Testing of induced dispersal as an HPAI mitigation measure

- Beneficial?
  - At population, metapopulation scale?
  - Significant additional risk of epidemic spread ?
- When to proceed?
- The best adapted species?
  - Model sensitivity analysis
  - Known parameters for this species?

Objectives :

- Building a stochastic model (Continuous time Markov chain) :

  Giving epidemiological, demographical and mobility parameters, the model provides the number of survived adults and nestling (response variables)

- Sensitivity analysis:

  Hierarchize parameters according to their contribution to measurement performance

- Bibliographic research to identify potential species
- Adapt the model to these species

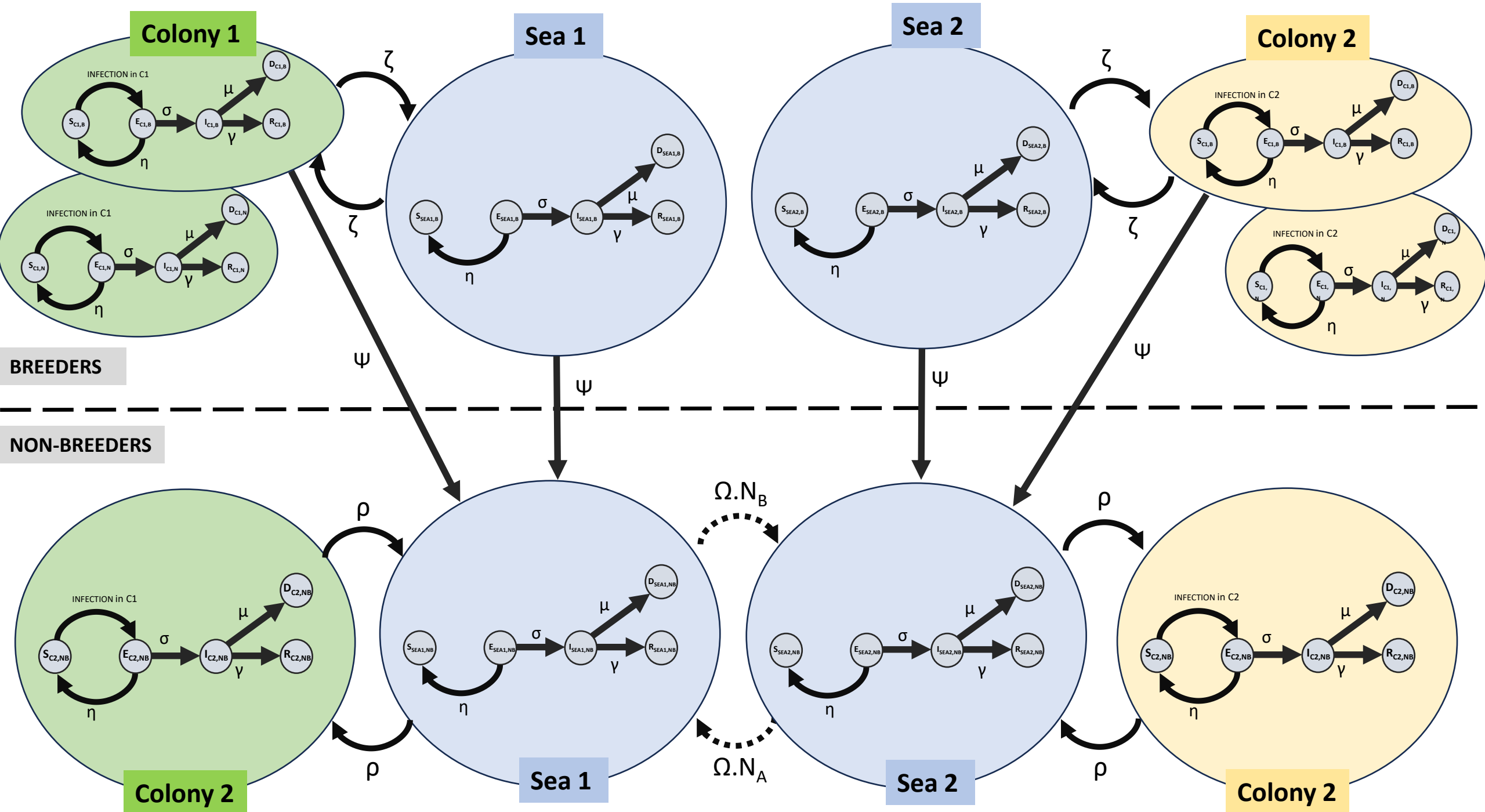
Status:

- Epidemiological status:
  - Susceptible (S)
  - Exposed (E)
  - Infectious (I)
  - Recovered (R)
  - Dead (D)
- Reproductive status:
  - Breeder (B)
  - Nestling (N)
  - Non-Breeder (NB)
- Localisation:
  - Colony 1 (C1)
  - Colony 2 (C2)

For example, an individual infectipous, non-breeder and associated to the colony 2 is noted as « $I_{\mathbf{C2,NB}}$ »

Parameters:

- β_E : Transmission rate from exposed individuals
- β_I Transmission rate from infectious individuals
- η : Rate of progression from infectious to exposed
- σ : Rate of progression from exposed to infectious
- γ : Recovery rate
- μ : Disease-related mortality rate
- ζ : Movement between colony and sea for breeders
- Ψ : Transition from breeder to non-breeder (reproductive failure)
- ρ : Movement between colony and sea for non-breeders
- Ω : Transition from one colony to another (prospecting)


Colony 1
Sea 1
Sea 2
Colony 2
INFECTION in C1
INFECTION in C2
BREEDERS
NON-BREEDERS
ζ
ψ
ρ
Ω.N_B
Ω.N_A
σ
μ
γ
η

Rates of infection:

- In colonie 1:

$$\beta_E.E_{C1,B} + \beta_E.I_{C1,B} + \beta_E.E_{C1,N} + \beta_E.I_{C1,N} + \beta_E.E_{C1,NB} + \beta_E.I_{C1,NB}$$

- In colonie 2:

$$\beta_E.E_{C2,B} + \beta_E.I_{C2,B} + \beta_E.E_{C2,N} + \beta_E.I_{C2,N} + \beta_E.E_{C2,NB} + \beta_E.I_{C2,NB}$$

Special events:

- Induced Dispersal:

  Two days after the first death, all breeders in colony 1 become non-breeders.

- The emergence of Nestlings:

  At a fixed date, a number of nestlings equal to the number of breeders alive appears for each colony.

Combined event:

- Each time the reproduction fails, two breeders become non-breeders and one nestling dies
- Death of a nestling => two breeders become non-breeders
- Death of an adult => one breeder becomes non-breeder and one chick dies

- Scenario:
  - 0 : No initial infected breeder and no induced dispersal
  - 1 : **One initial infected breeder** and no induced dispersal
  - 2 : **One initial infected breeder** and **induced dispersal**
  - 3 : No initial infected breeder and **induced dispersal**

- Model output:
  - Number of surviving adults
  - Number of surviving nestlings