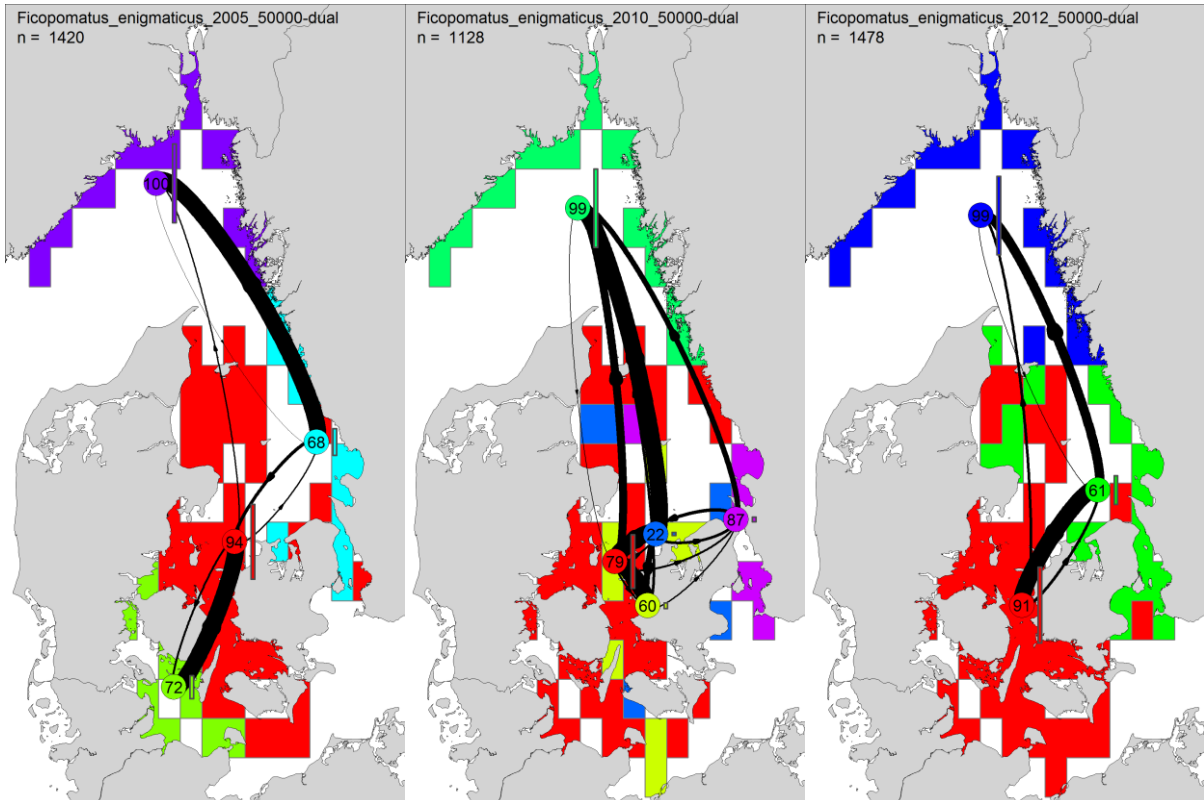
### 12.1.1 200 000 agents



### 12.1.2 200 000 agents (0-15 m)

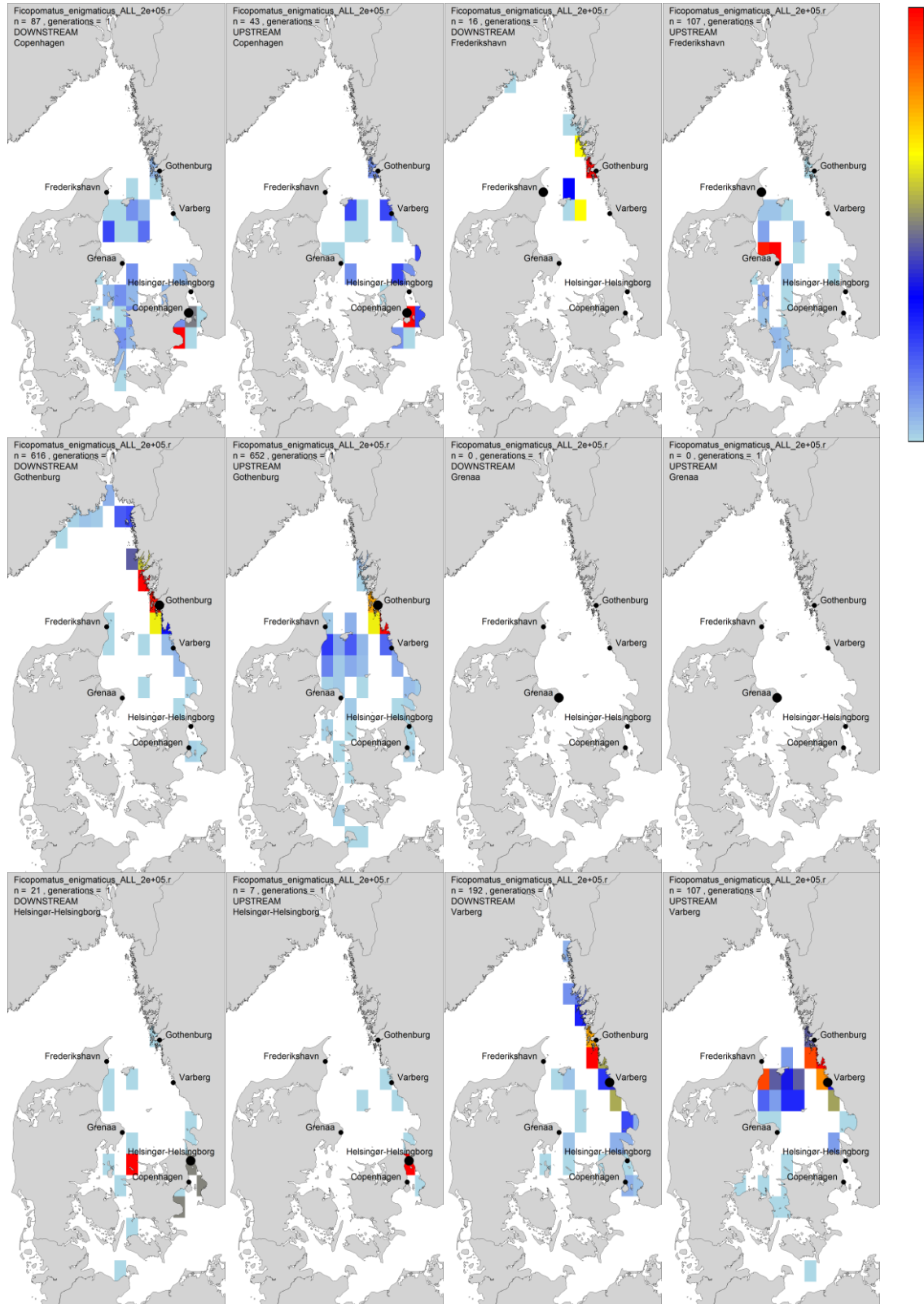


### 12.1.3 500 000 agents



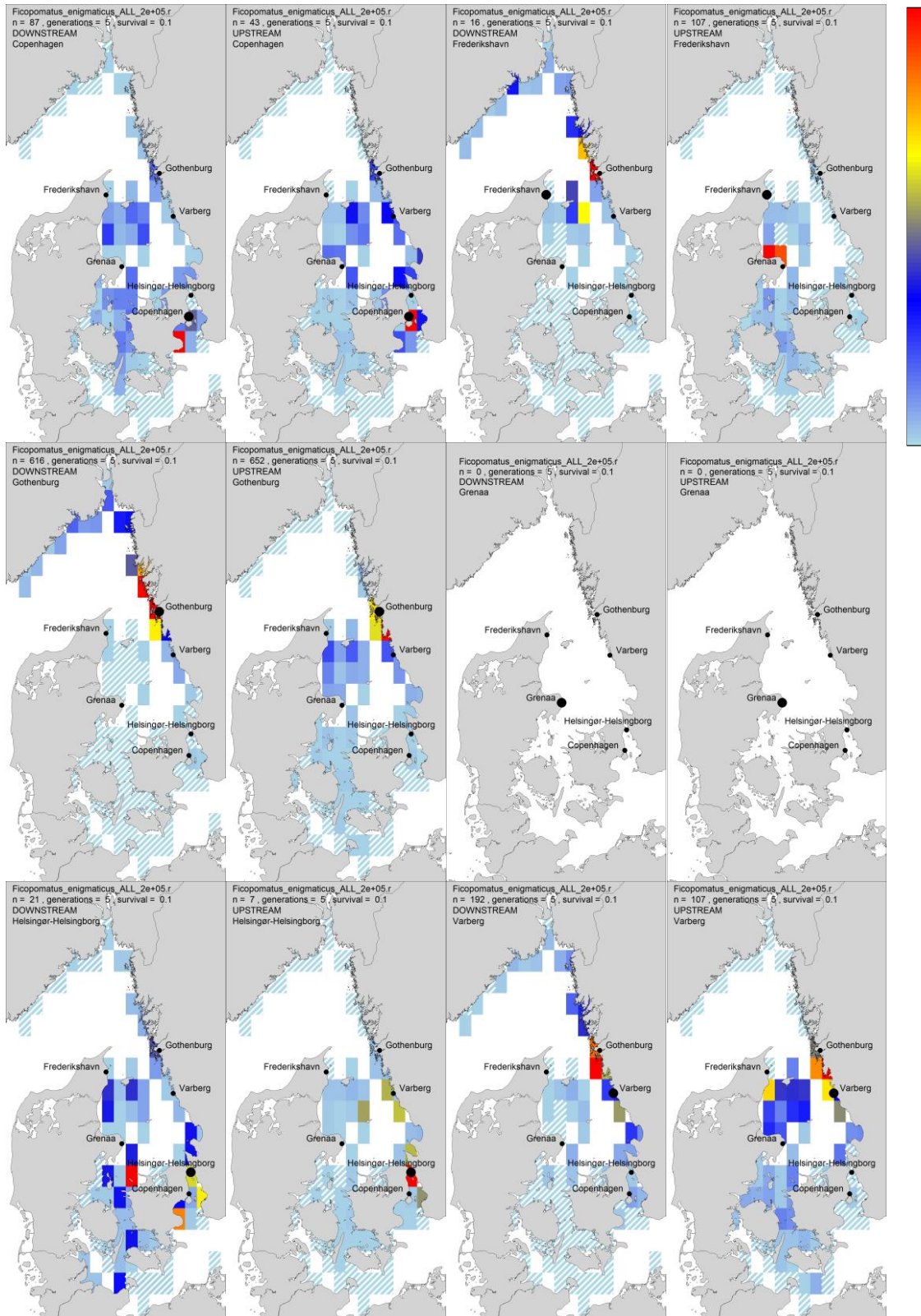
## 12.2 Dispersal probability plots

### 12.2.1 Single generation





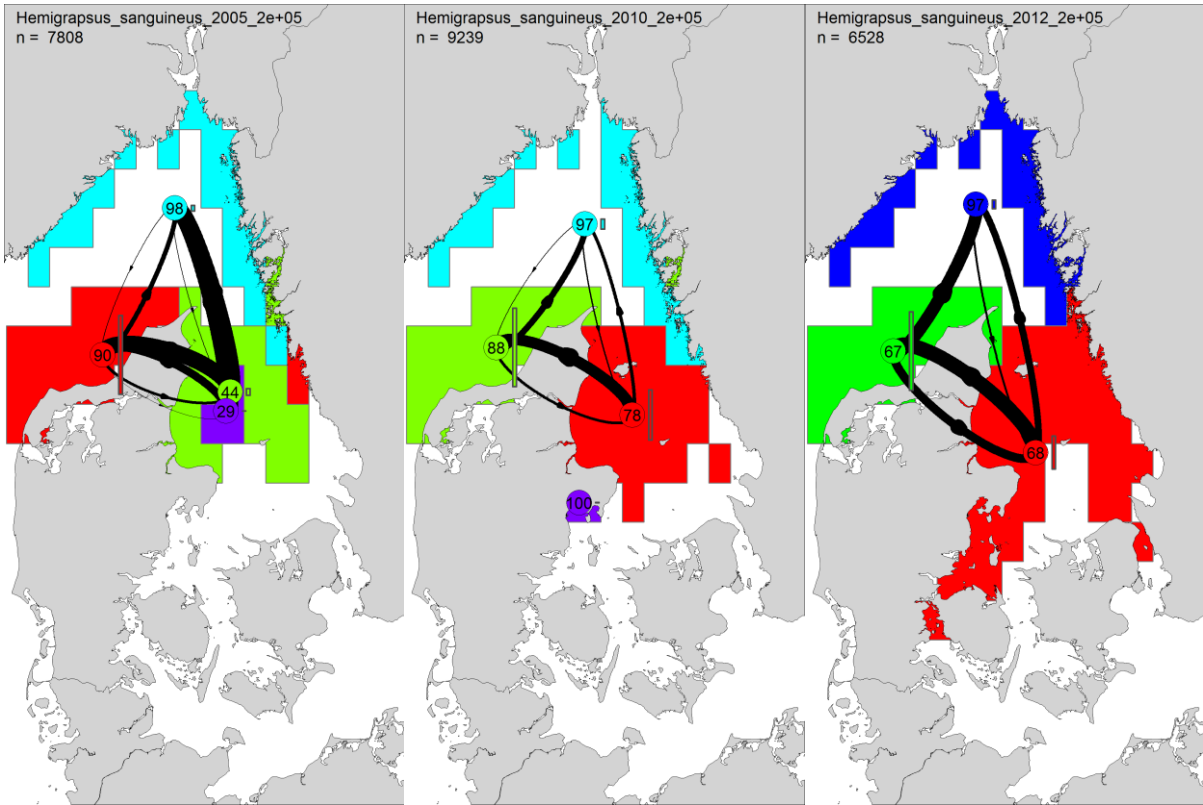
## 12.2.2 Multiple generations



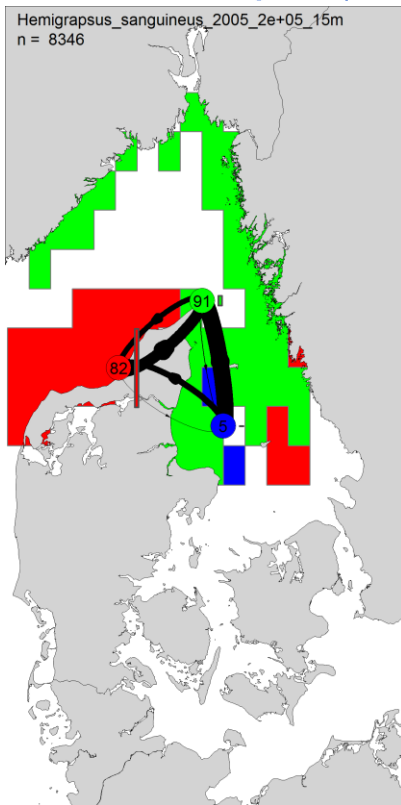
# 13 Hemigrapsus sanguineus

## 13.1 Hydrographic regions

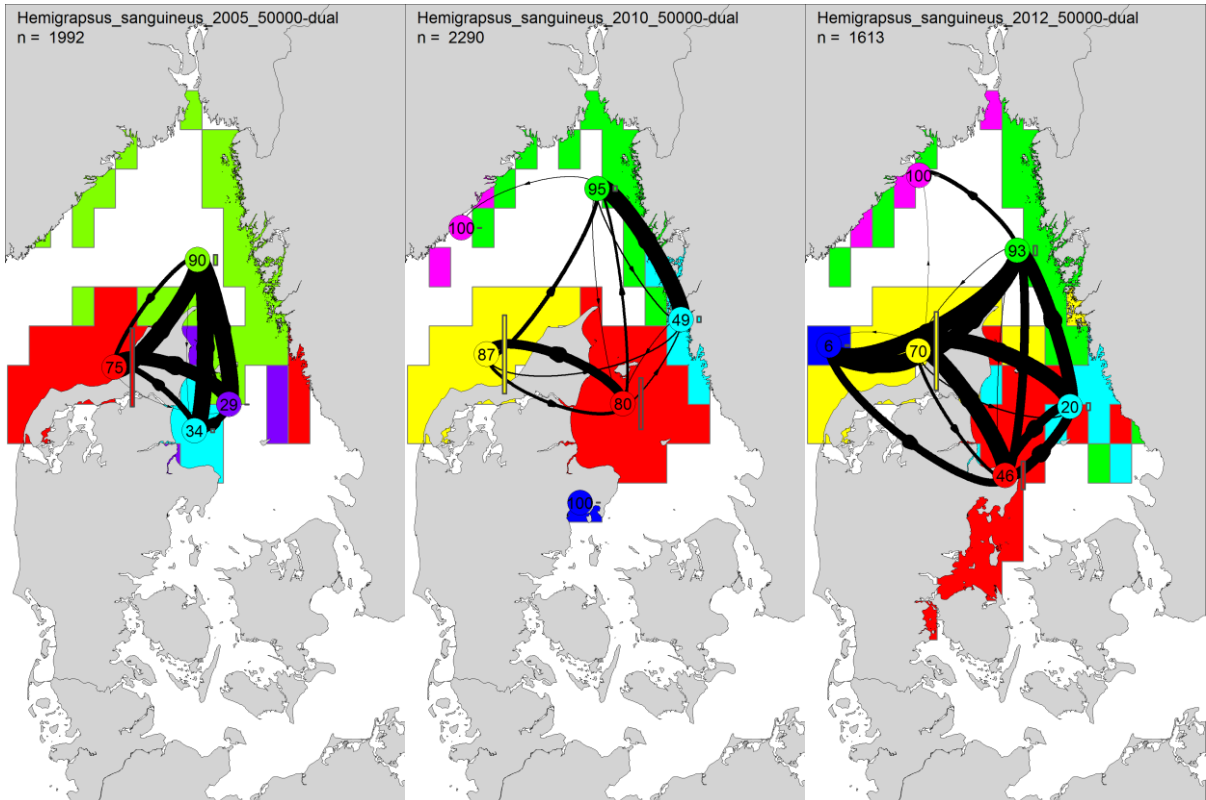
### 13.1.1 200 000 agents



### 13.1.2 200 000 agents (0-15 m)

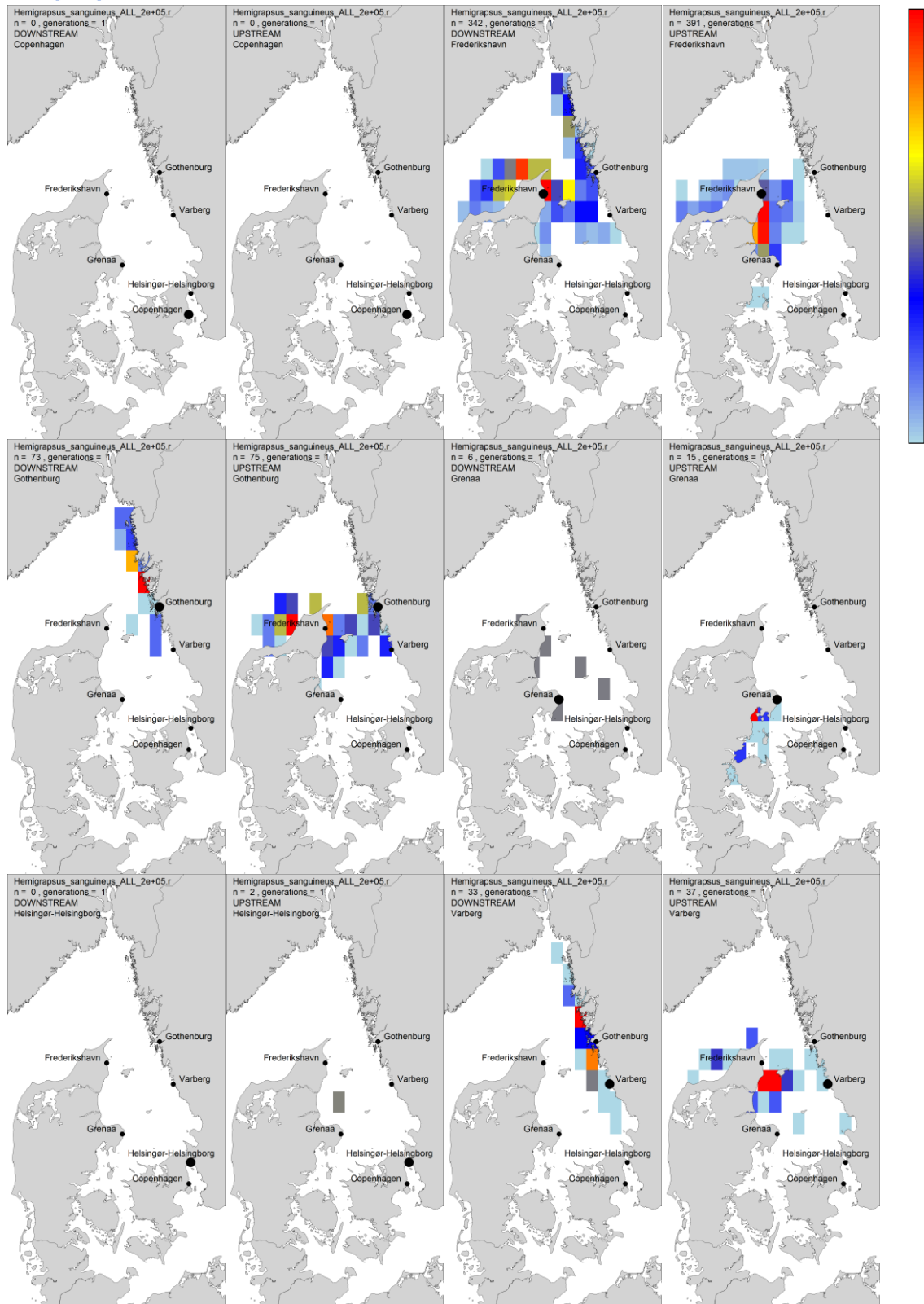


### 13.1.3 50 000 agents

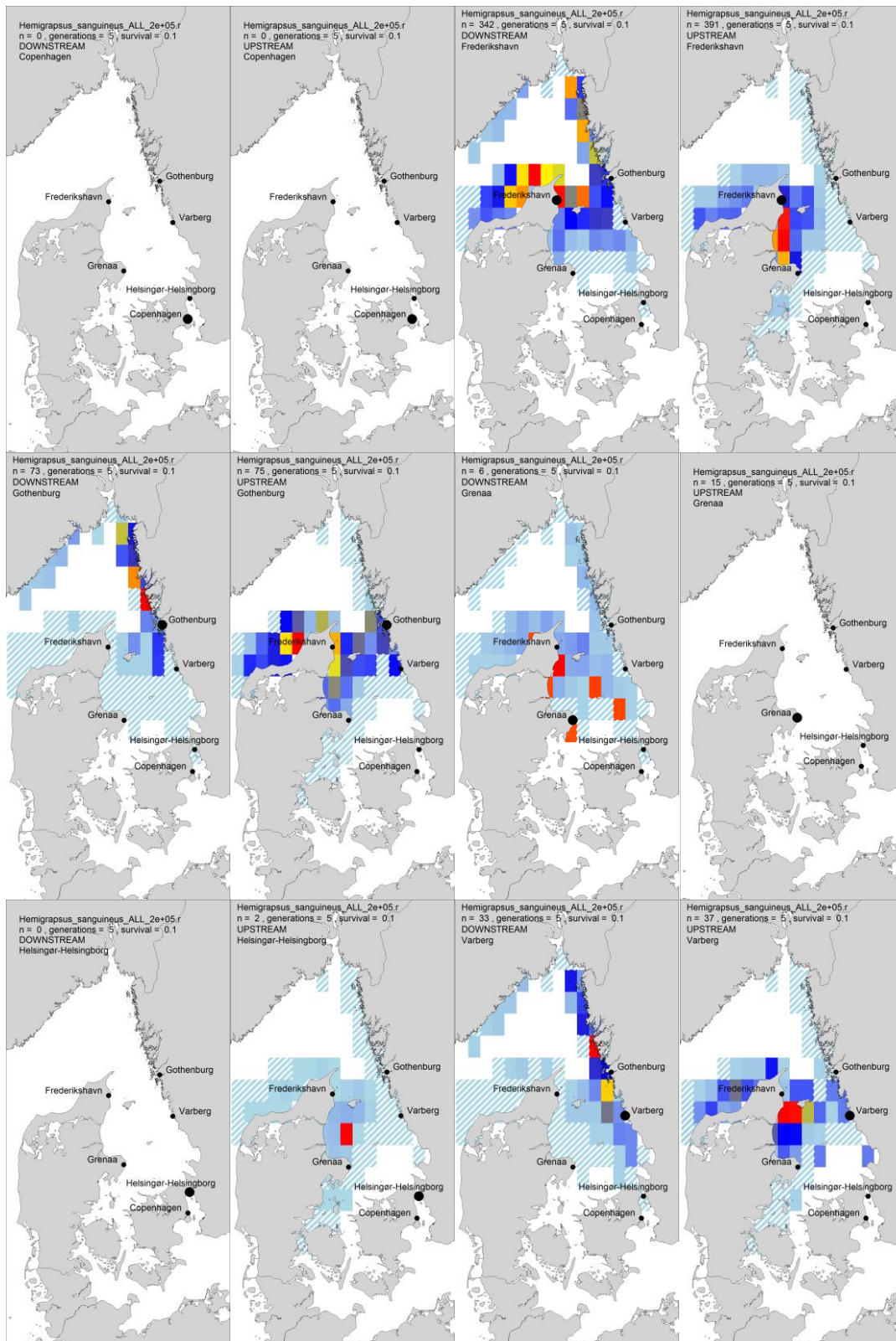


## 13.2 Dispersal probability plots

### 13.2.1 Single generation



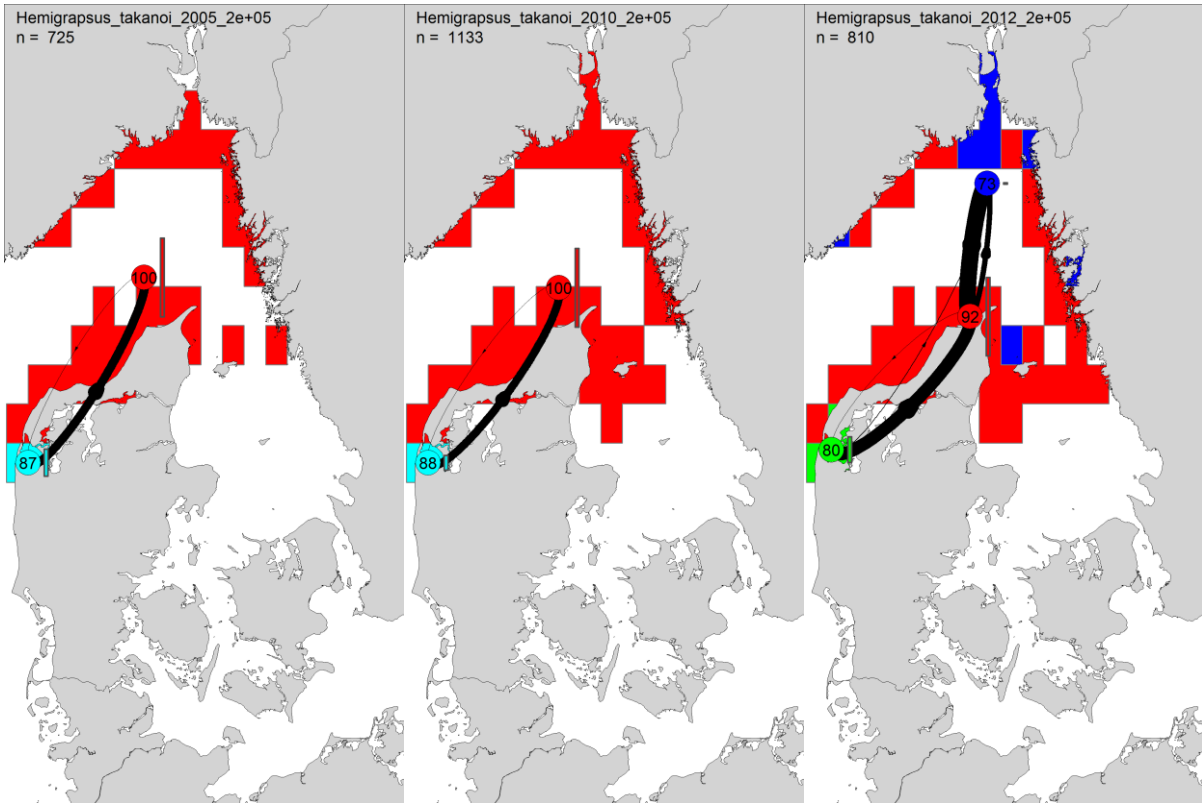
### 13.2.2 Multiple generations



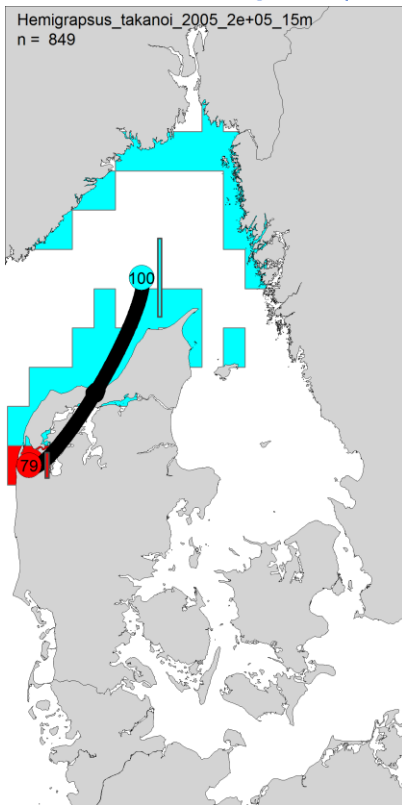
# 14 Hemigrapsus takanoi

## 14.1 Hydrographic regions

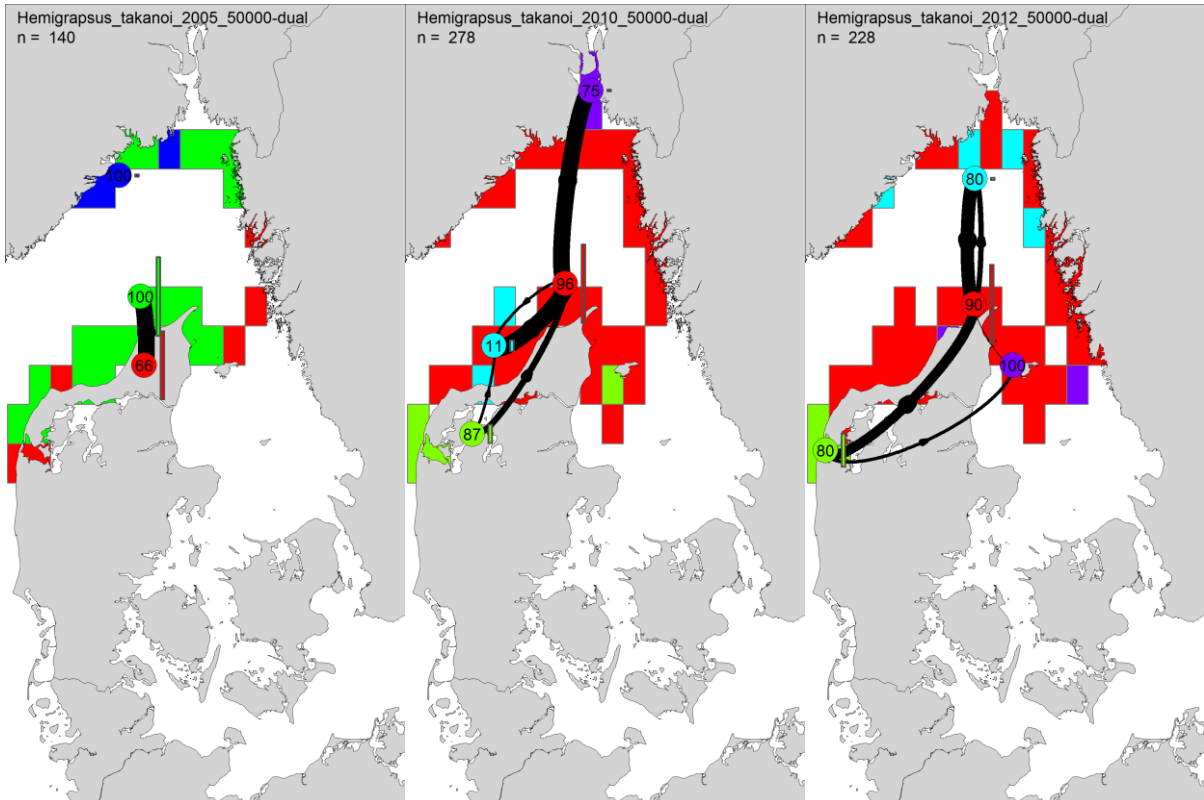
### 14.1.1 200 000 agents



### 14.1.2 200 000 agents (0-15 m)

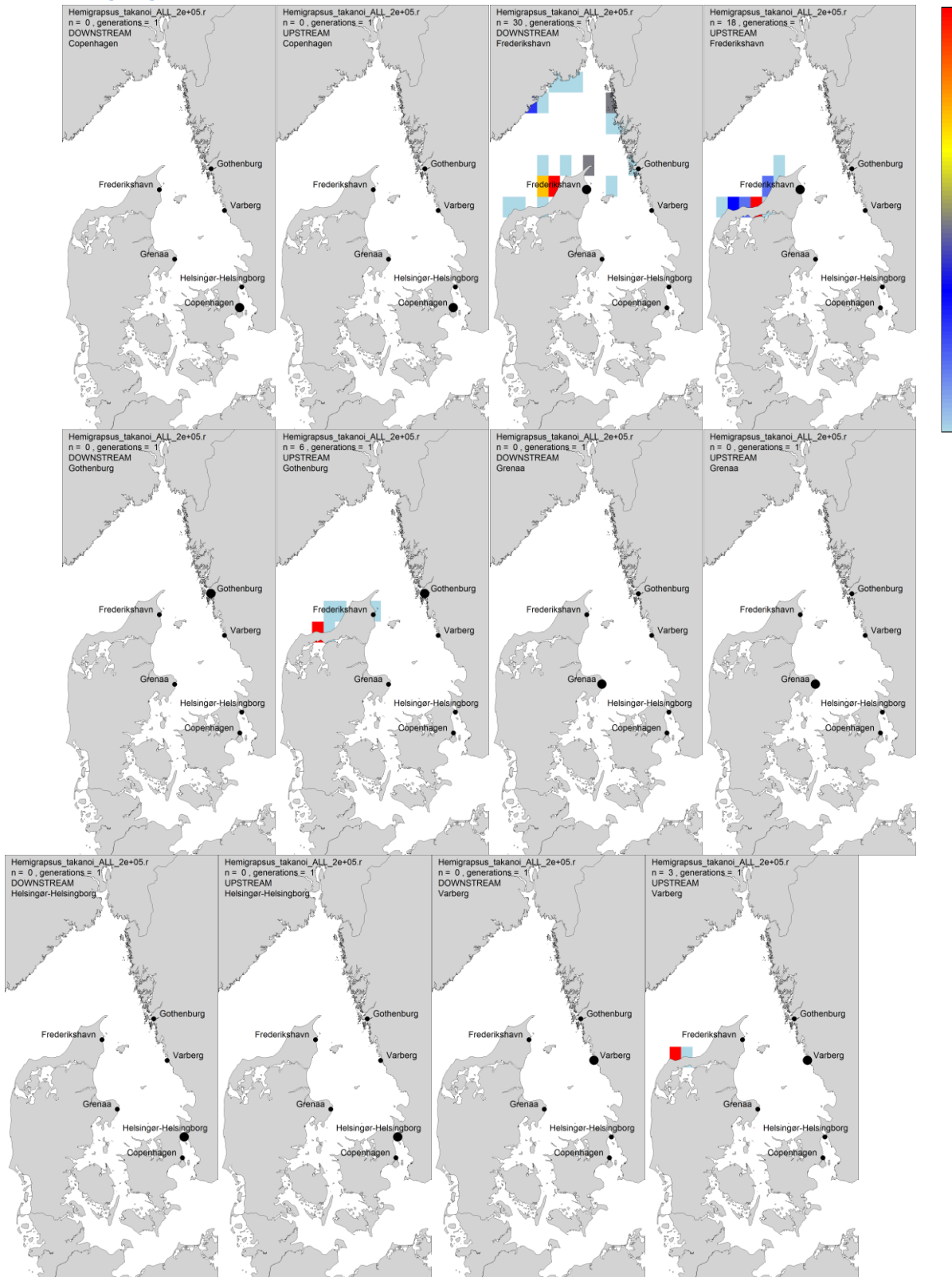


### 14.1.3 50 000 agents



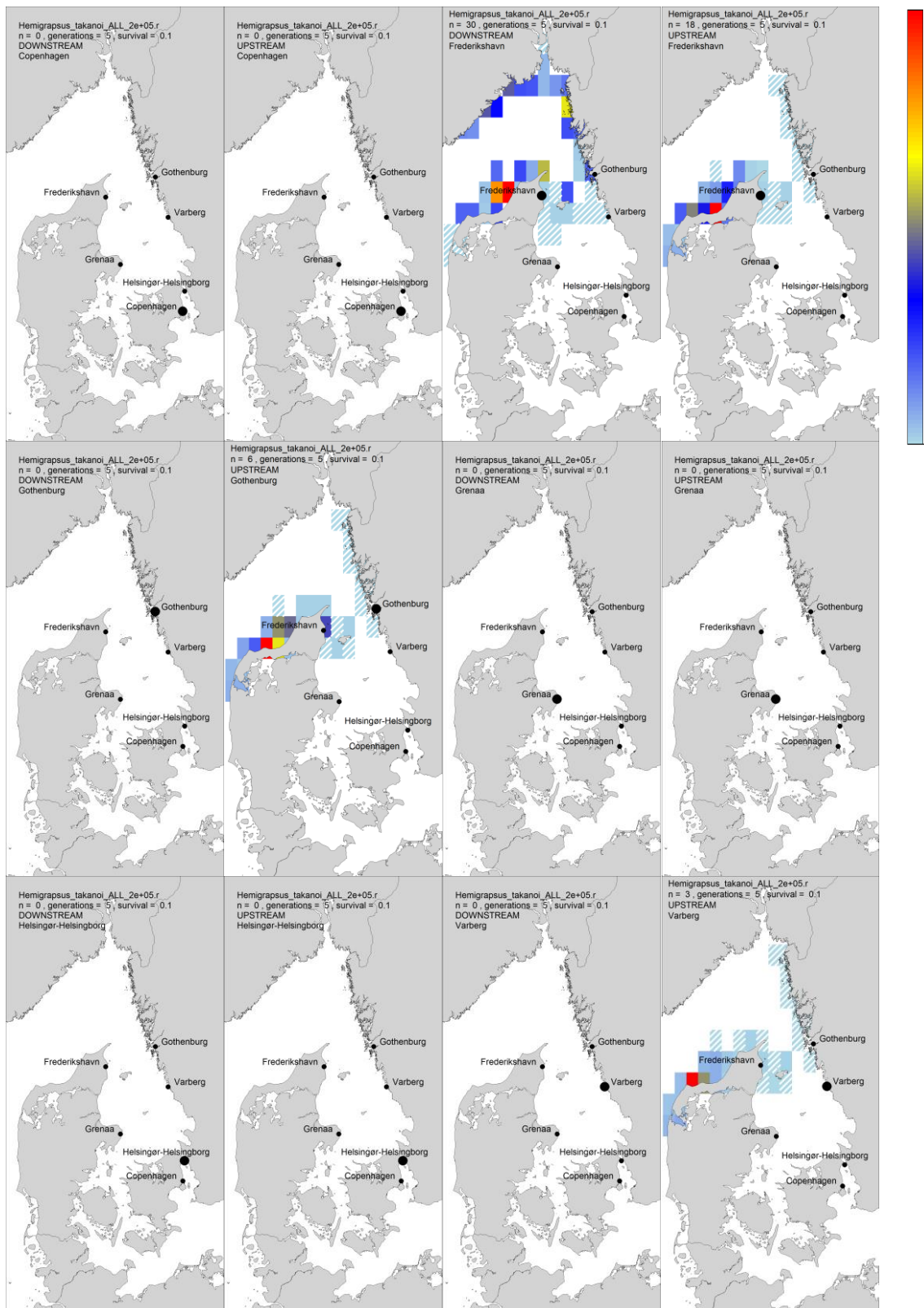
## 14.2 Dispersal probability plots

### 14.2.1 Single generation





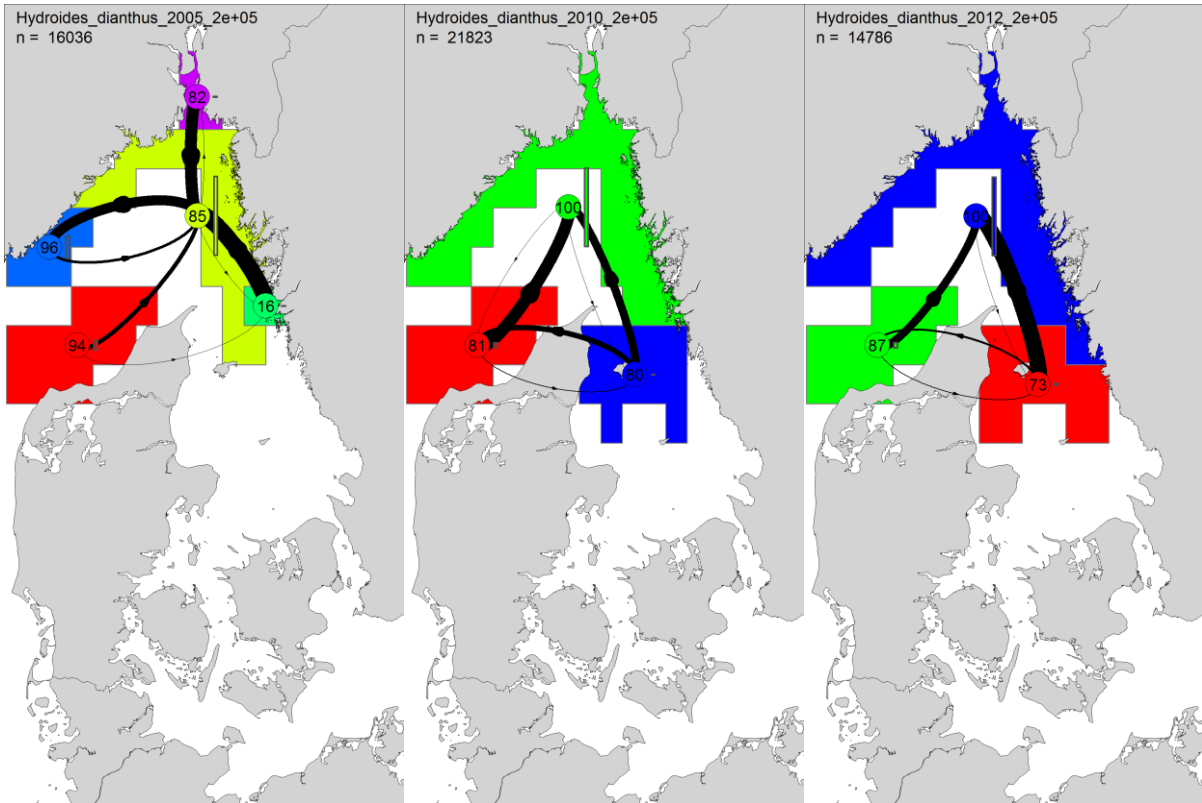
## 14.2.2 Multiple generations



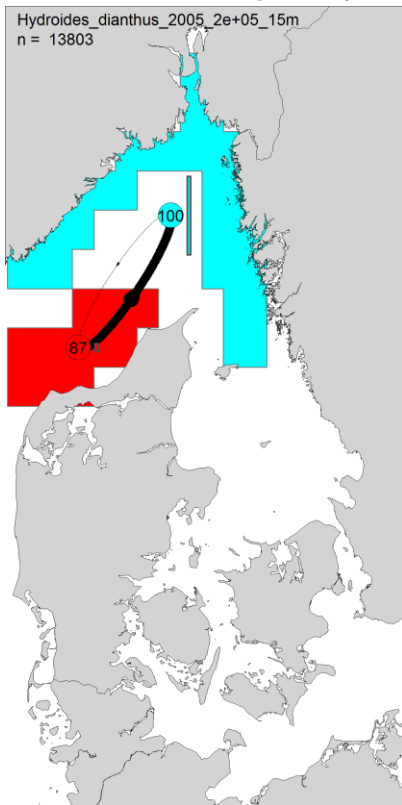
# 15 Hydroides dianthus

## 15.1 Hydrographic regions

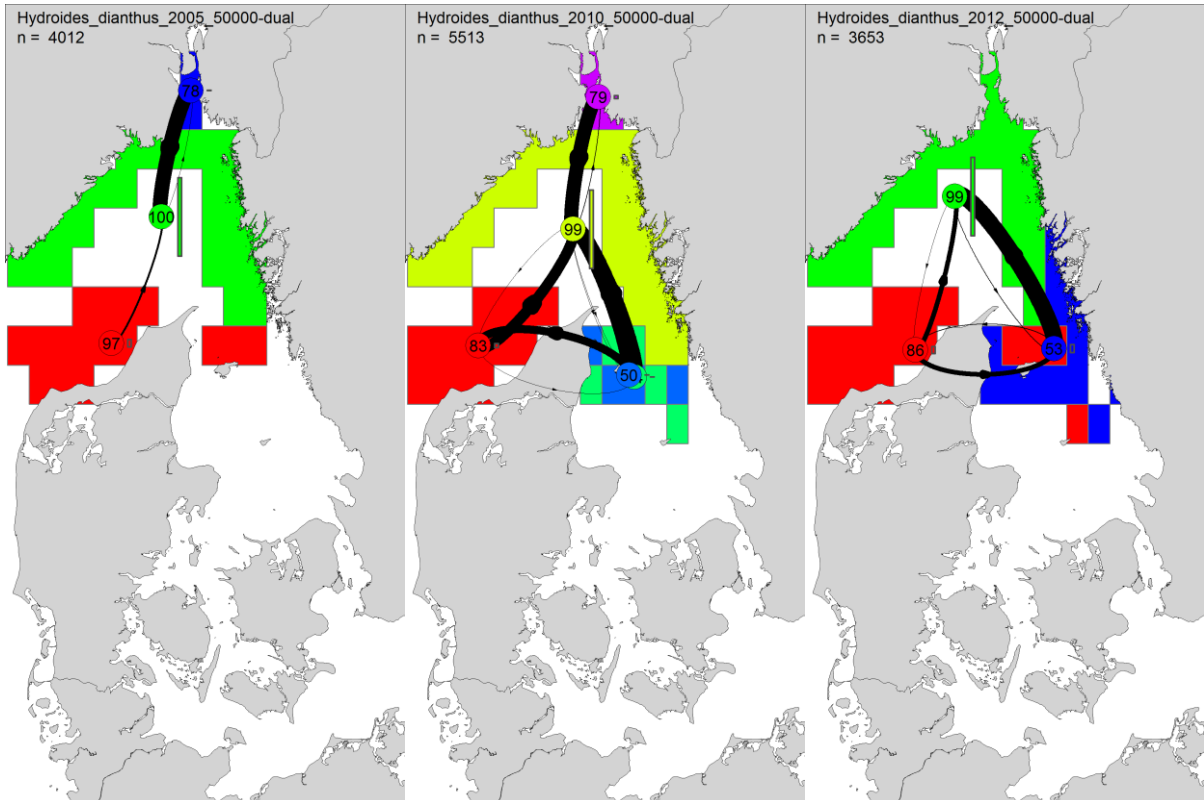
### 15.1.1 200 000 agents



### 15.1.2 200 000 agents (0-15 m)

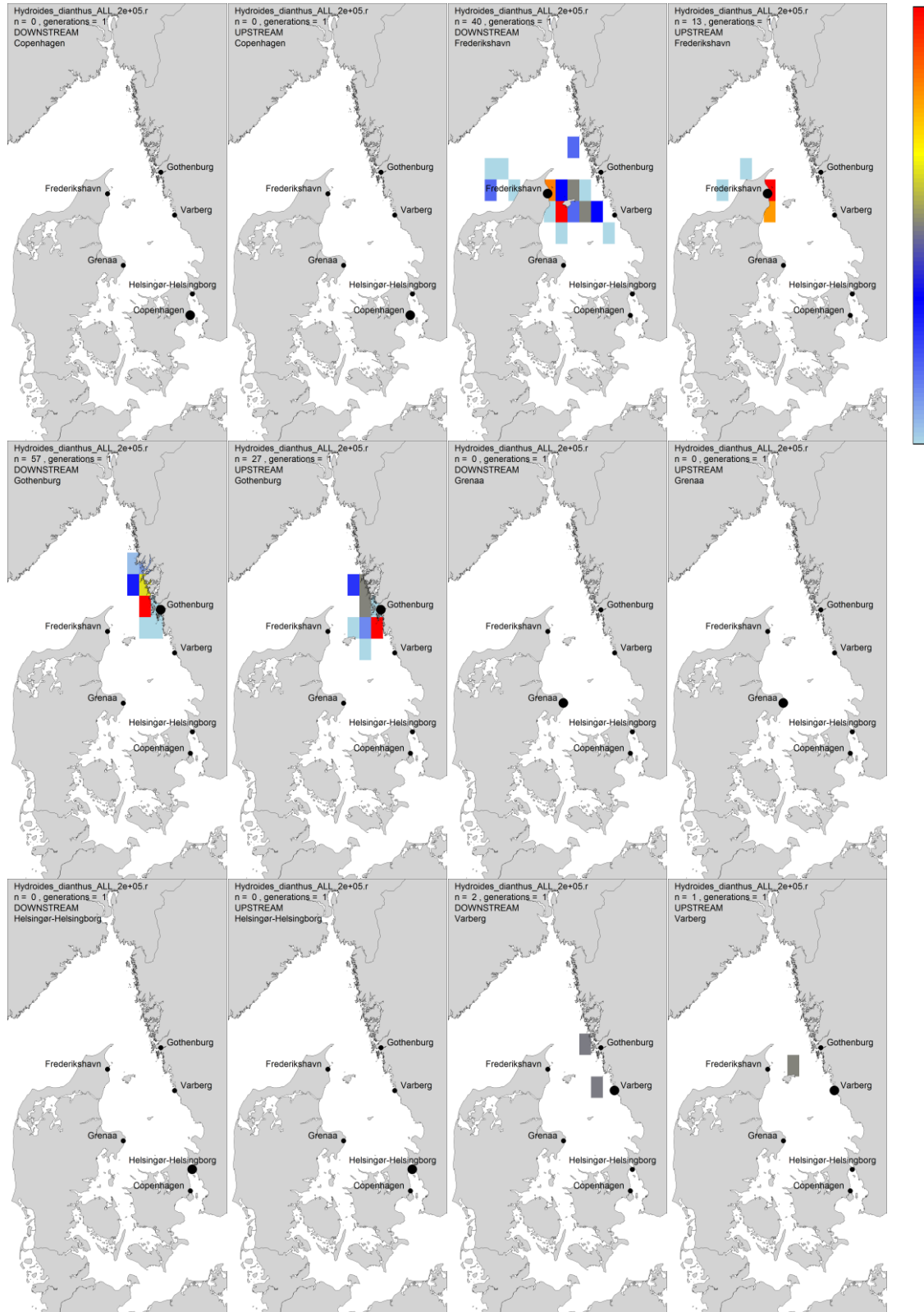


### 15.1.3 50 000 agents

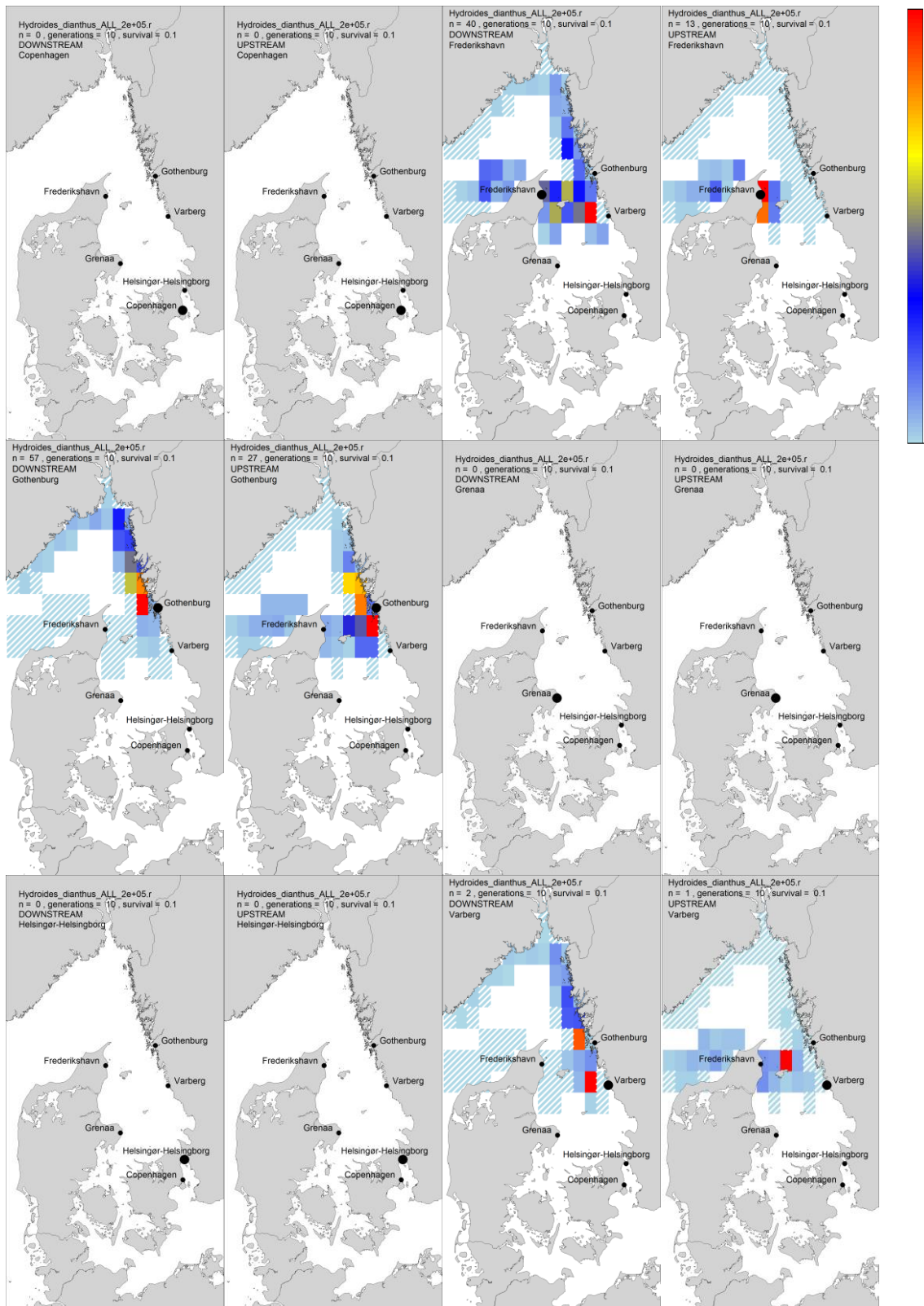


## 15.2 Dispersal probability plots

### 15.2.1 Single generation



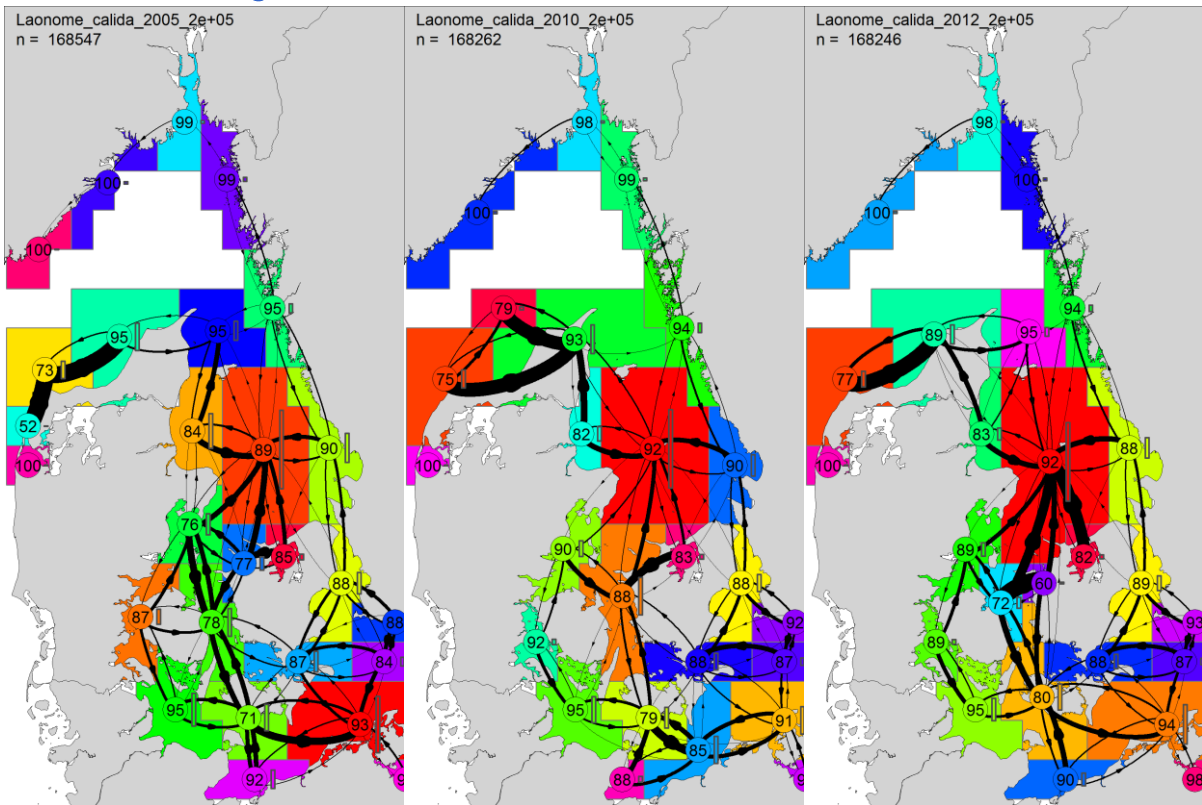
## 15.2.2 Multiple generations



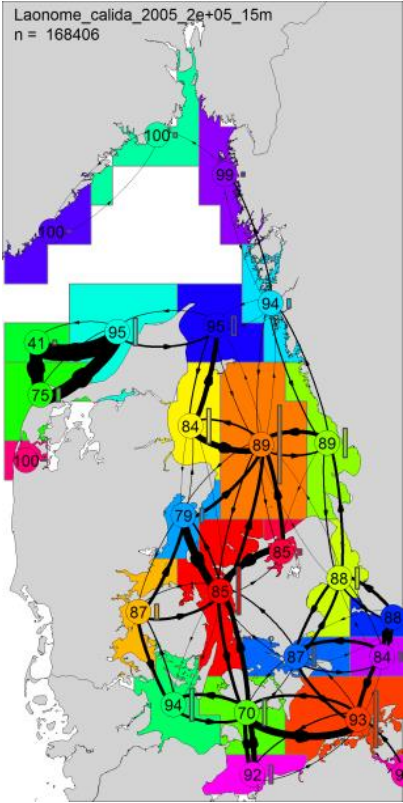
# 16 Laonome calida

## 16.1 Hydrographic regions

### 16.1.1 200 000 agents



16.1.2 200 000 agents (0-15 m)

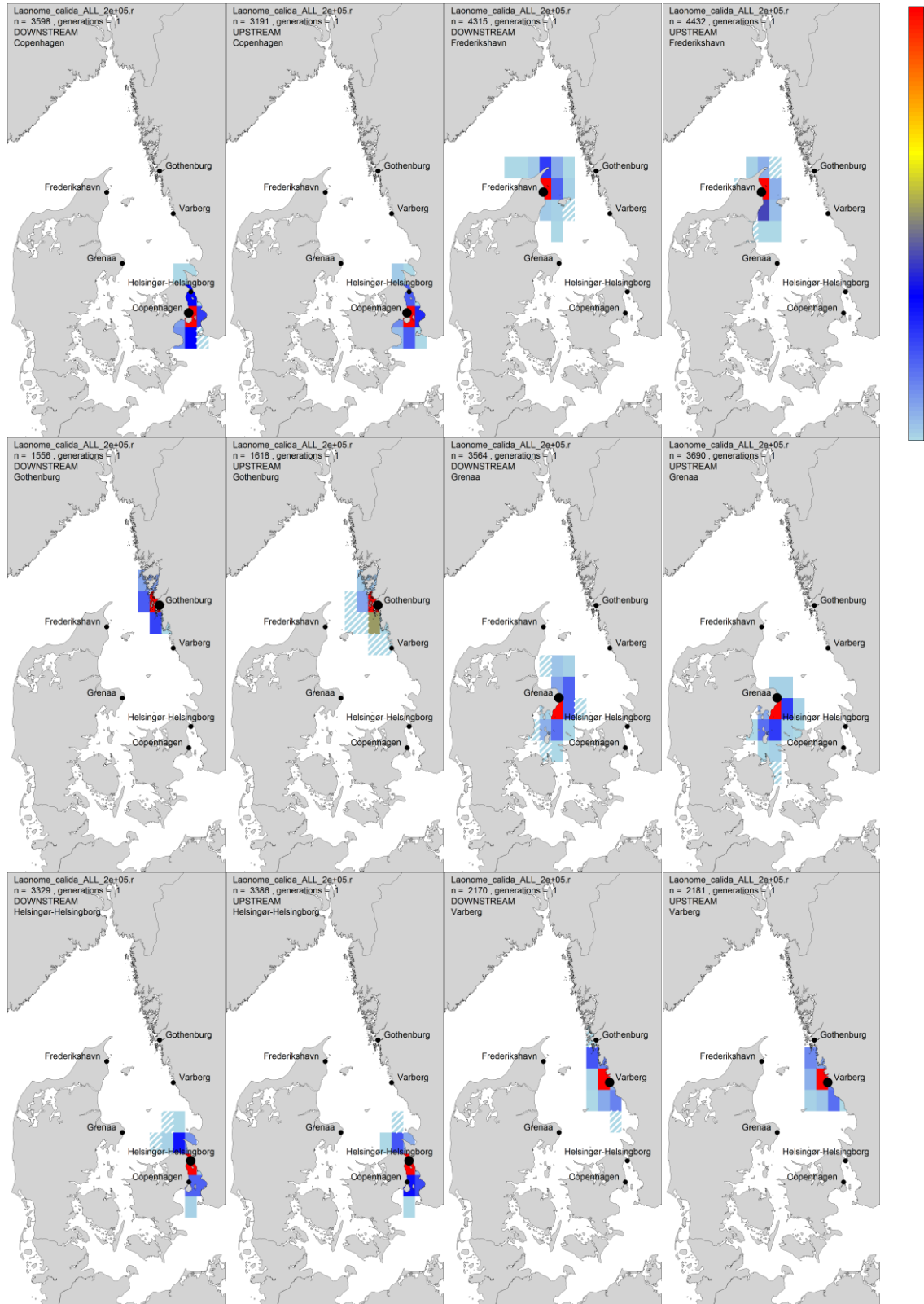


16.1.3 50 000 agents

NOT INCLUDED

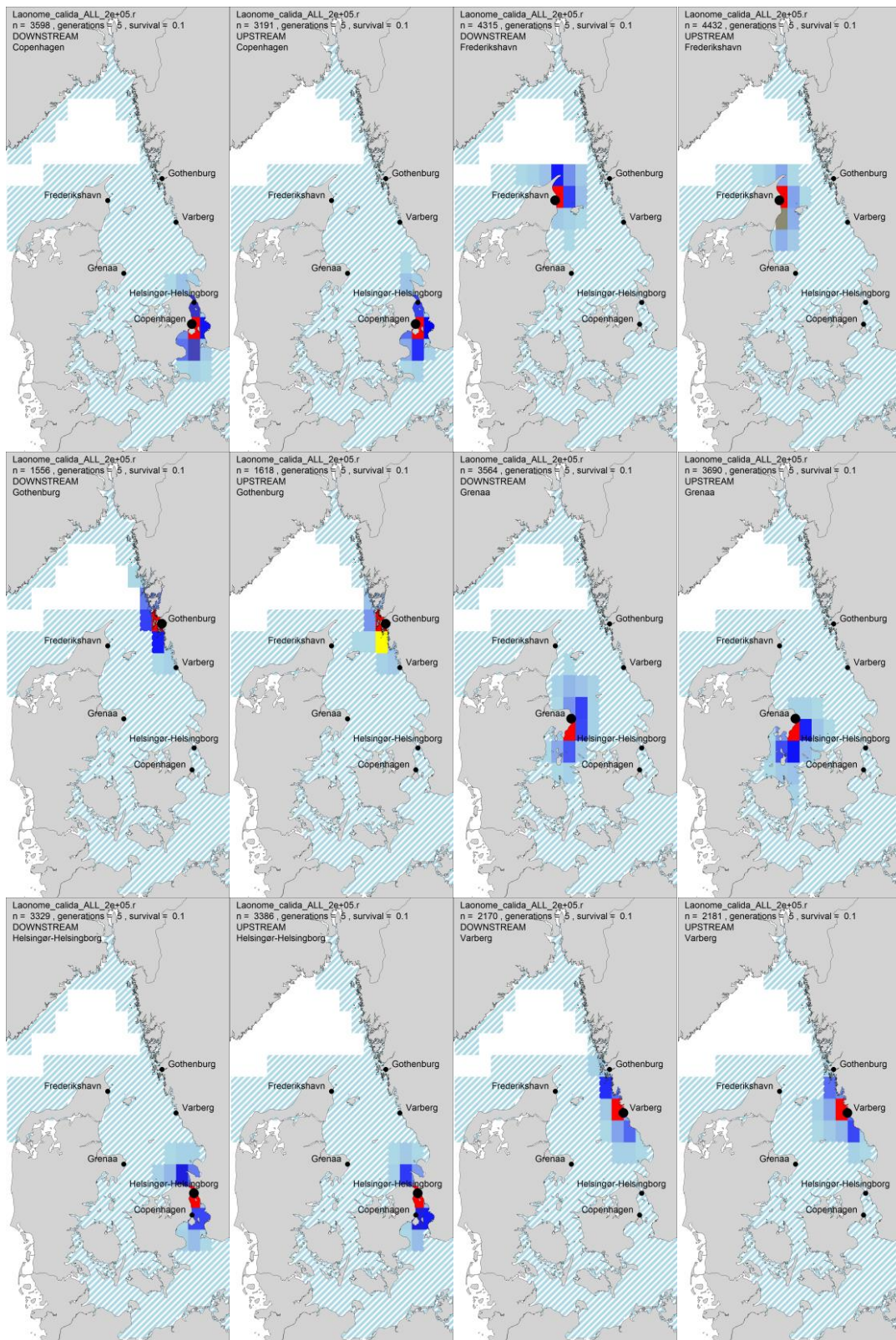
## 16.2 Dispersal probability plots

### 16.2.1 Single generation





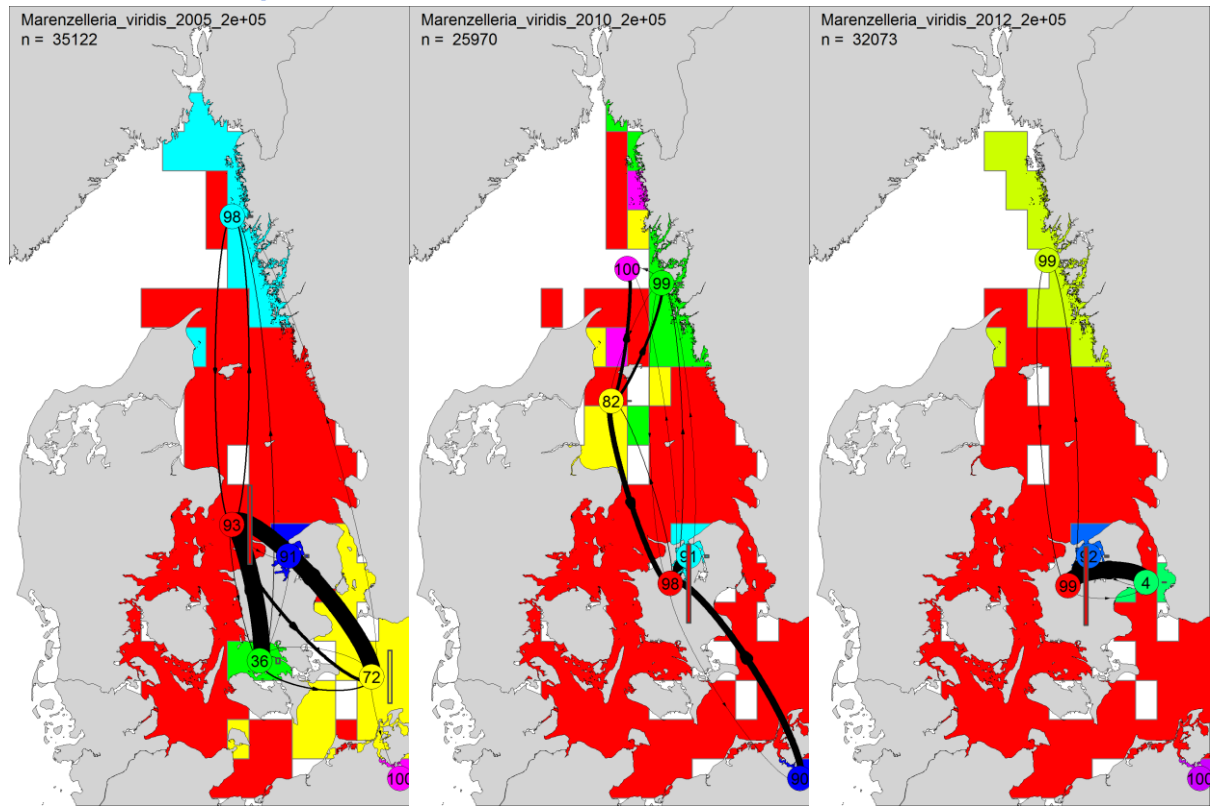
## 16.2.2 Multiple generations



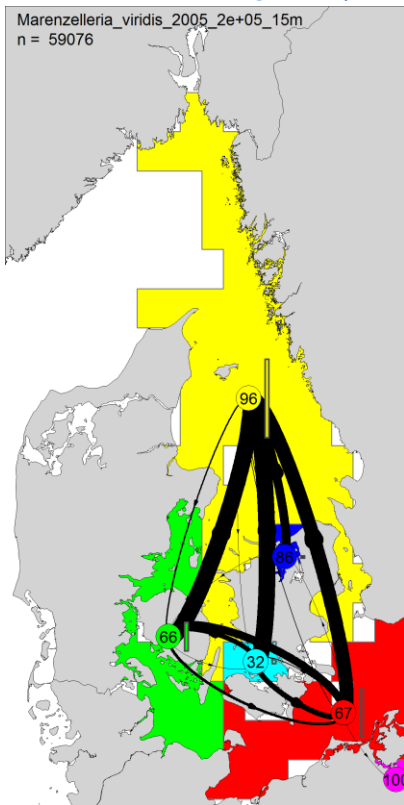
# 17 Marenzelleria viridis

## 17.1 Hydrographic regions

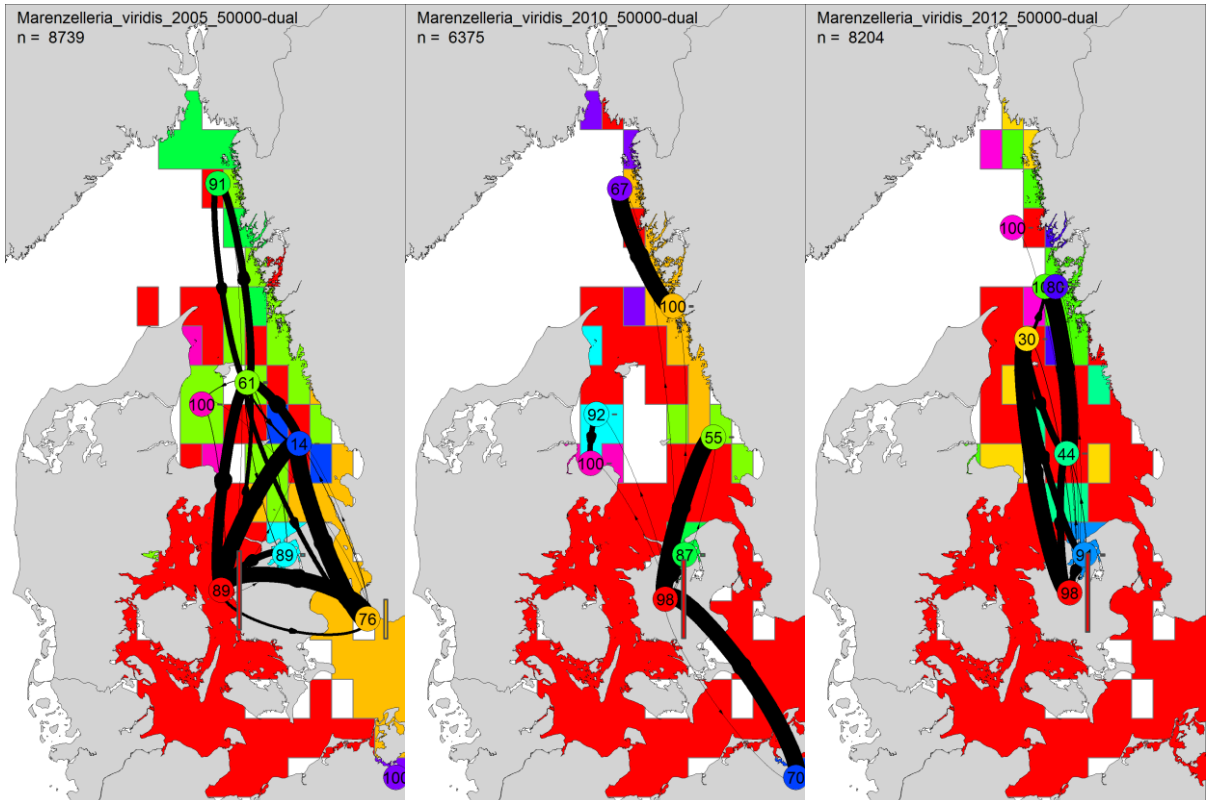
### 17.1.1 200 000 agents



### 17.1.2 200 000 agents (0-15 m)

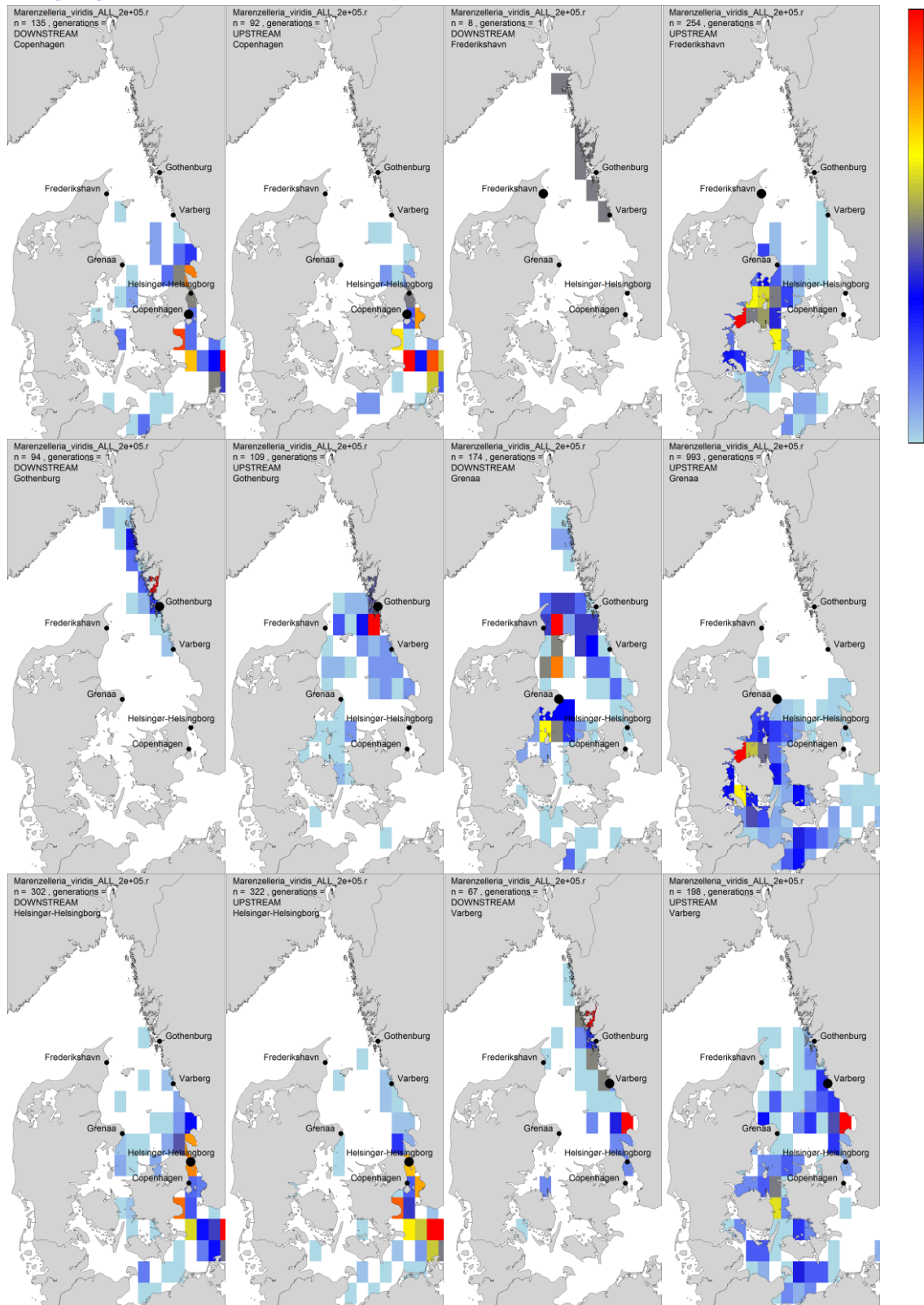


### 17.1.3 50 000 agents

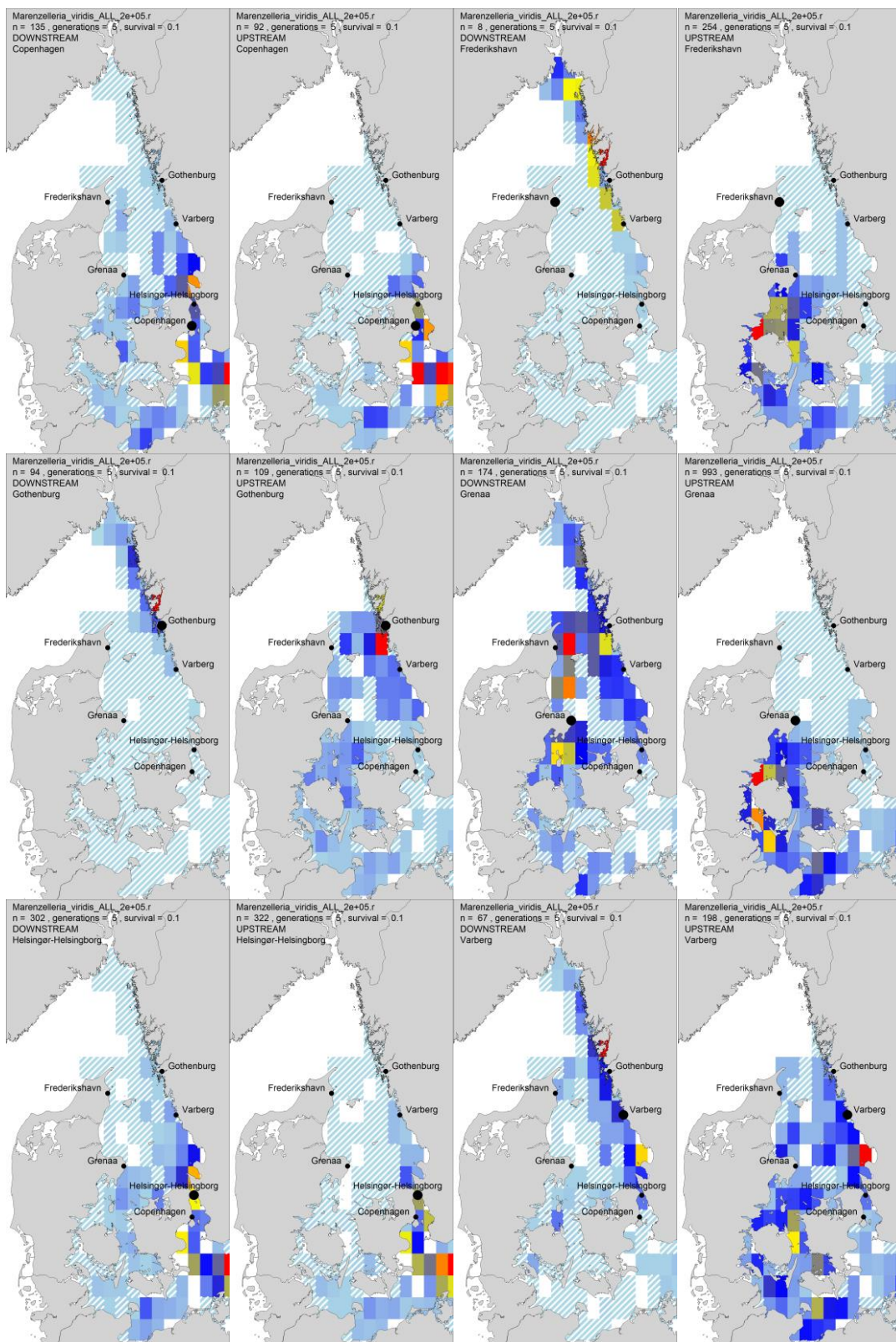


## 17.2 Dispersal probability plots

### 17.2.1 Single generation



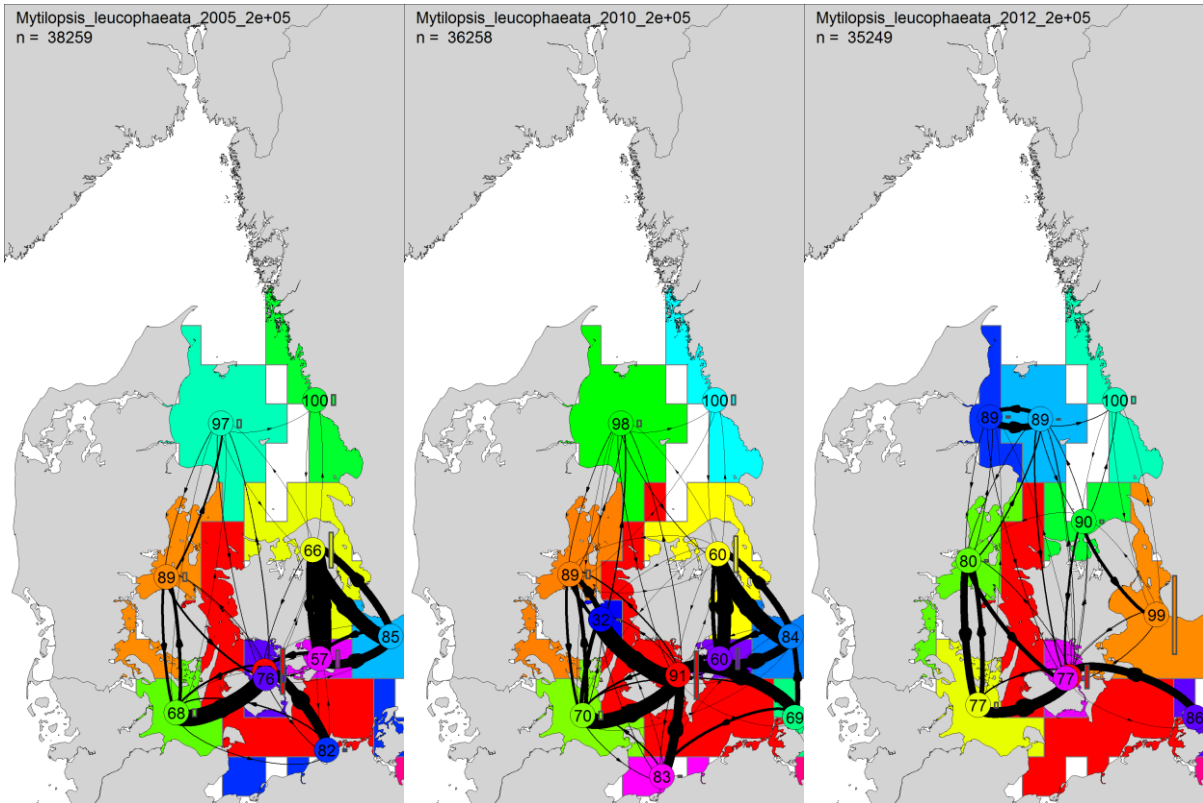
## 17.2.2 Dispersal probability plots - Multiple generations



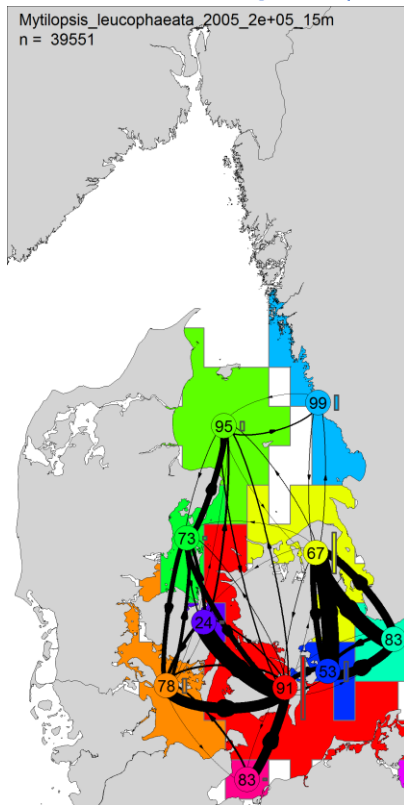
# 18 Mytilopsis leucophaeata

## 18.1 Hydrographic regions

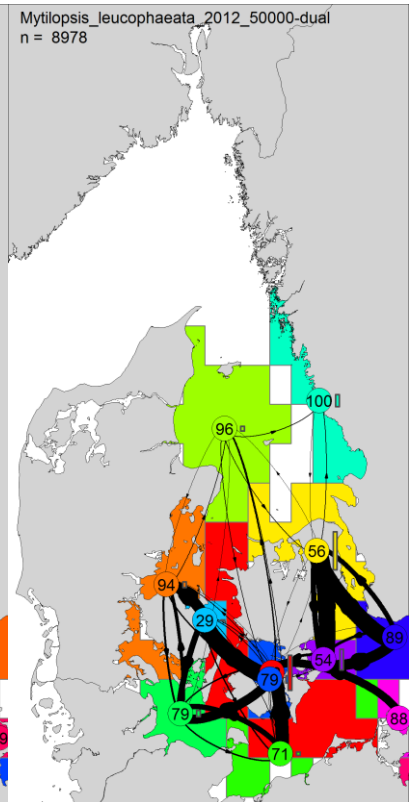
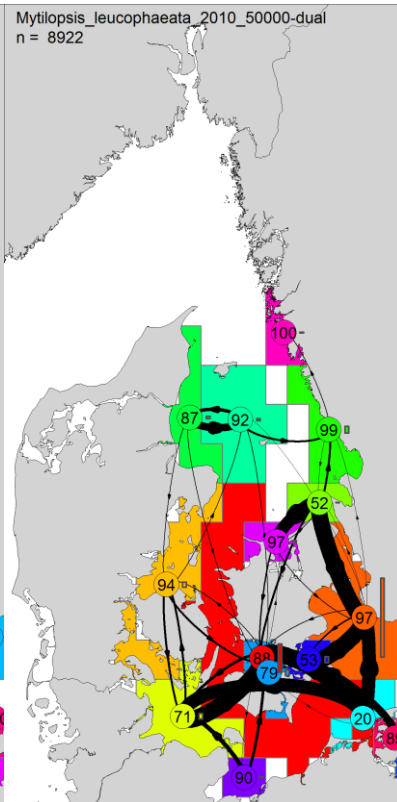
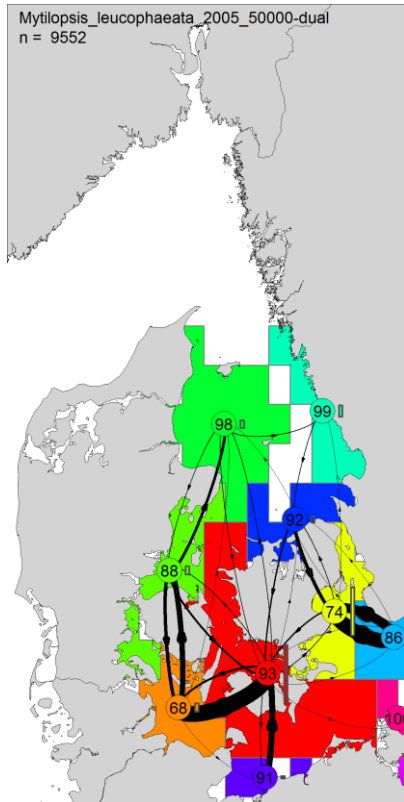
### 18.1.1 200 000 agents



### 18.1.2 200 000 agents (0-15 m)

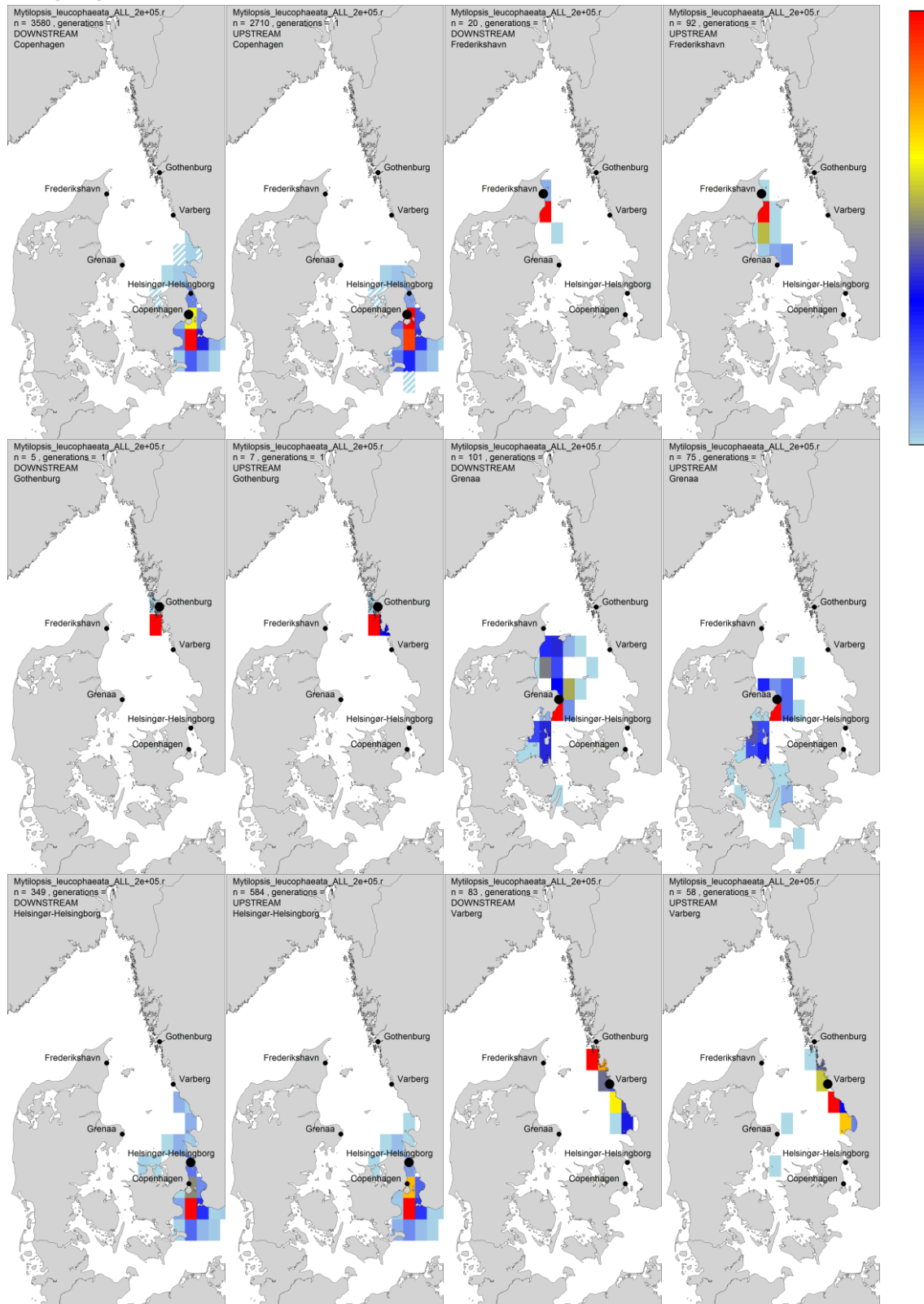


### 18.1.3 50 000 agents



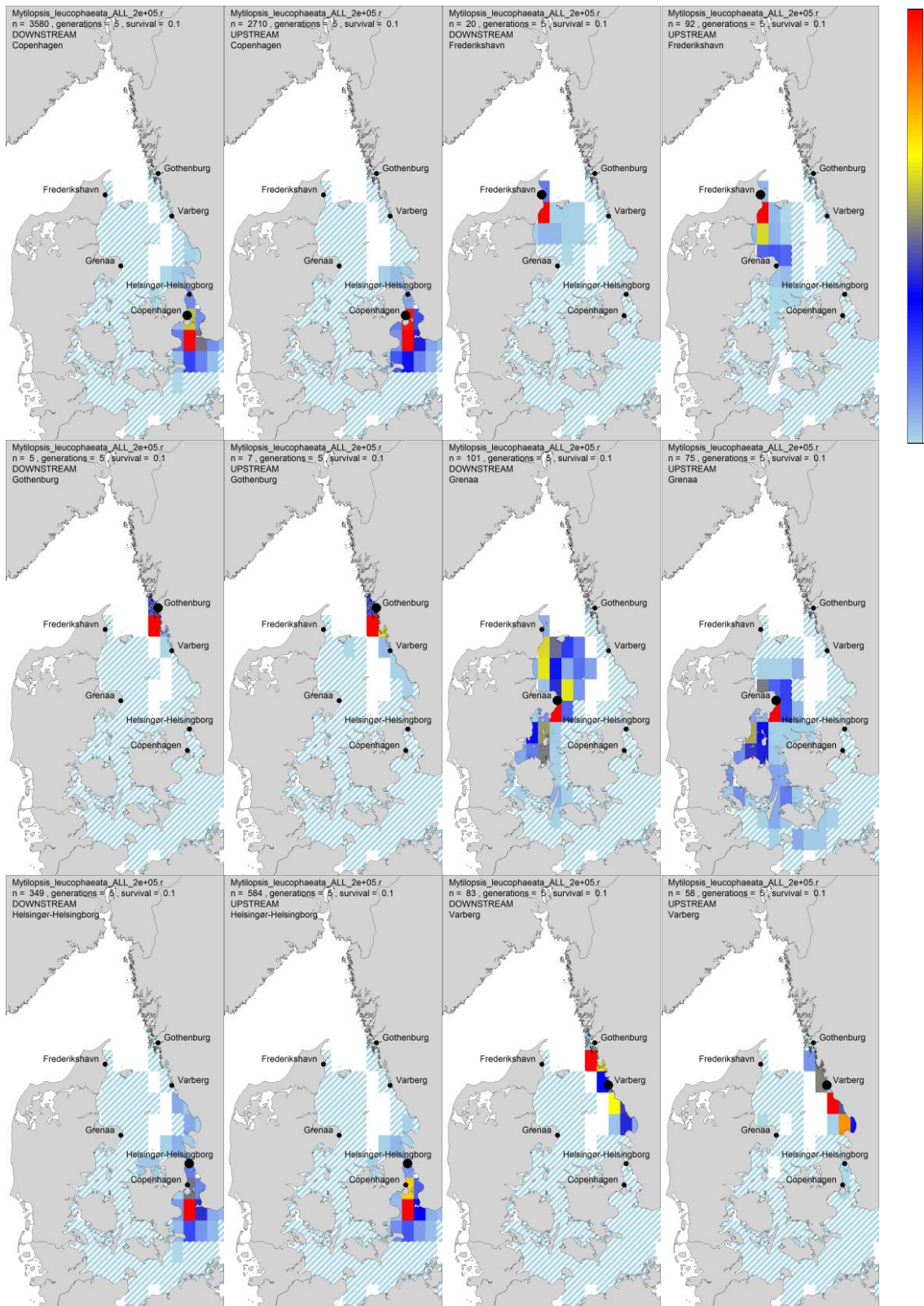
## 18.2 Dispersal probability plots

### 18.2.1 Single generation





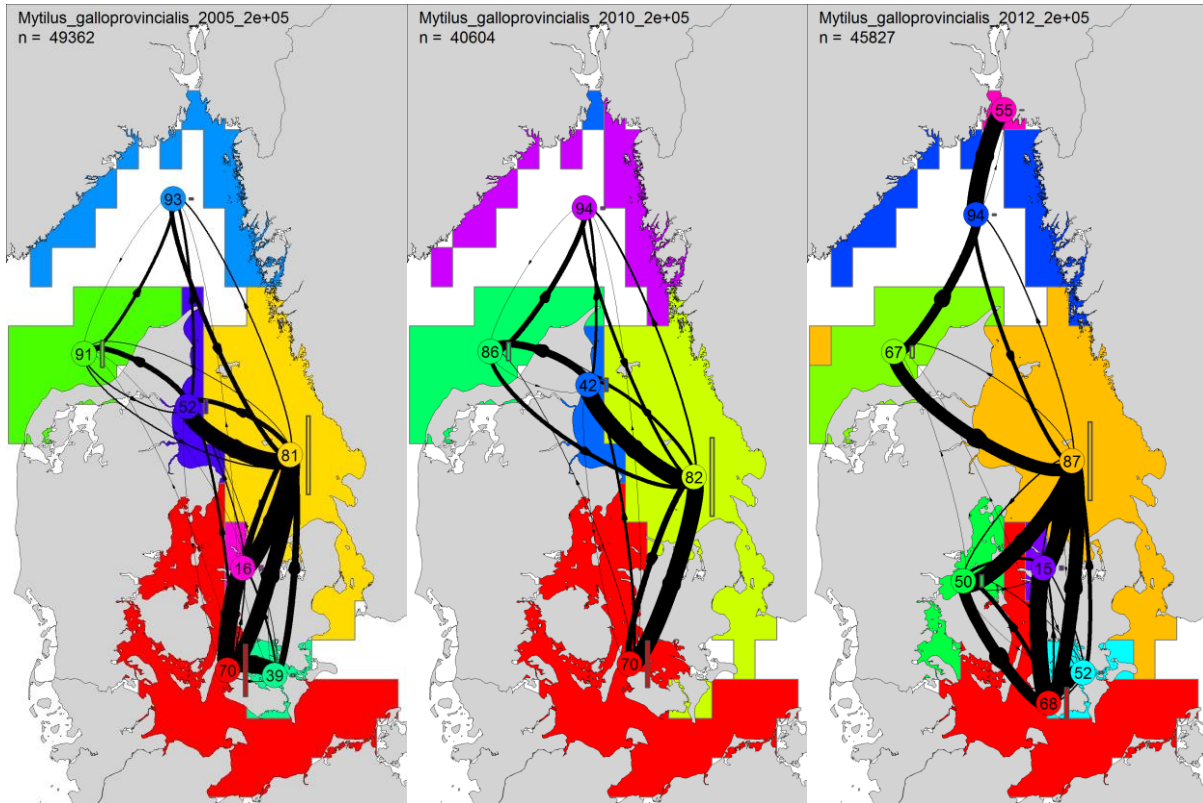
## 18.2.2 Multiple generations



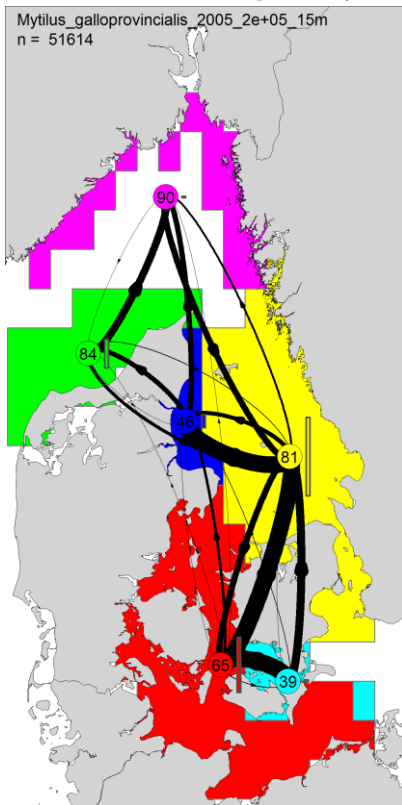
# 19 Mytilus galloprovincialis

## 19.1 Hydrographic regions

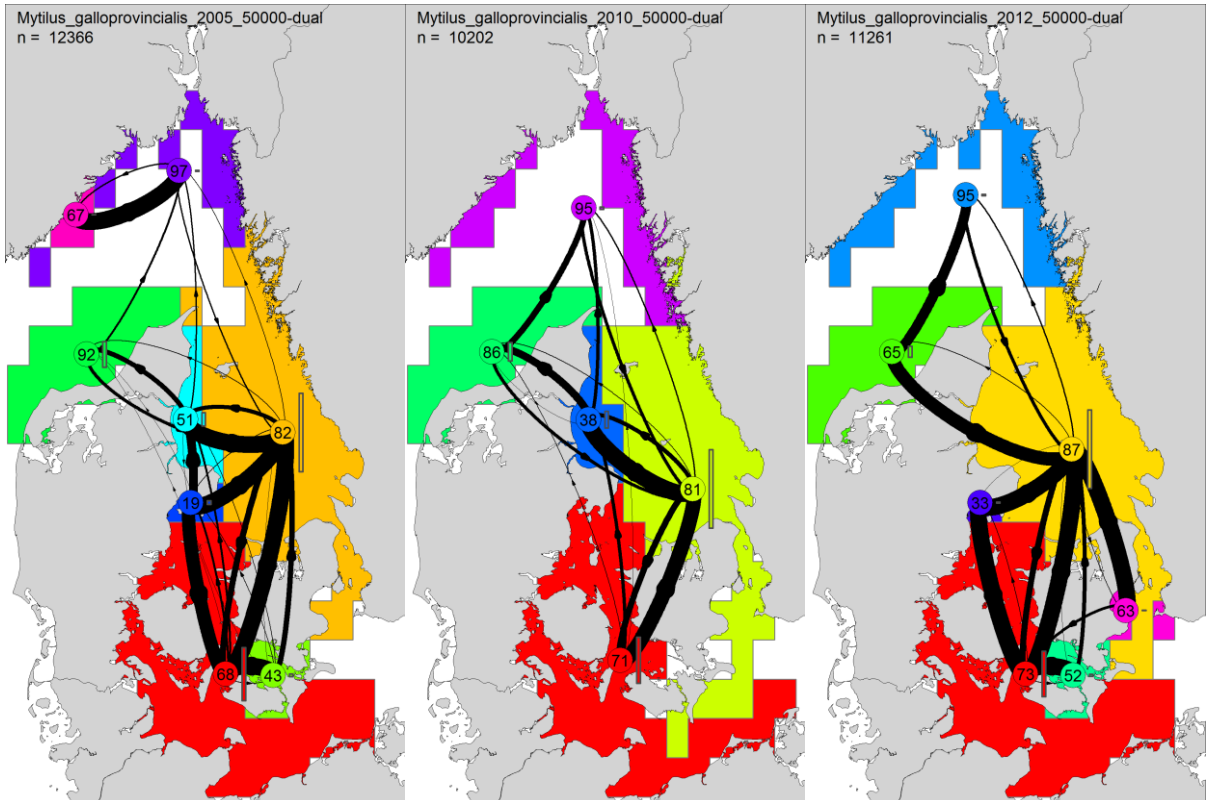
### 19.1.1 200 000 agents



### 19.1.2 200 000 agents (0-15 m)

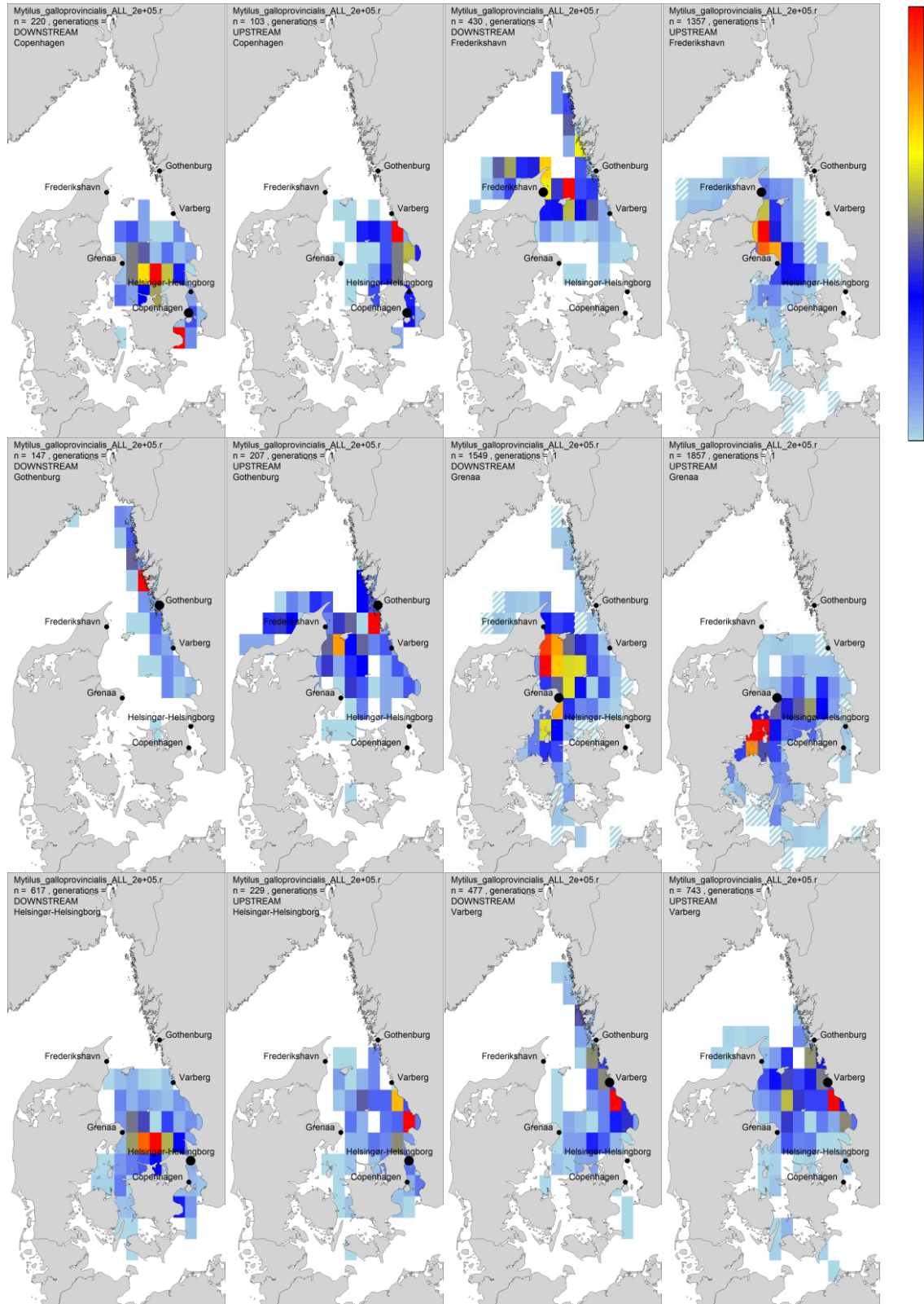


### 19.1.3 50 000 agents

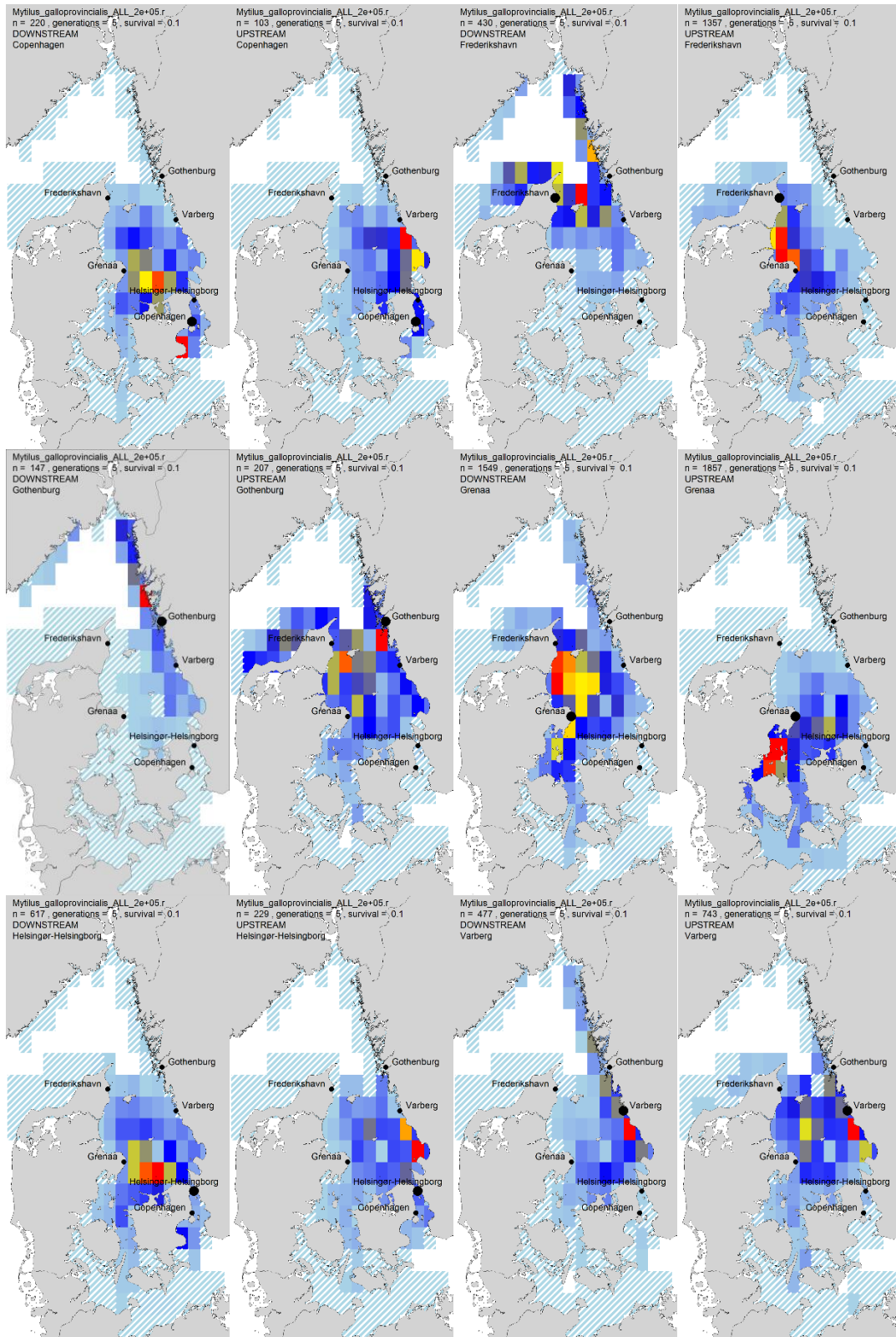


## 19.2 Dispersal probability plots

### 19.2.1 Single generation



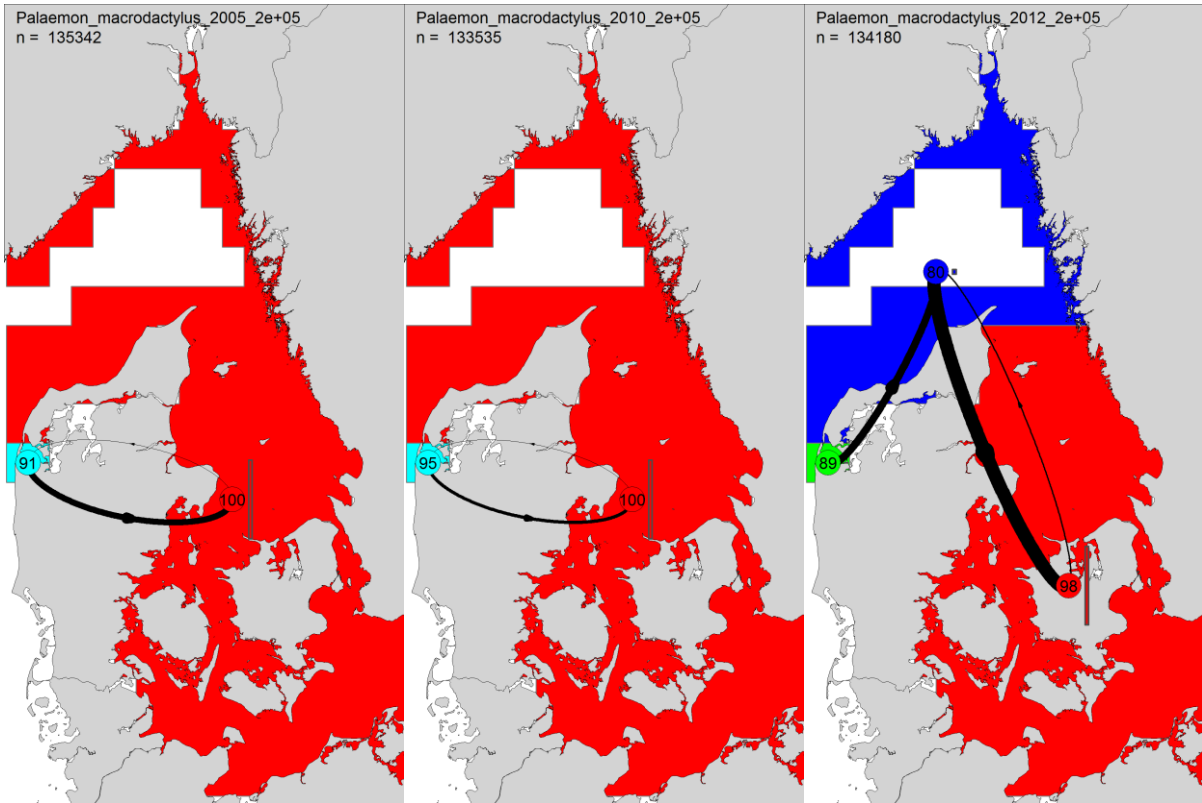
## 19.2.2 Multiple generations



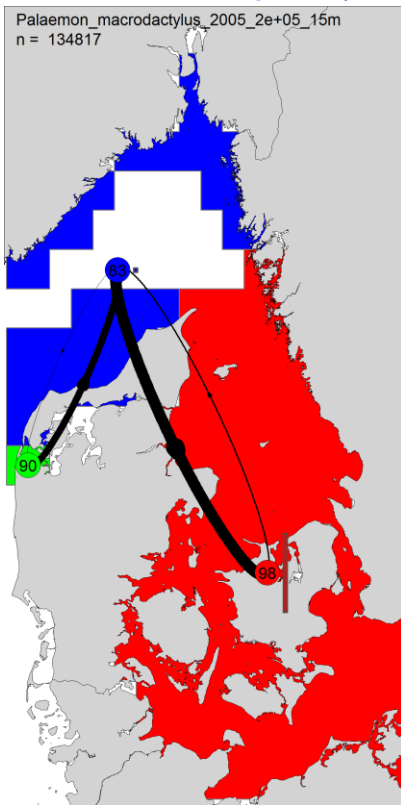
## 20 Palaemon macrodactylus

### 20.1 Hydrographic regions

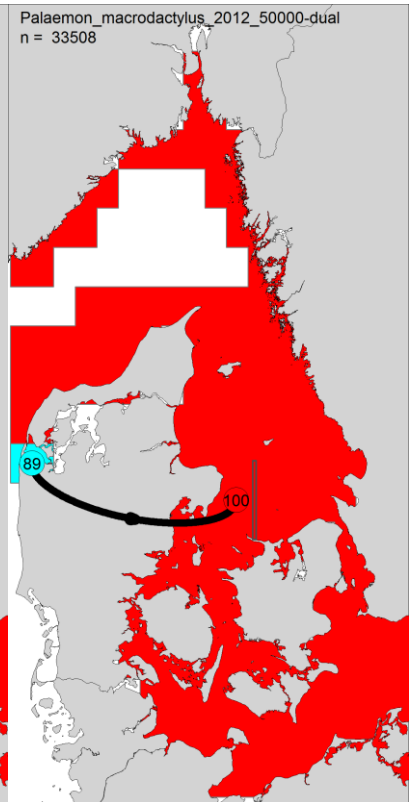
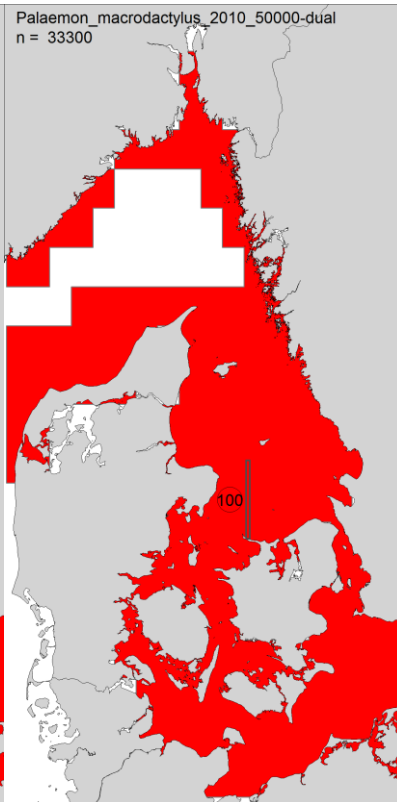
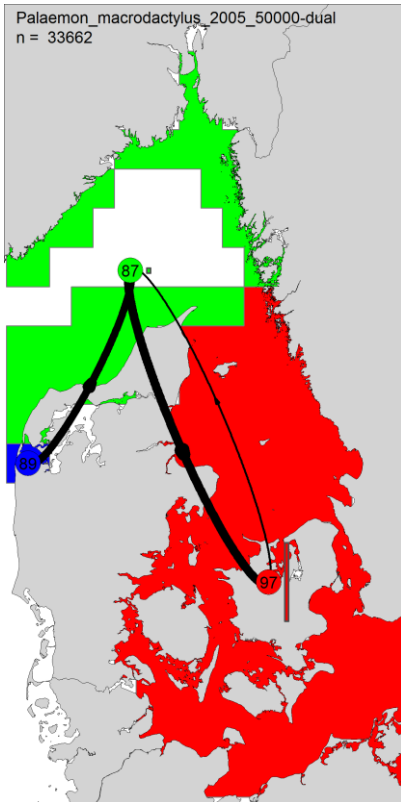
#### 20.1.1 20 000



### 20.1.2 200 000 agents (0-15 m)

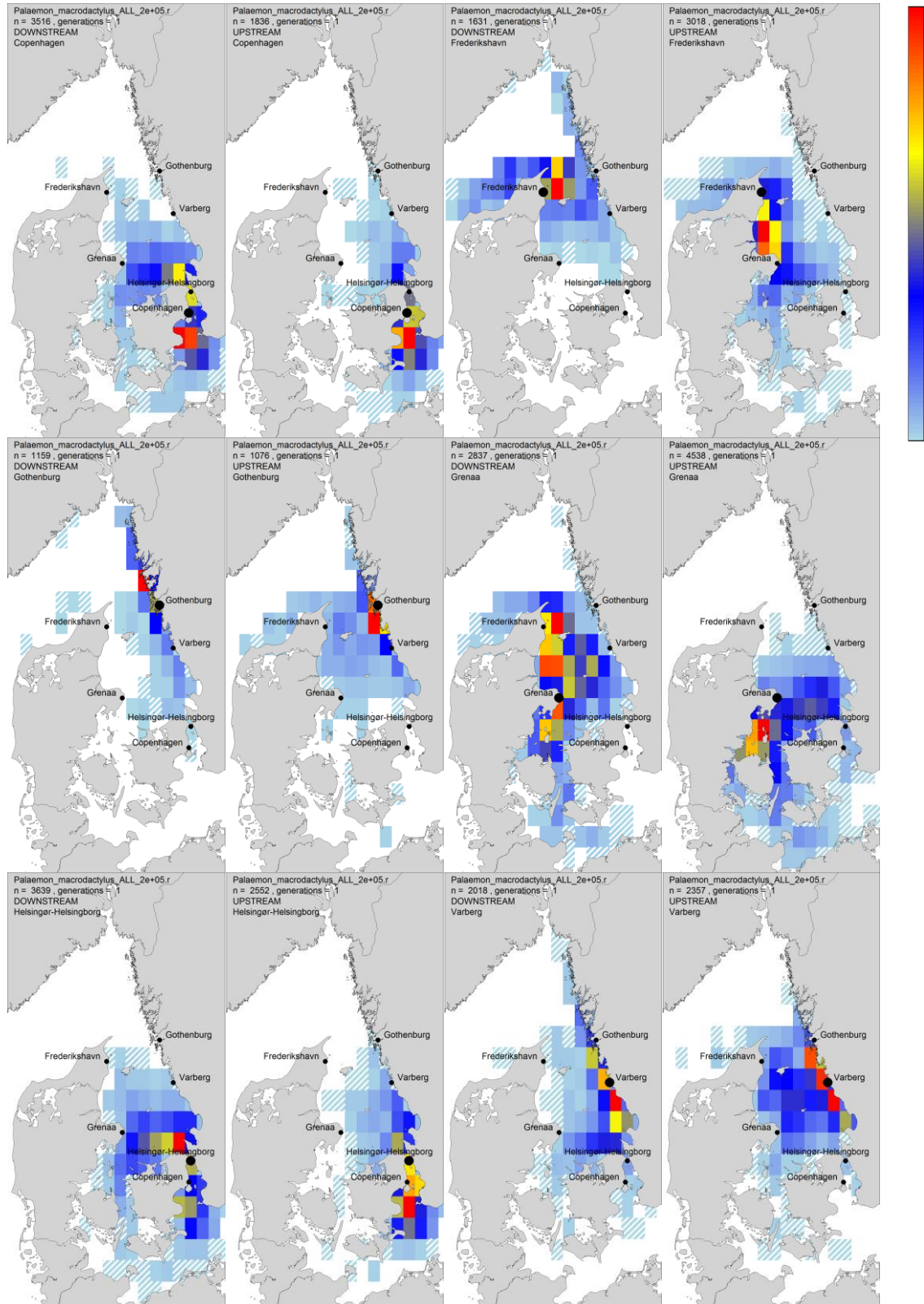


### 20.1.3 50 000 agents



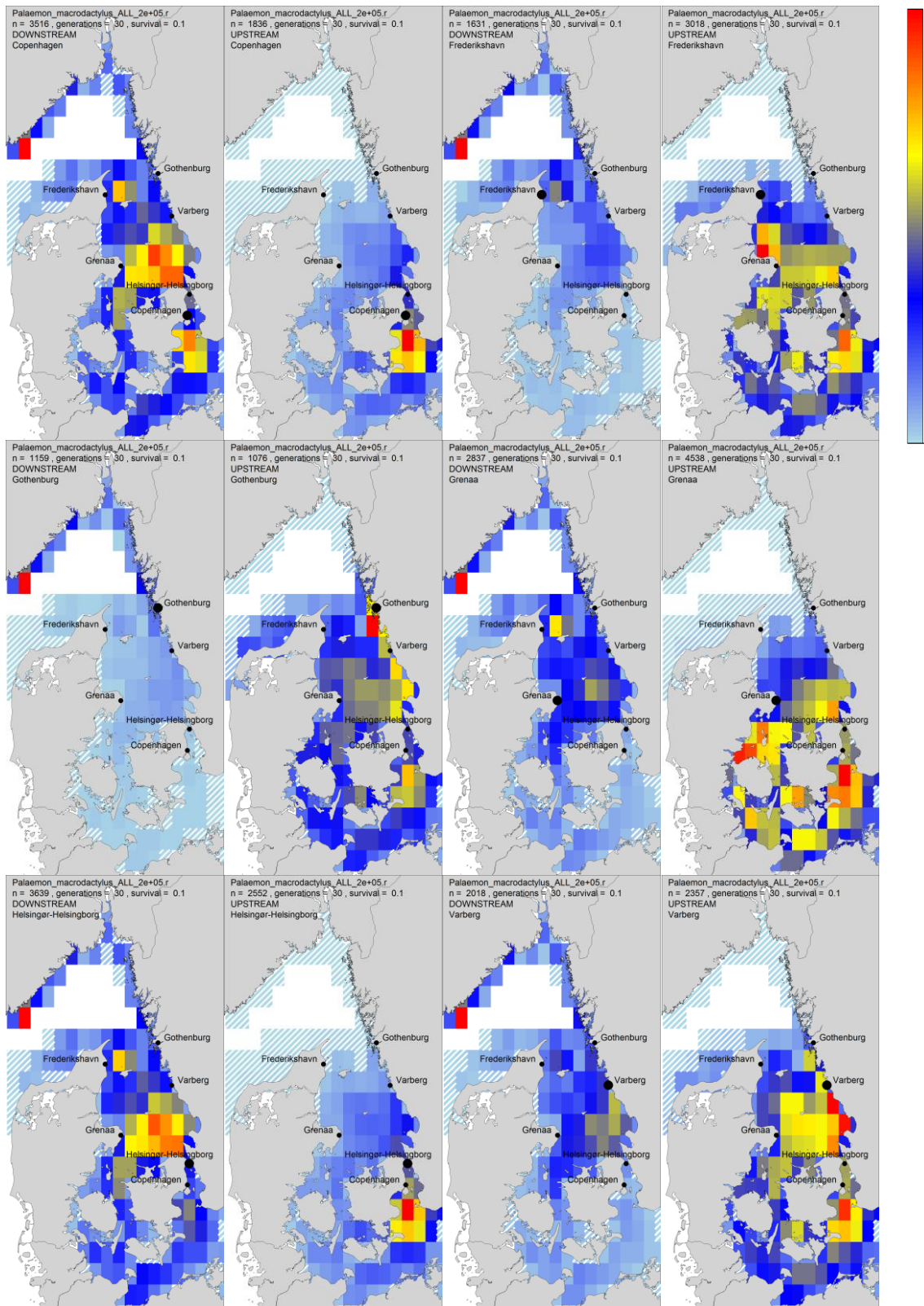
## 20.2 Dispersal probability plots

### 20.2.1 Single generation





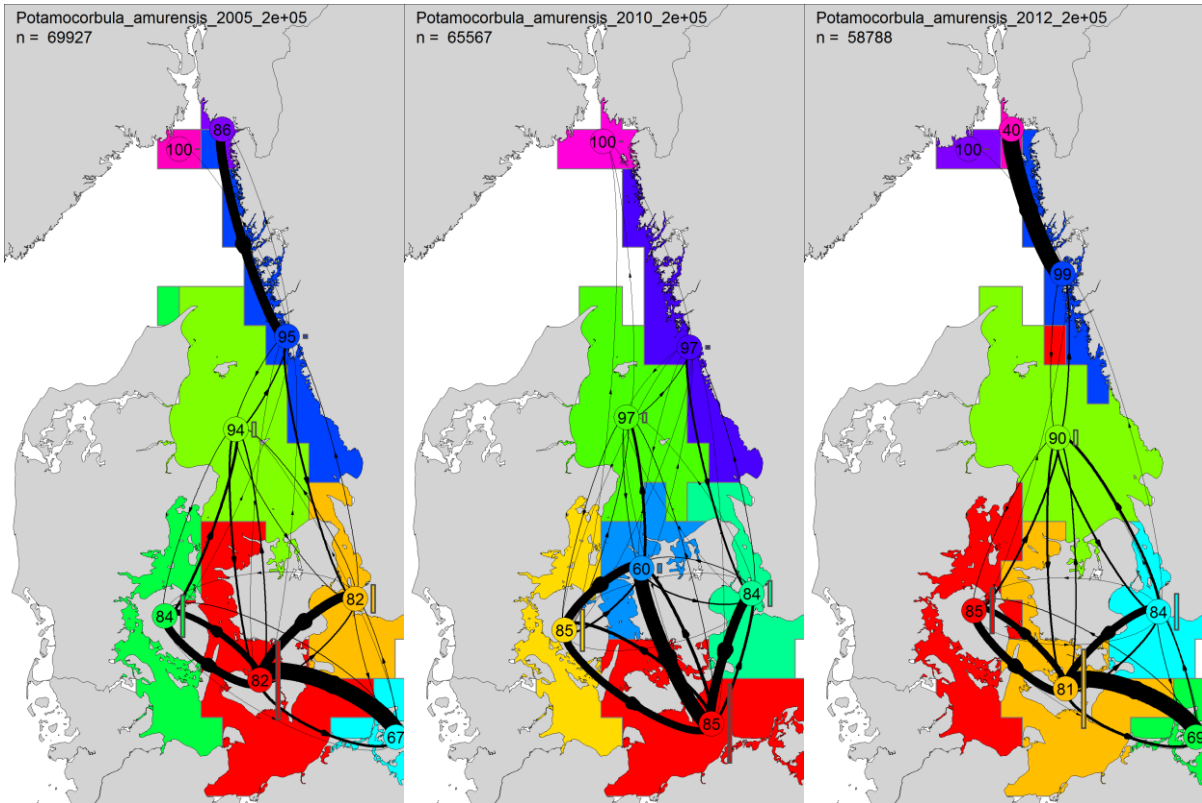
## 20.2.2 Multiple generations



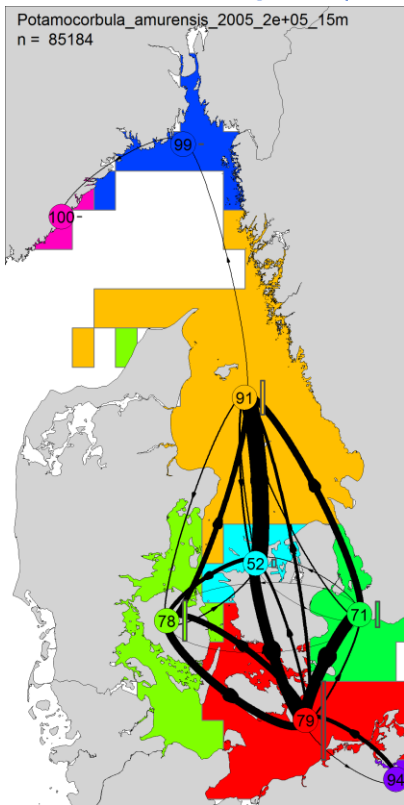
# 21 Potamocorbula amurensis

## 21.1 Hydrographic regions

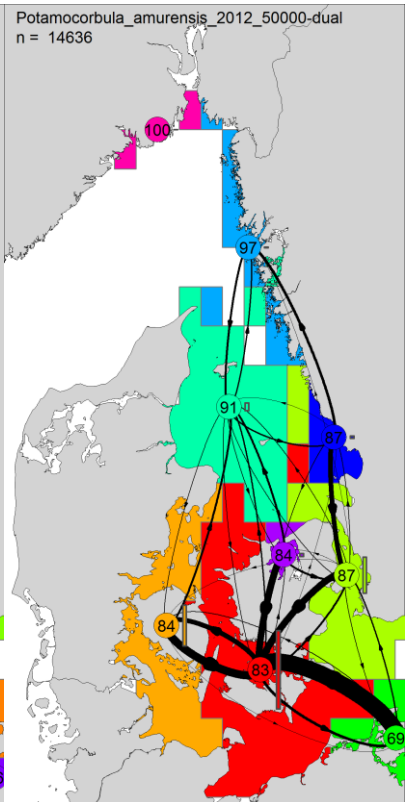
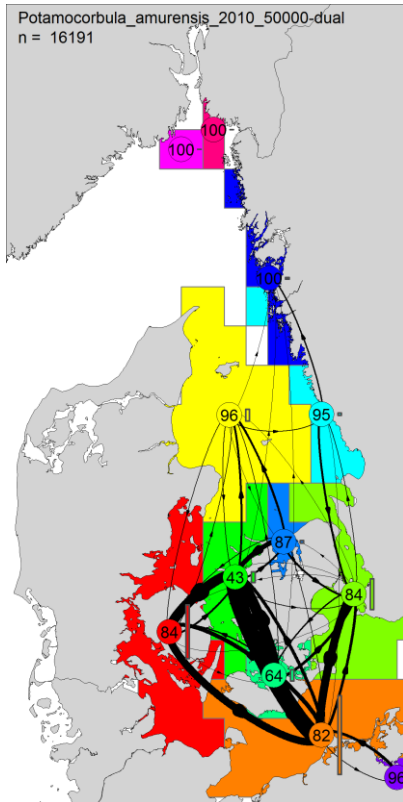
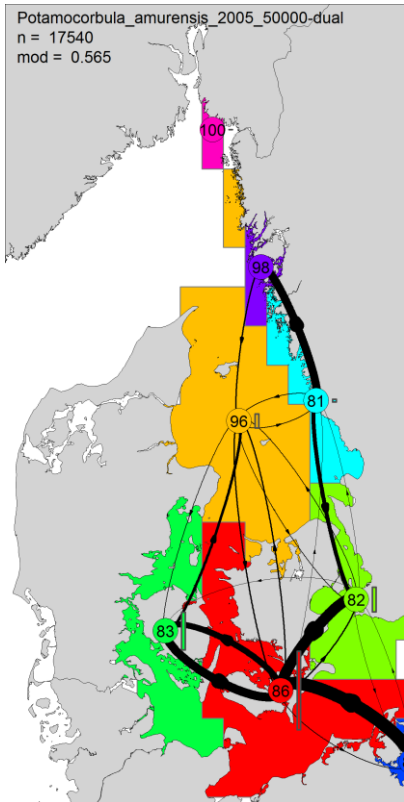
### 21.1.1 200 000 agents



### 21.1.2 200 000 agents (0-15 m)

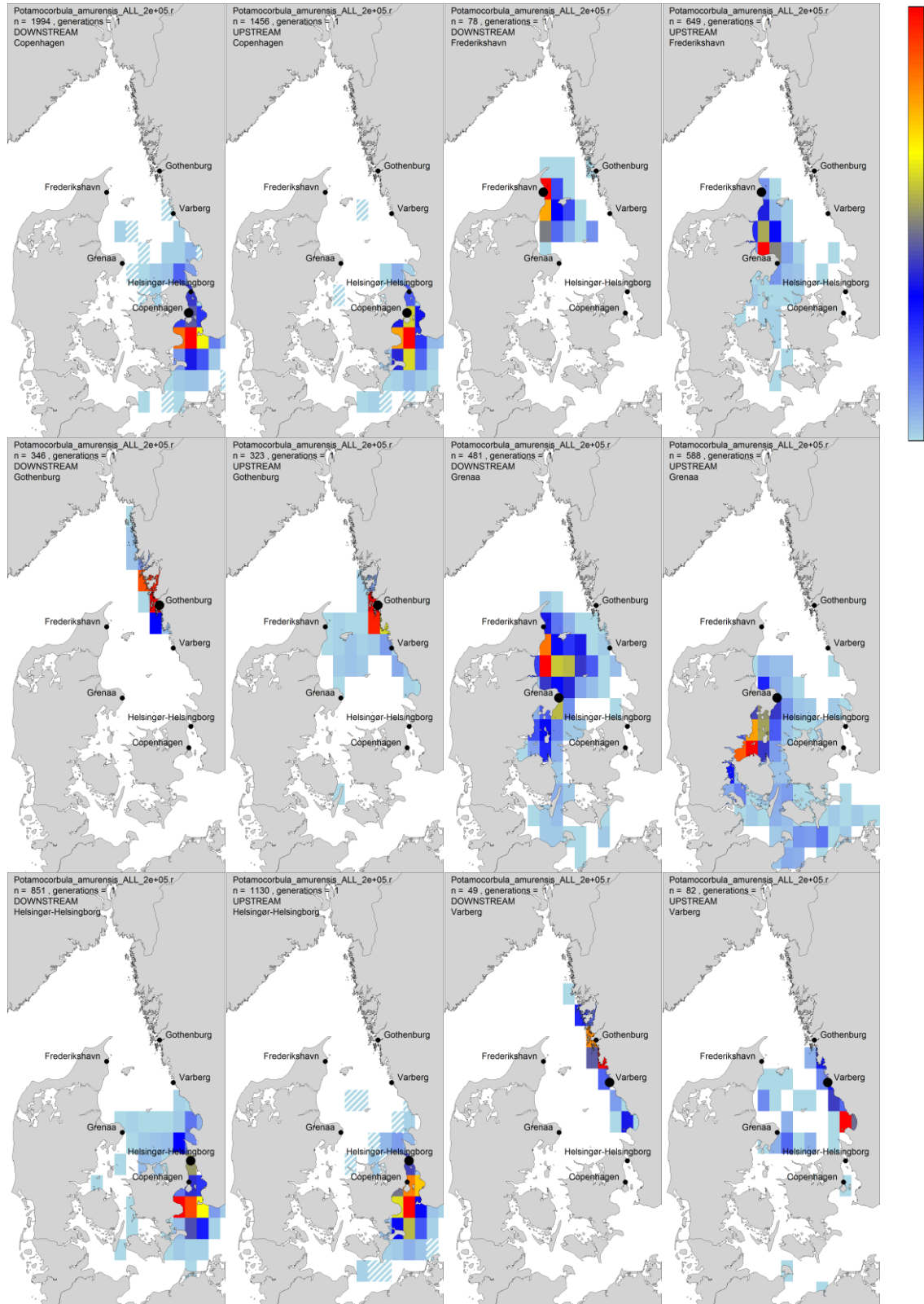


### 21.1.3 50 000 agents

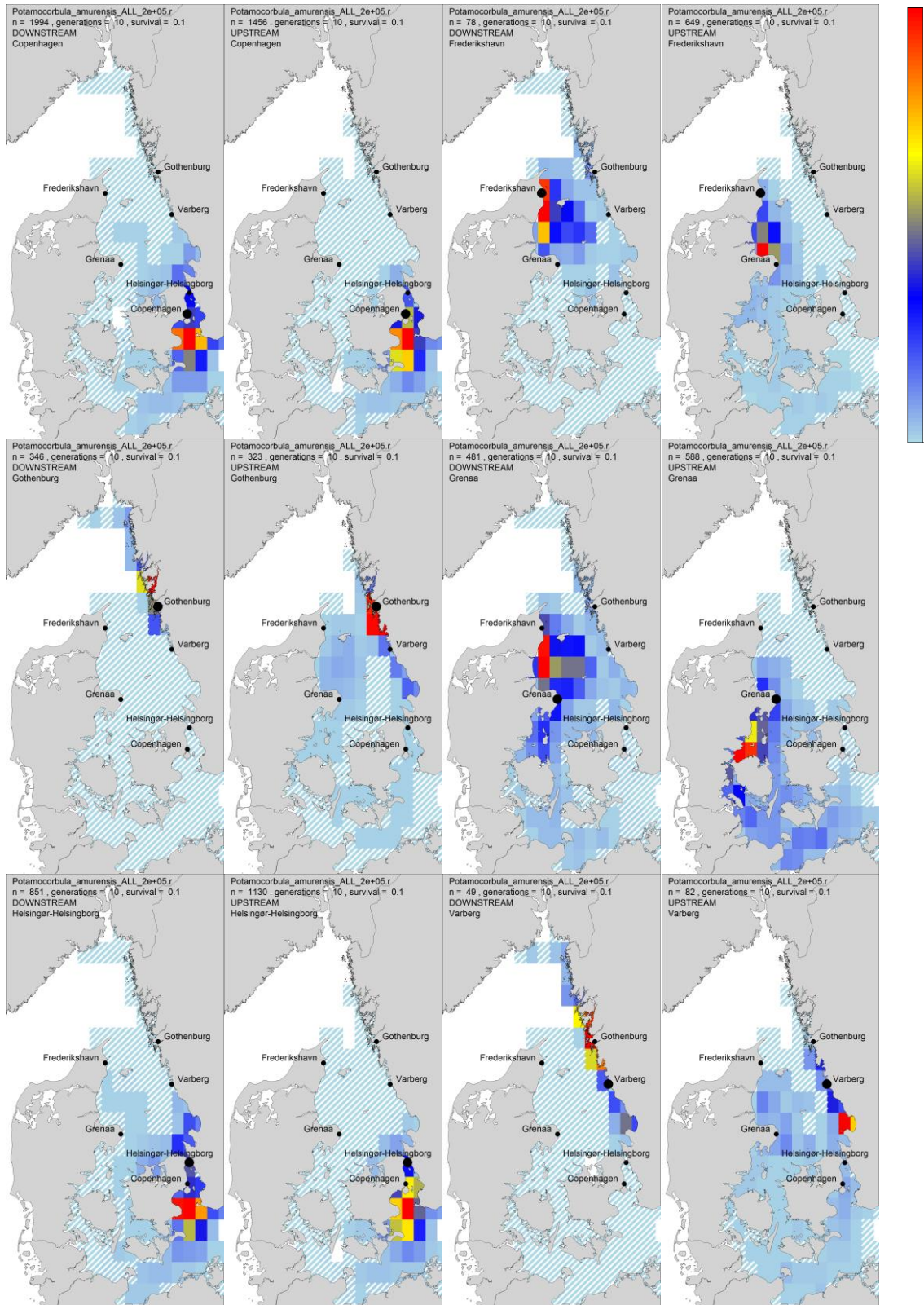


## 21.2 Dispersal probability plots

### 21.2.1 Single generation



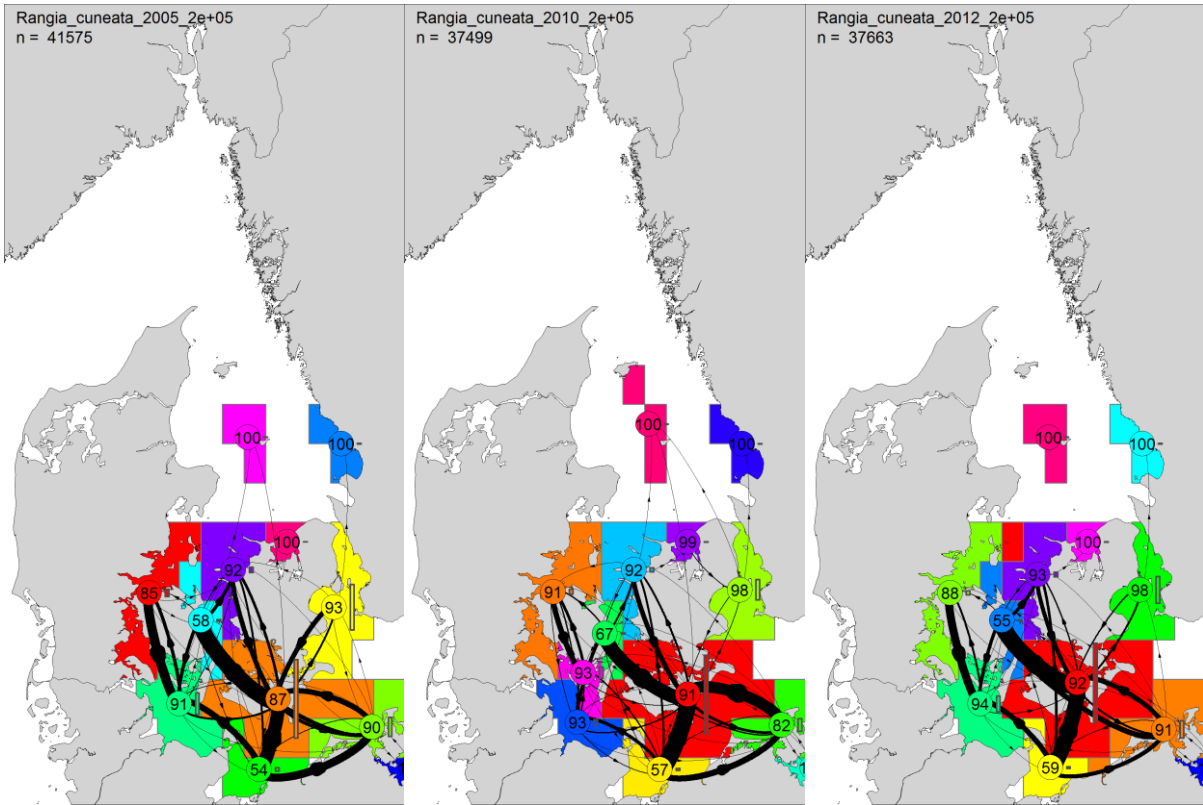
## 21.2.2 Multiple generations



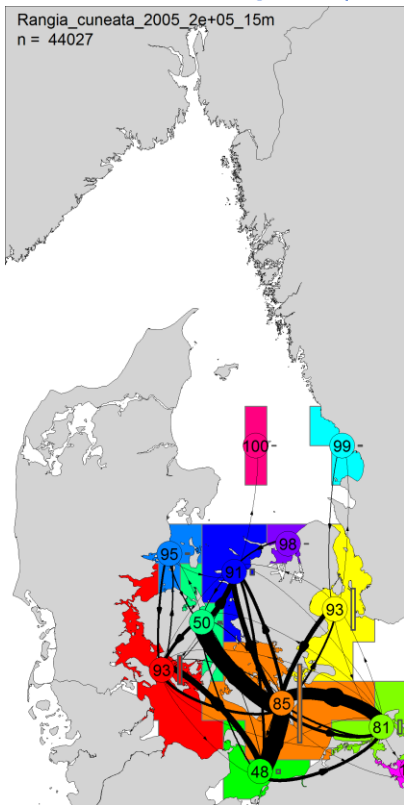
## 22 Rangia cuneate

### 22.1 Hydrographic regions

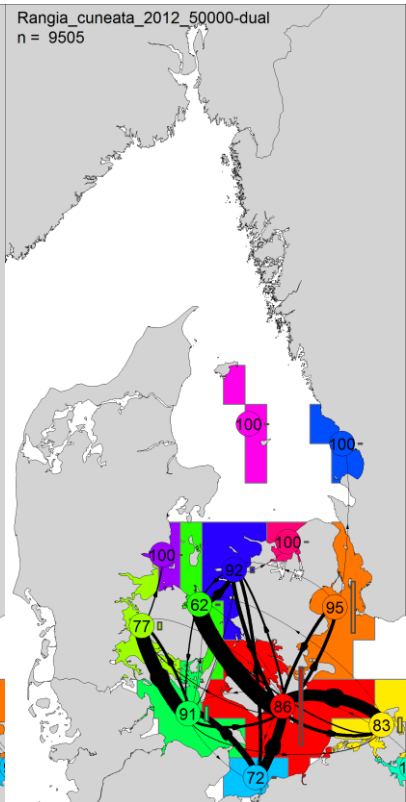
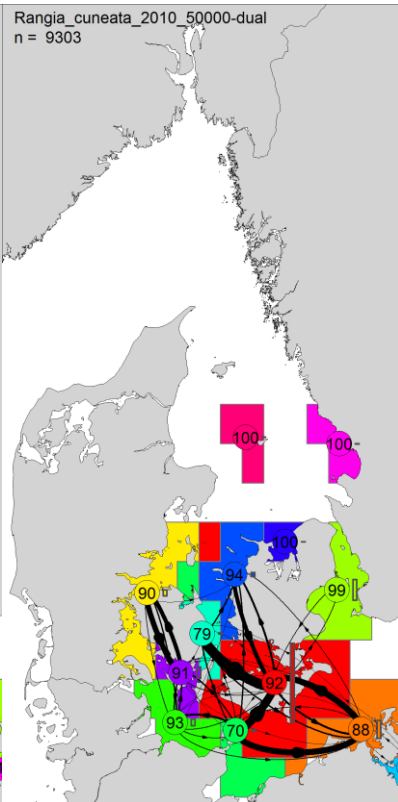
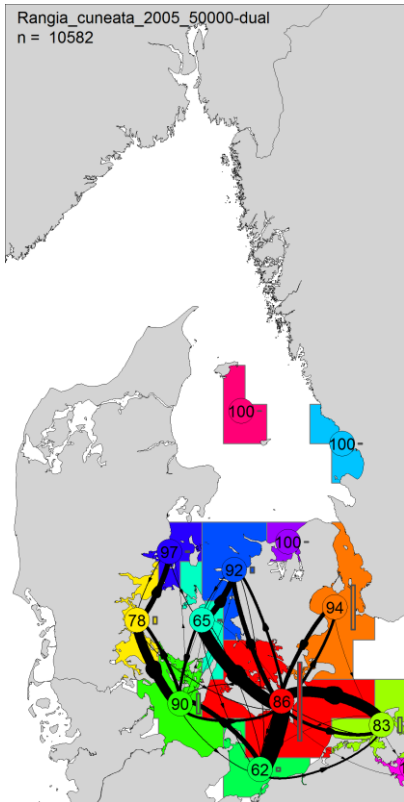
#### 22.1.1 200 000 agents



### 22.1.2 200 000 agents (0-15 m)

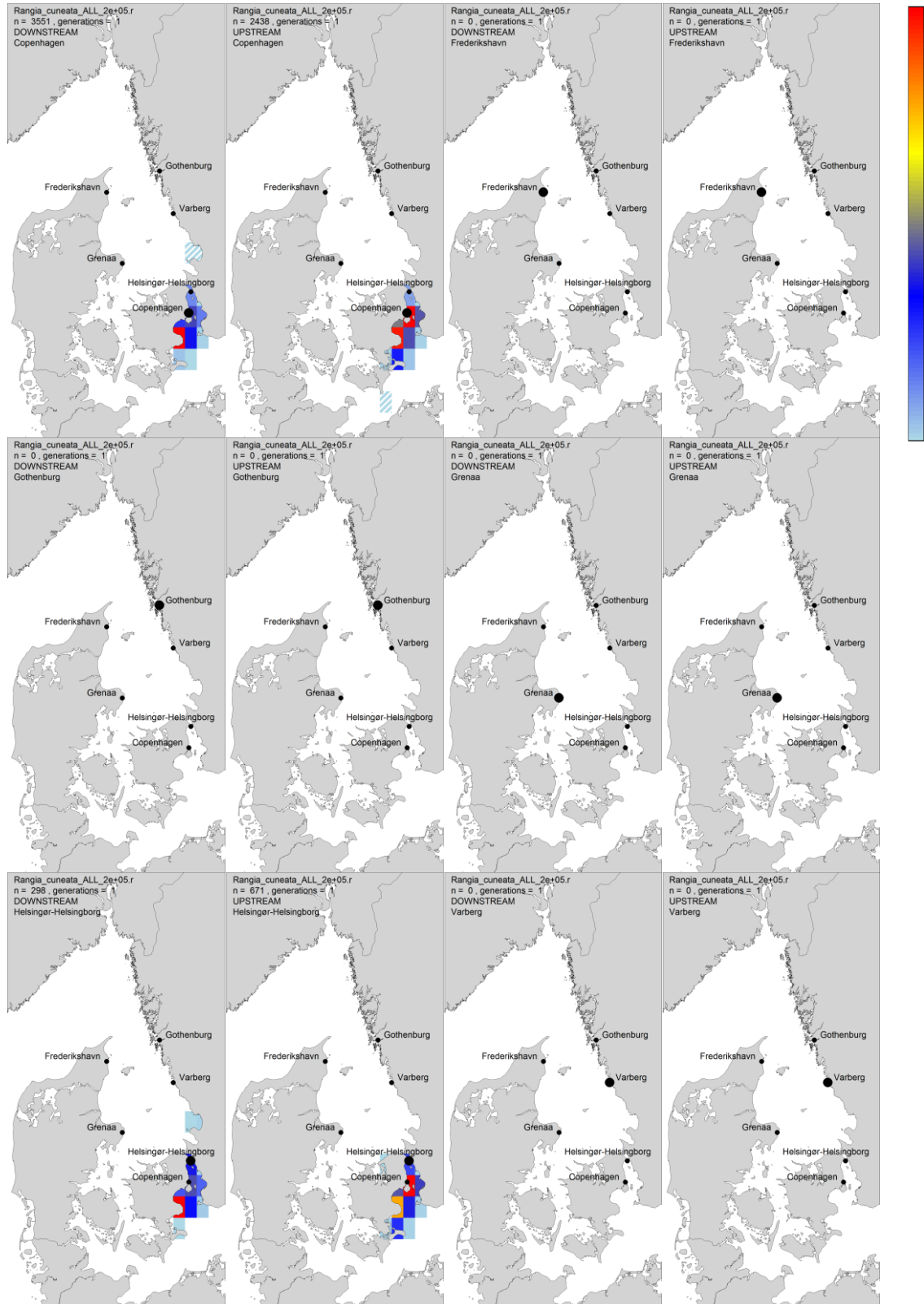


### 22.1.3 50 000 agents



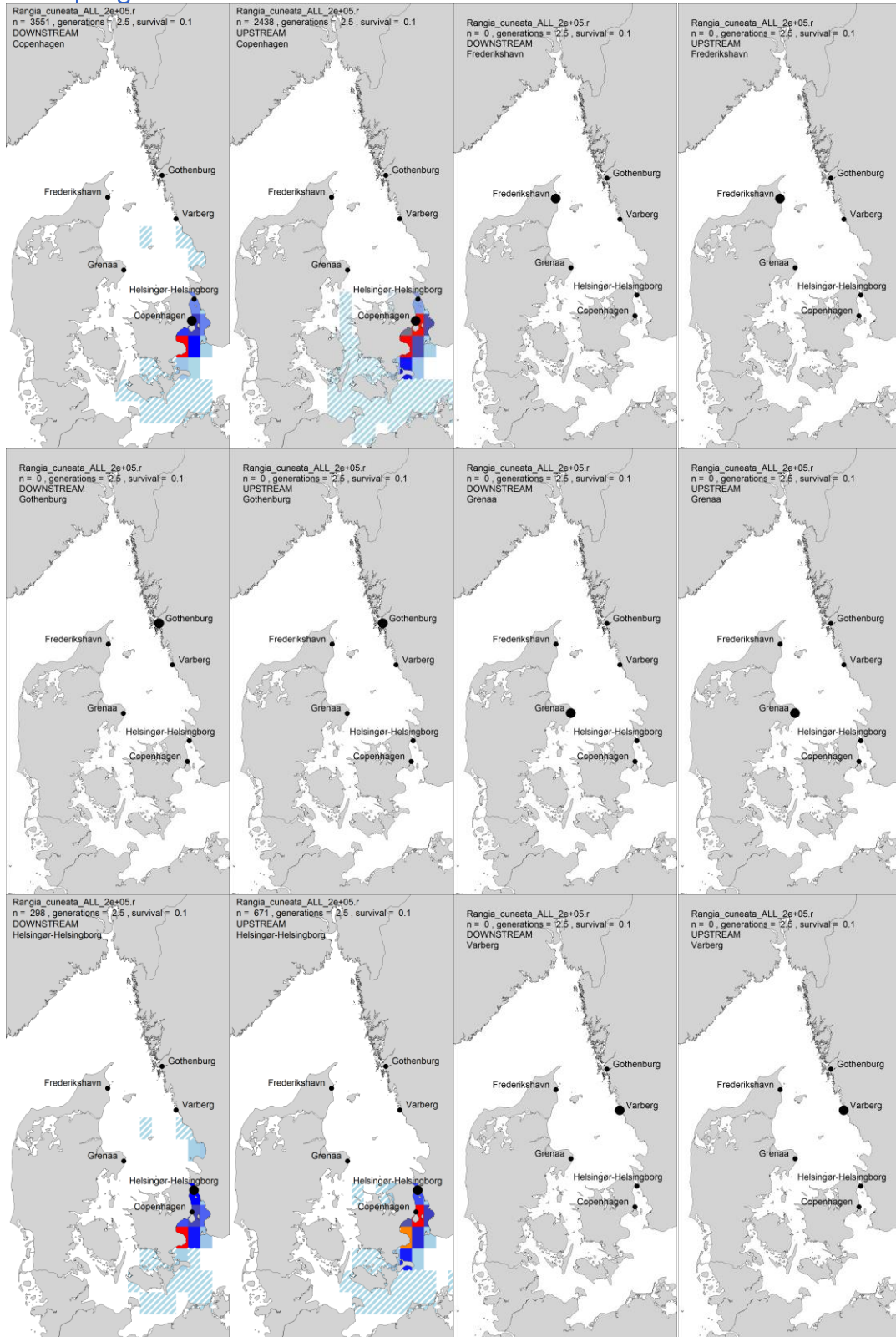
## 22.2 Dispersal probability plots

### 22.2.1 Single generation





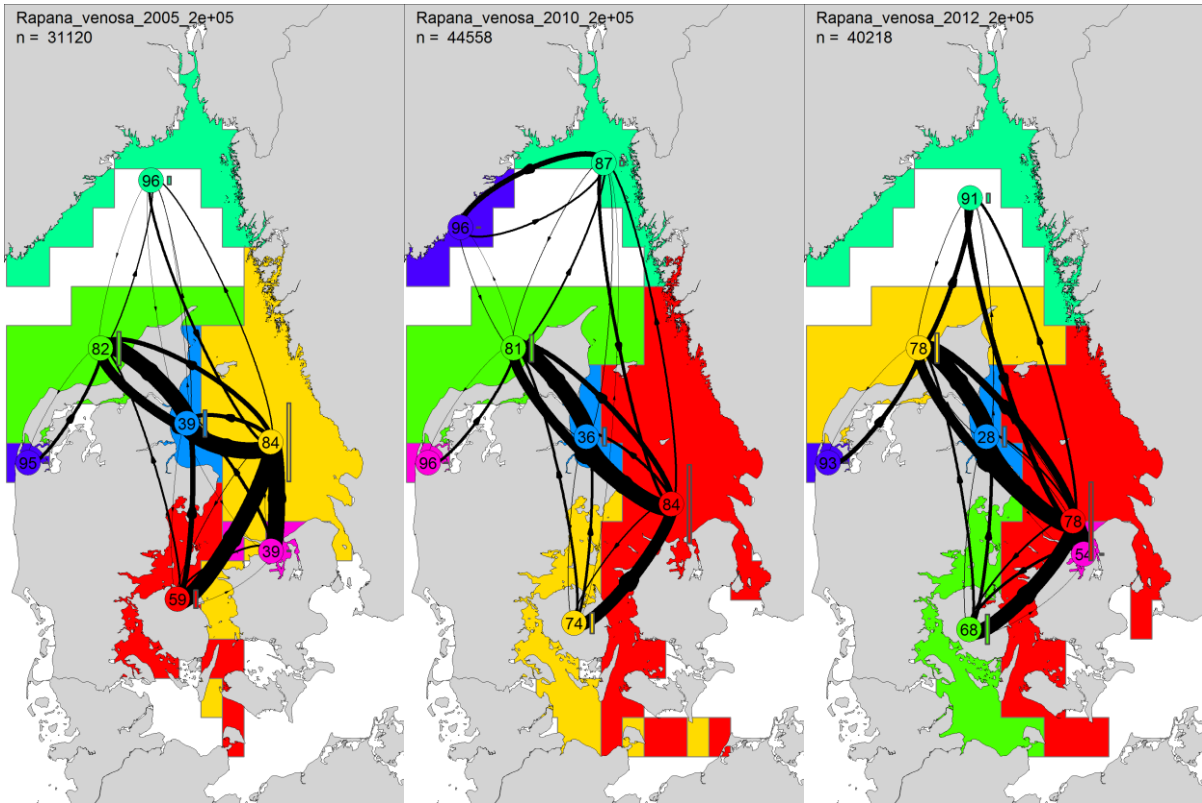
## 22.2.2 Multiple generations



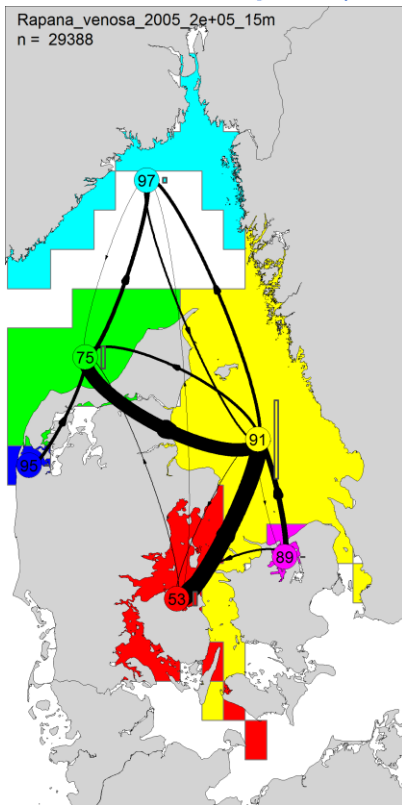
# 23 Rapana venosa

## 23.1 Hydrographic regions

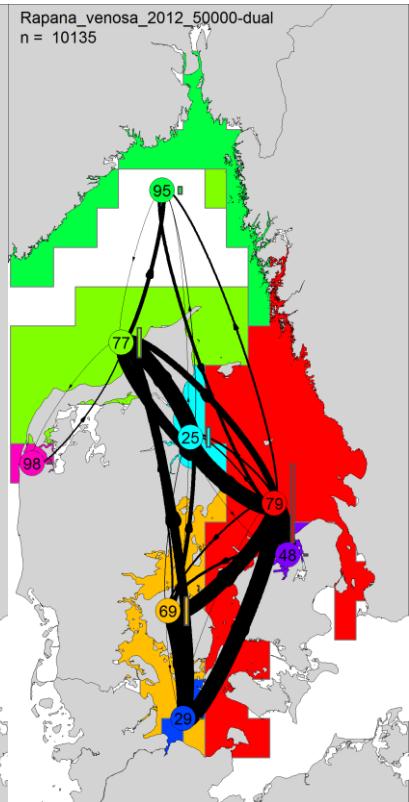
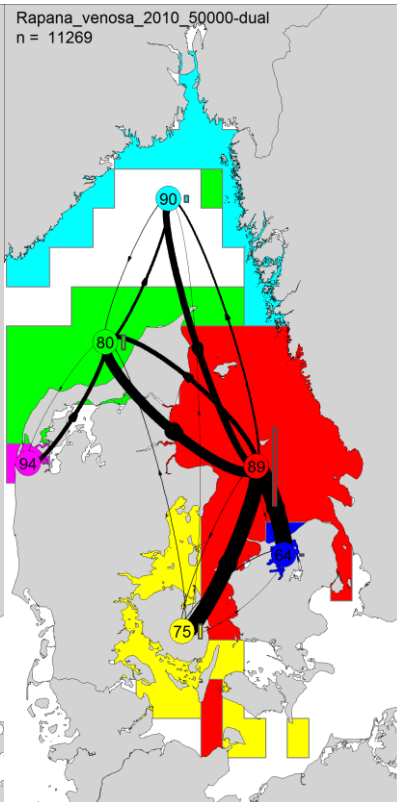
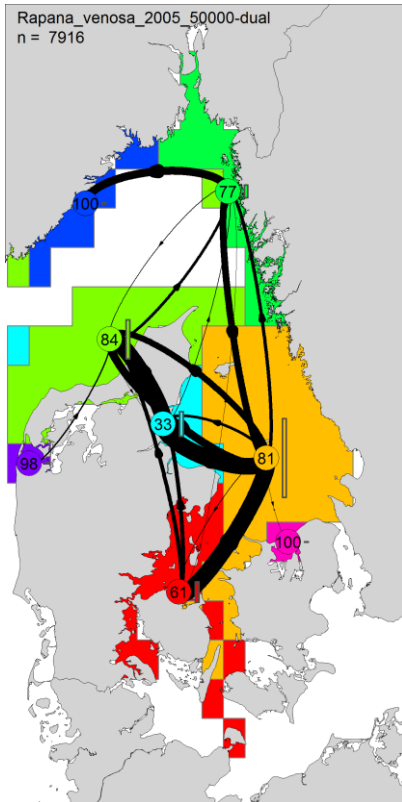
### 23.1.1 200 000 agents



### 23.1.2 200 000 agents (0-15 m)

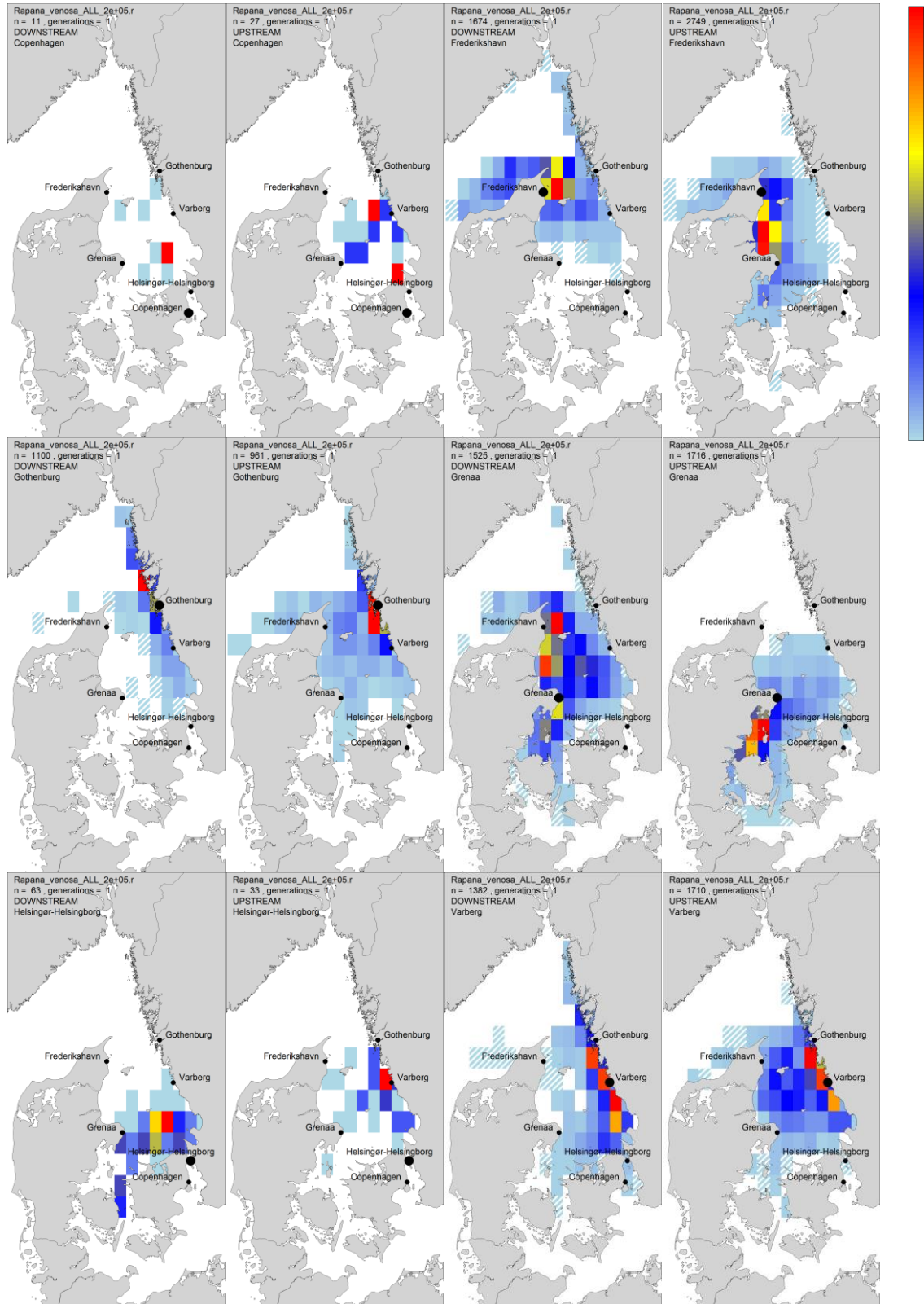


### 23.1.3 50 000 agents

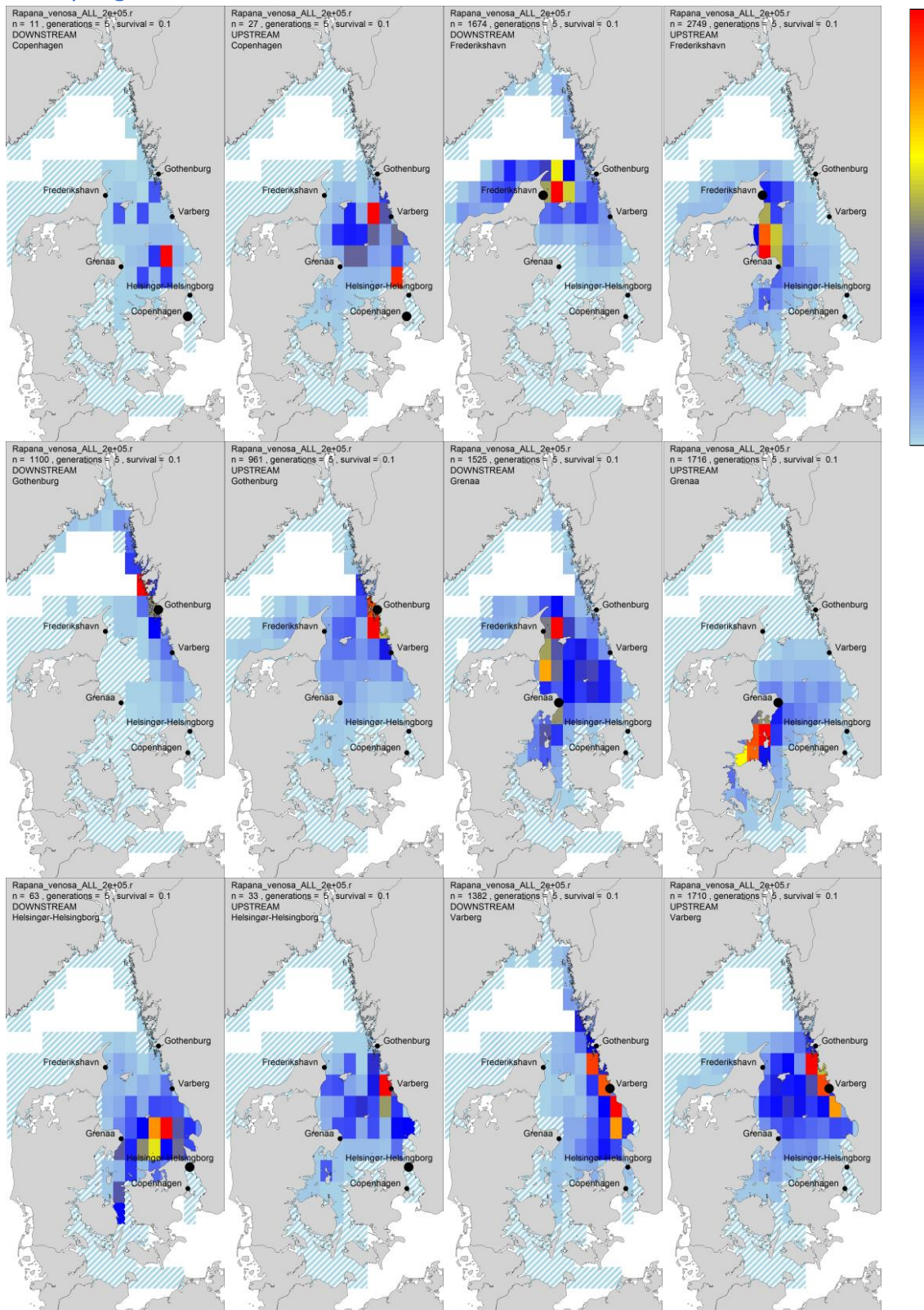


## 23.2 Dispersal probability plots

### 23.2.1 Single generation



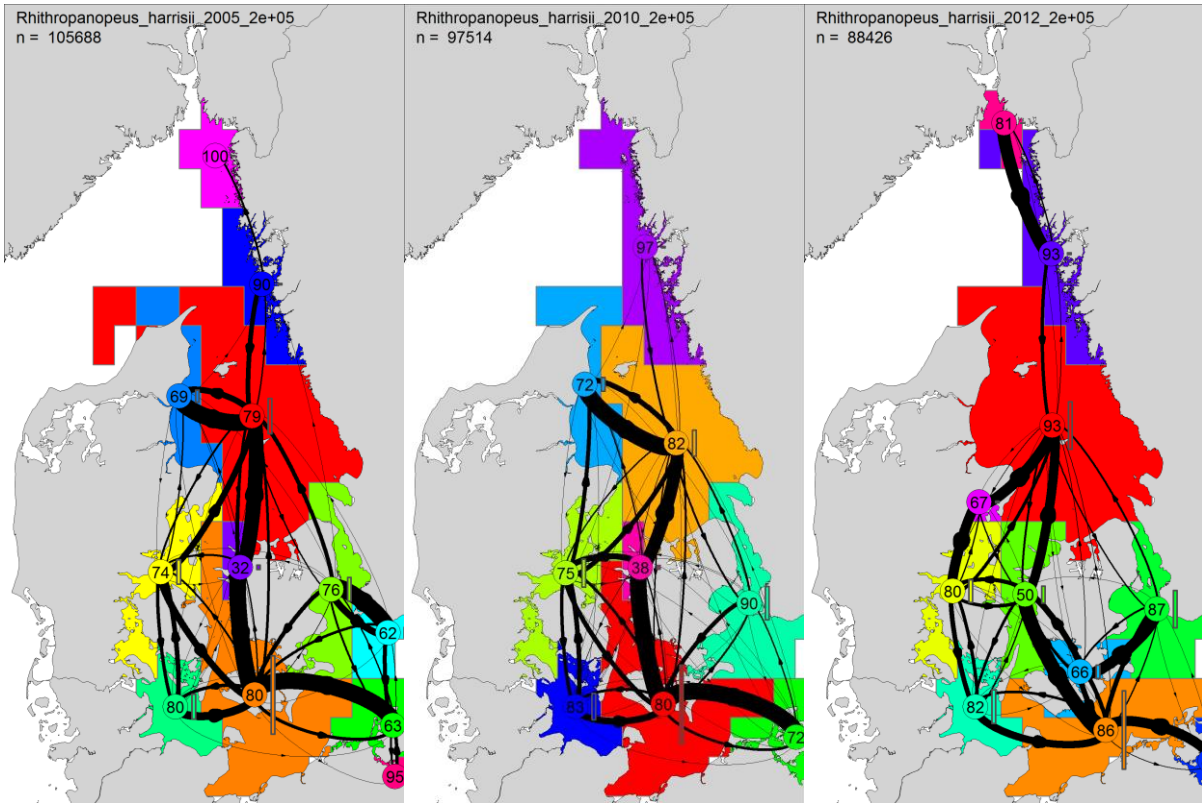
### 23.2.2 Multiple generations



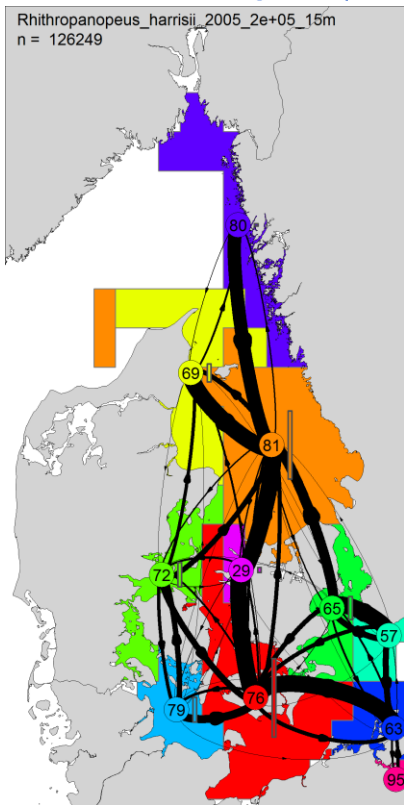
# 24 Rhithropanopeus harrisii

## 24.1 Hydrographic regions

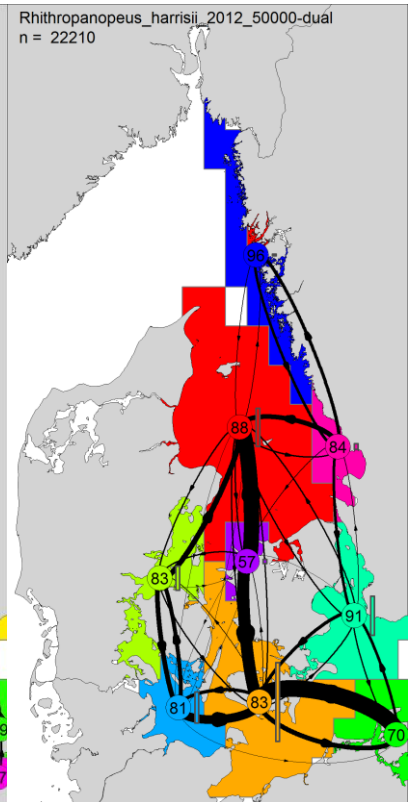
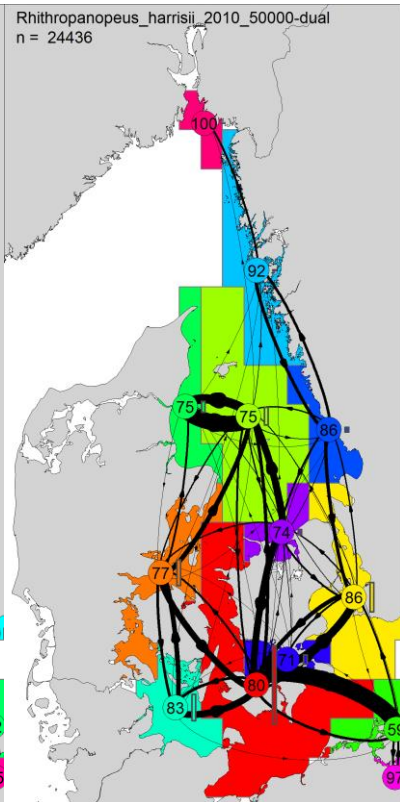
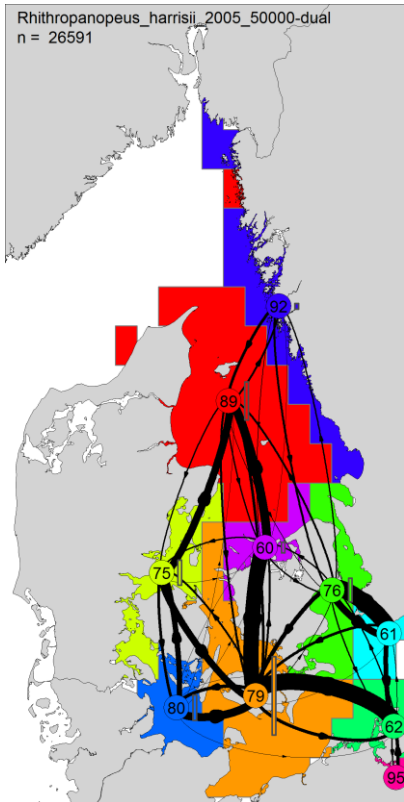
### 24.1.1 200 000 agents



### 24.1.2 200 000 agents (0-15 m)

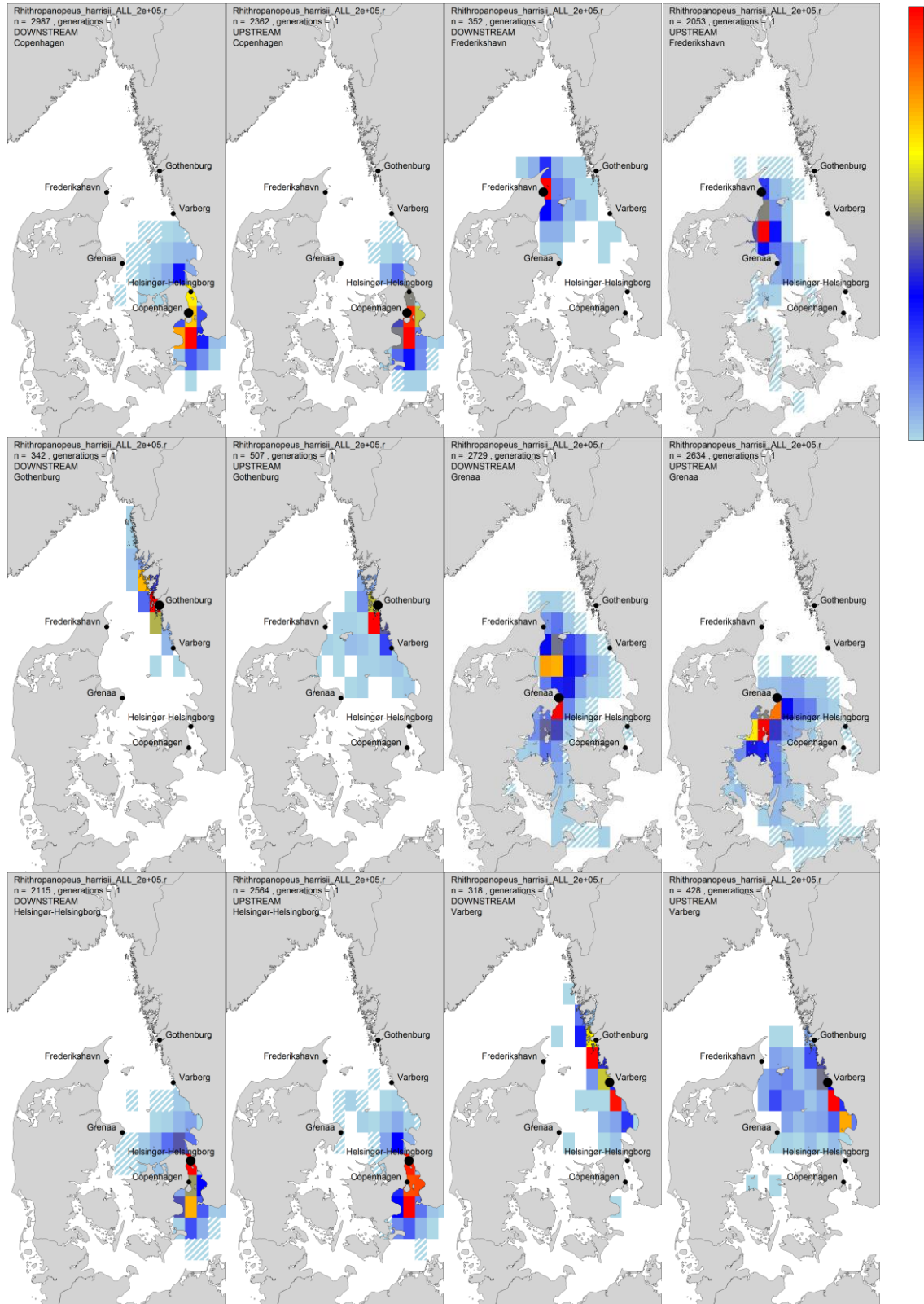


### 24.1.3 50 000 agents



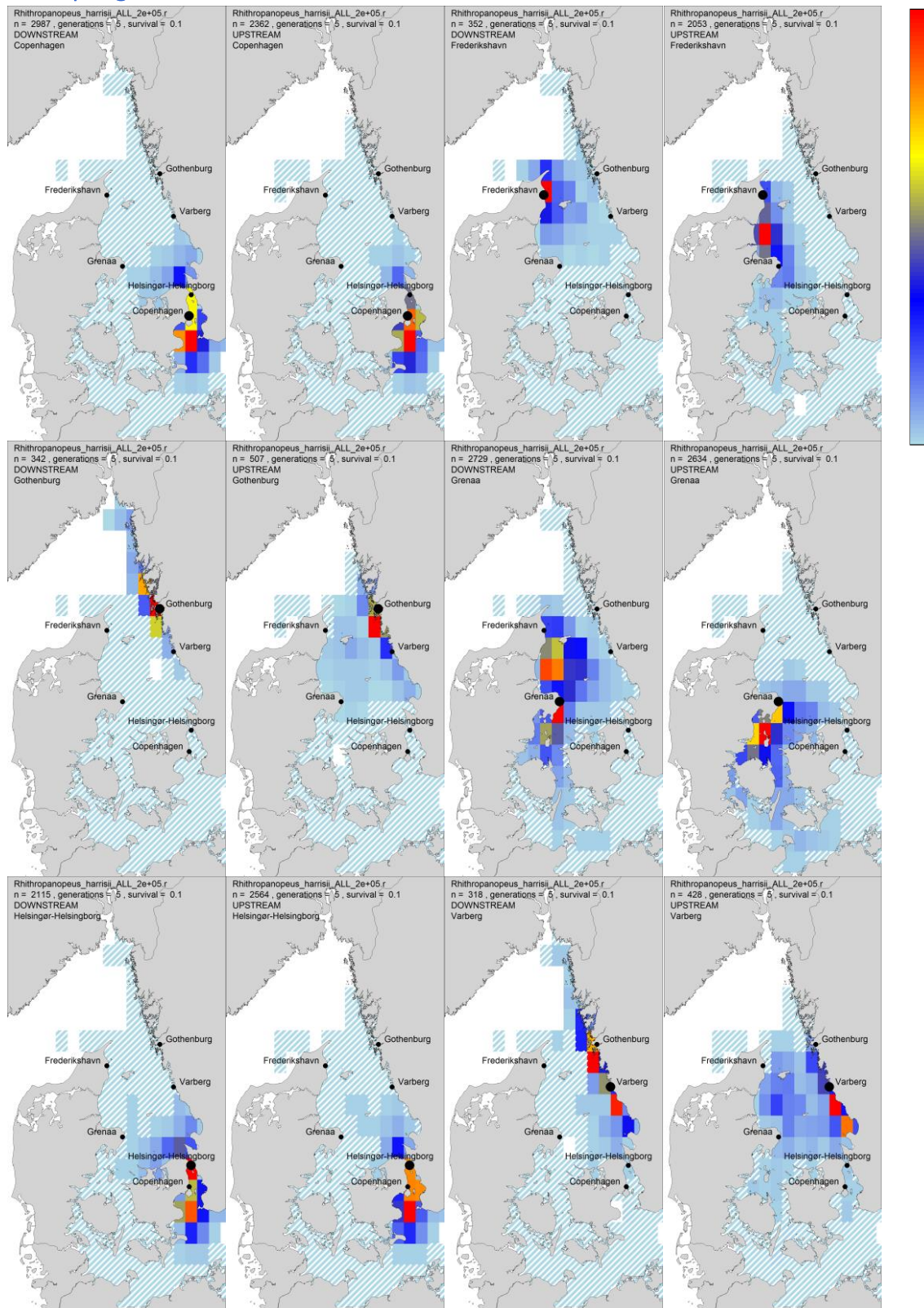
## 24.2 Dispersal probability plots

### 24.2.1 Single generation





## 24.2.2 Multiple generations



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