The COEXIST project, some lessons learned on MSP with emphasis on aquaculture management

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Coastal zones – competing claims

- ✓ Aquaculture – increased pressure
  - ✓ Increasing globally
  - ✓ NOT increasing in the EU
- ✓ Fisheries – stagnant at best
  - ✓ Conflicts with other users
- ✓ Tourism
  - ✓ Conflicts with other users
- ✓ Windfarms, wavefarms
  - ✓ Extreme growth potential
- ✓ Marine Protected Areas (MPA), conservation

Aquaculture

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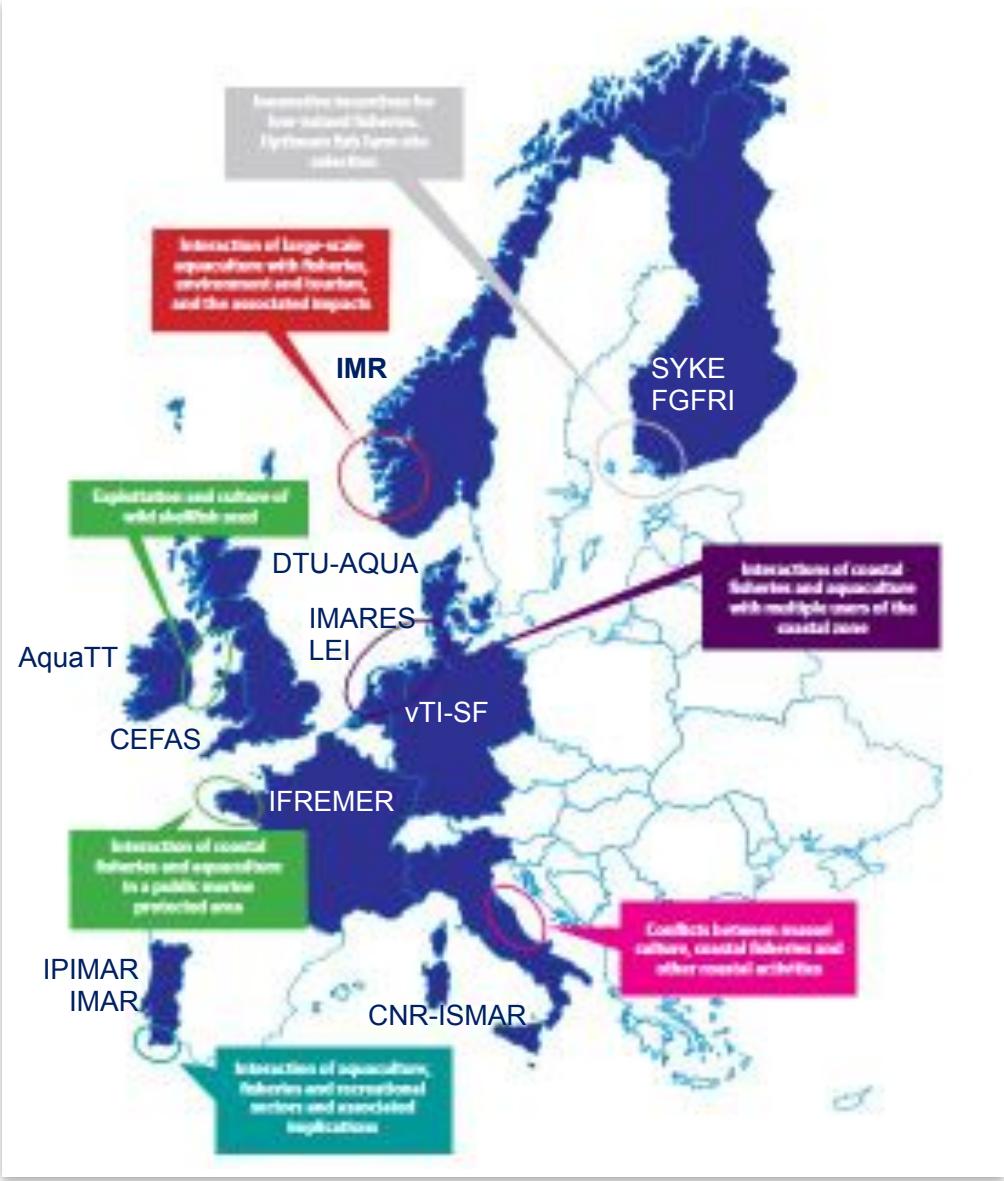
Fisheries

Energy, Transport,
Tourism,
Environment, etc.

Consortium and Case Studies

1. HARDANGERFJORD – LP:IMR
2. ATLANTIC SEA COAST - LP: UCC
3. ALGARVE COAST - LP: IPIMAR
4. ADRIATIC SEA COAST – LP: CNR-ISMAR
5. COASTAL NORTH SEA – LP: vTI-SF
6. BALTIC SEA – LP: FGFRI



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Multi-Criteria Analysis - what is it?

Most MCAs incorporates the following steps:

- ✓ Define and structure the problem
- ✓ Identify relevant alternatives (possible solutions)
- ✓ Identify relevant objectives/ criteria (interests/ values/ aspects)
- ✓ Identify scores for each alternative
- ✓ Identify weights (preferences)
- ✓ Compare results
  - By looking at the MCA matrix, or
  - By aggregating with a suitable MCA techniques

Evaluation of spatial management tools

Objective: To **assess the existing spatial management** tools for each selected case study and propose improvements to those tools

Outcomes: Framework for multi-objective quantitative and qualitative evaluation of marine spatial management of coastal zones


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Deliverable D2.4

Framework for multi-objective quantitative and qualitative evaluation of marine spatial management in coastal zones

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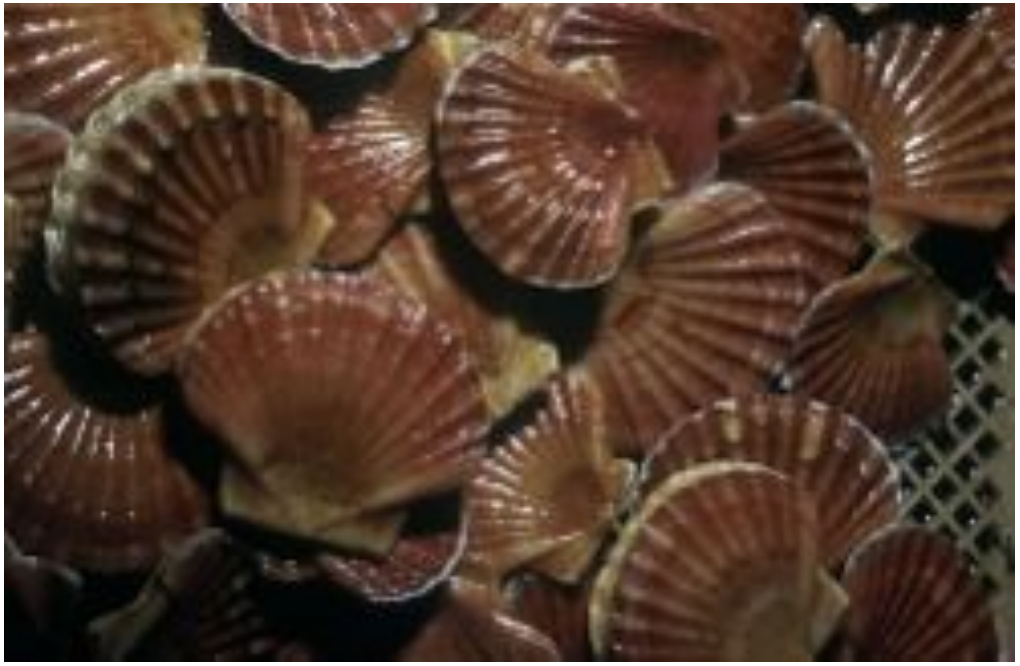
Aquaculture – impact on pathogens

Pathogen reservoirs in wild organisms -

Pathogens proliferates in aquaculture

Movement of cultured organisms: vectors for pathogens



Disease

- ✓ Most significant limiting factor in aquaculture
- ✓ Direct impact: mortality
- ✓ Pathogens can be amplified within farm, causing significant infection pressure towards wild stocks
- ✓ Aquaculture and coastal management practices influence the transmission and impact of pathogens

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We do know:

Diseases are an integral part of nature

Pathogens are subject to evolution, thus diseaes are, too

There is no such thing as a disease-free wild population

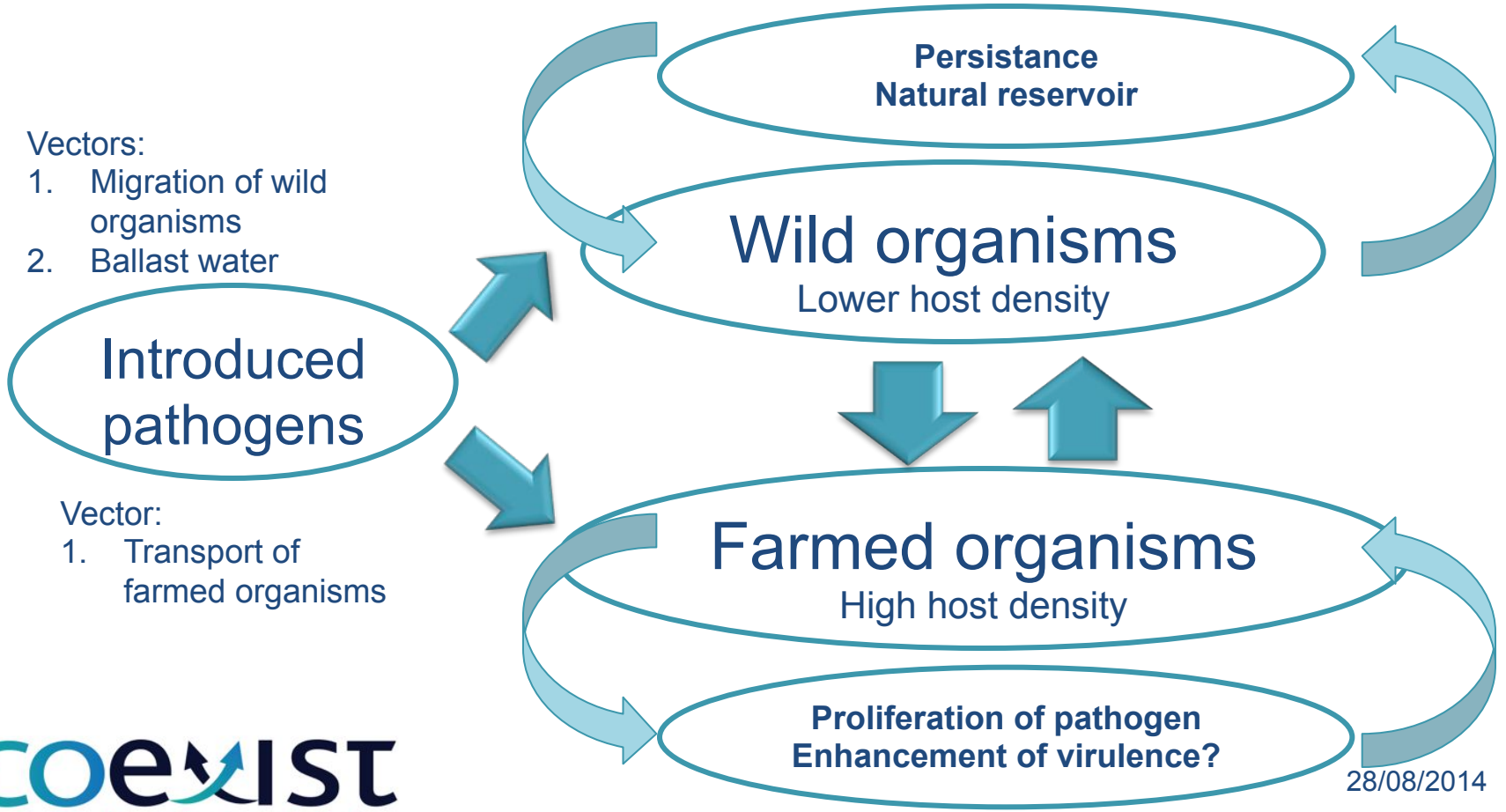
1. *Absence of pathogens: a situation only existing in an imaginary world of some environmental NGO´s.*
2. *Human behaviour affect proliferation and distribution of pathogens in the wild*

Lessons learned

- Knowledge based on experience
  - Often very expensive ”learning”
    - ✓Introductions of diseases.
    - ✓Uncontrolled proliferation of diseases
- Models learned from culture of other species
  - Adapt the models
    - ✓to the marine environment
    - ✓to bivalves

Exchange of pathogens wild-farmed

Integration of models and processes



Vectors:
1. Migration of wild organisms
2. Ballast water

Vector:
1. Transport of farmed organisms

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Compartment-based models:

Individuals transcend through a series of states

- ✓Susceptible
- ✓Infected
- ✓(potentially) back to susceptible

Maximum host carrying capacity – **critical threshold** N_t

- ✓= maximum number of susceptible individuals
- ✓ - total number of individuals is N

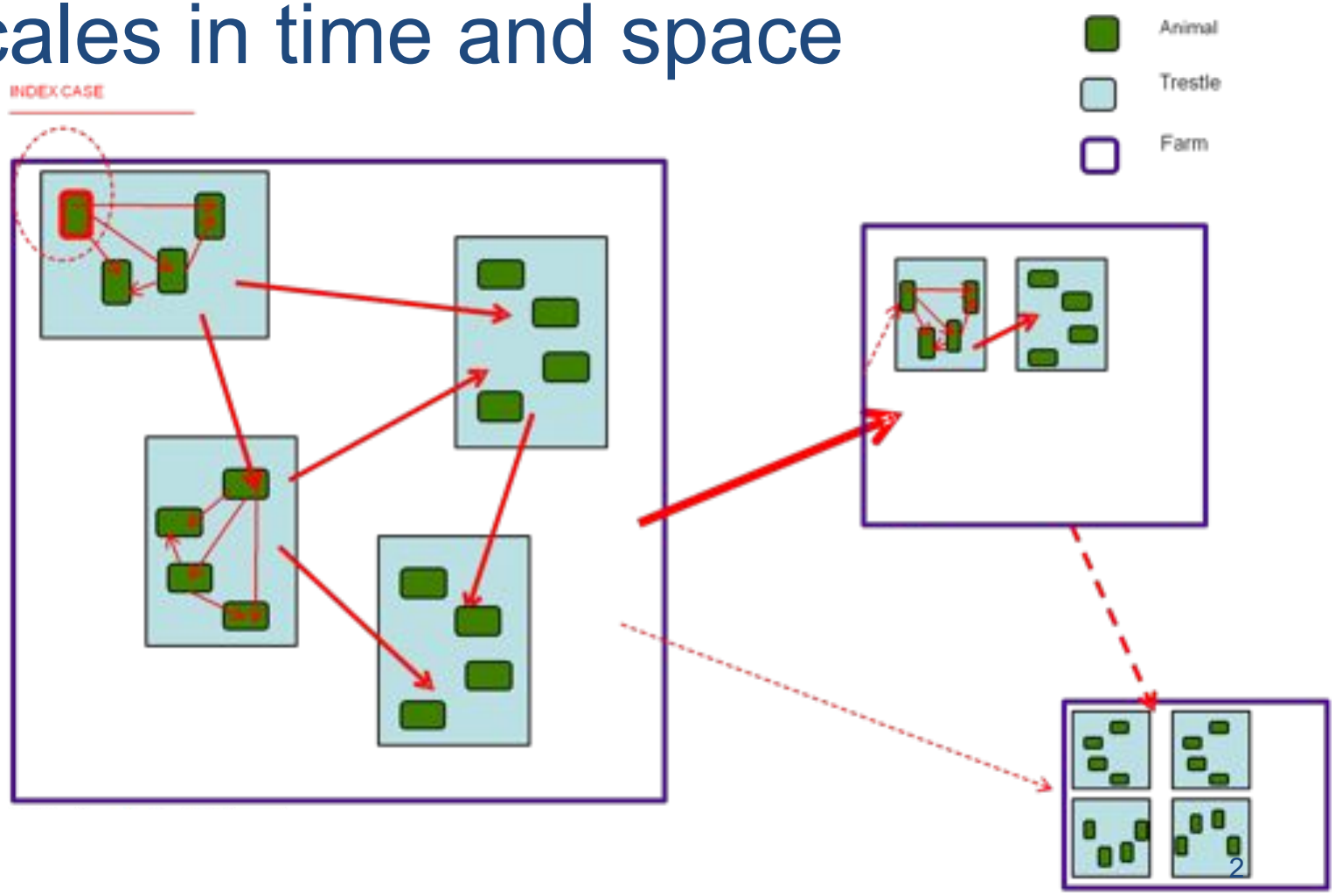
In aquaculture N_t/N can be **manipulated**

Network-based models

Take into account the **contacts between populations** that actually DO take place:

- ✓Movement of populatons
- ✓Movement of people
- ✓Movement of equipment
- ✓Movement of water
- ✓Movement of other vectors

Network models working at different scales in time and space



Examples of tools

- Distance between farms
- Maximum amount of animals per farm
- Maximum impact on environment
- Fallowing
- Restriction on movement of animals
- Restrictions on sources of juveniles
    - Specific-pathogen-free quality
    - Screening for pathogens

Impact from aquaculture 2012

Escapees – RED LIGHT

- Wild salmon stocks vulnerable

Salmon Louse – RED LIGHT

- Affecting wild trout and salmon

Pharmaceuticals – Yellow light

- Antibacterials: Green, Antiparacitics: RED

Eutrophication – green light

- Coastal current from Baltic dominates area

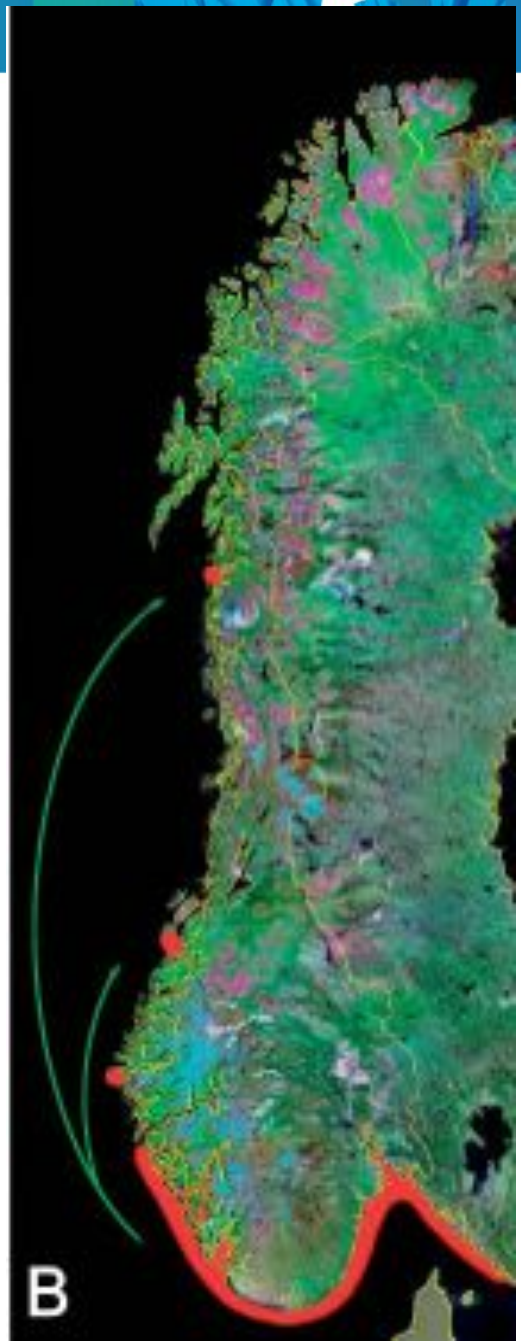
Other diseases – n.a., Shellfish n.a.

Why is disease linked to temperature?

- ✓ Diseases may define the geographical distribution of hosts
- ✓ Interaction between immune defence and certain pathogens
  - Well known in terrestrial systems
  - Complex coevolution parasite-host
  - Dynamic relationship in a changing environment

Pathogens defining habitats of their hosts?

Do *Francisella noatunensis* take part in defining the southern borders of the habitat of Atlantic cod?



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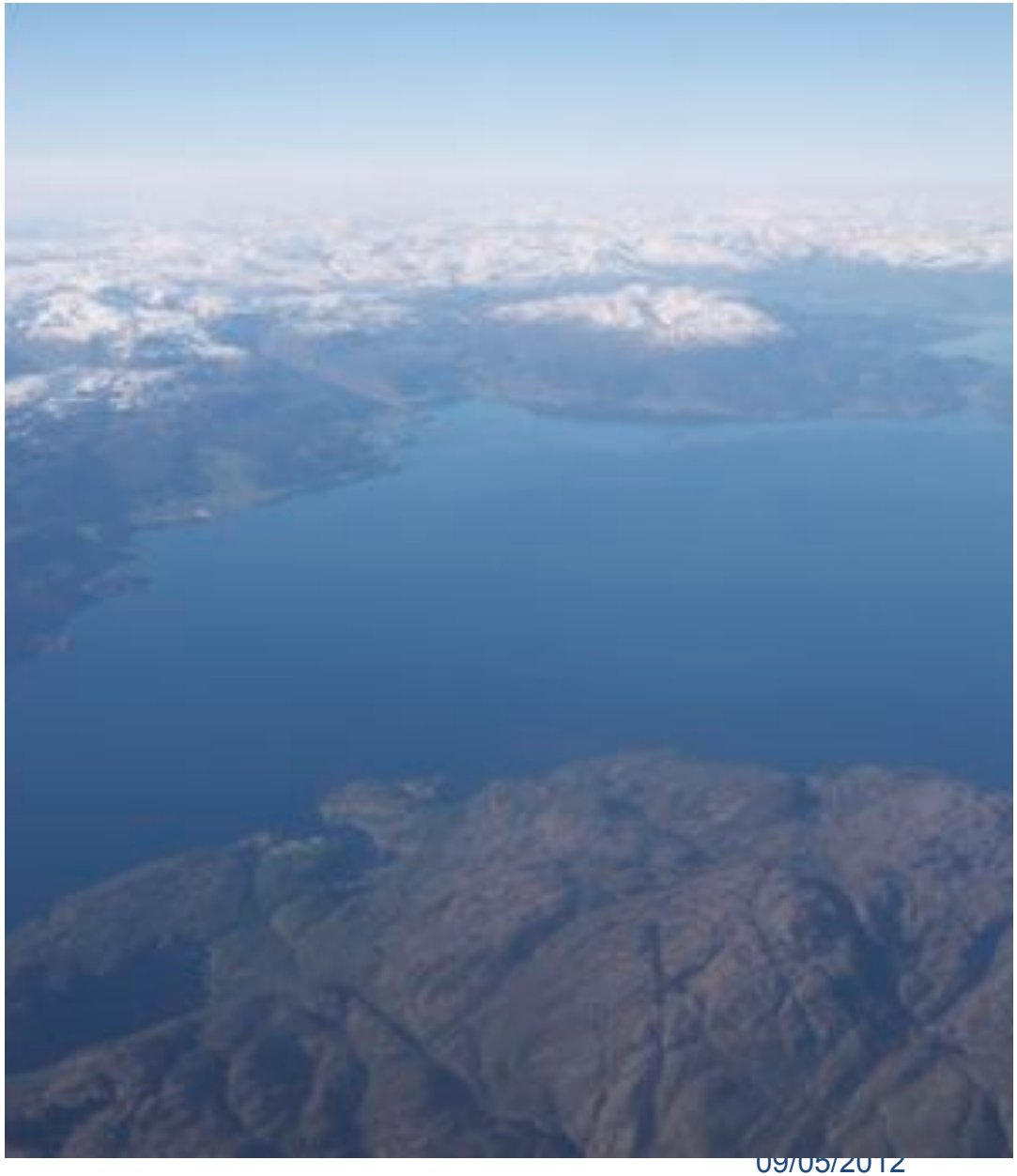
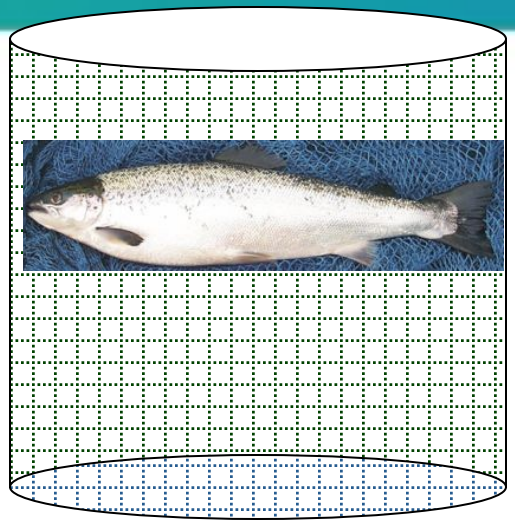


Interaction in coastal waters

Salmon/rainbow trout:
n=300 000 000
Wild salmon/sea trout
n=1,5-2 000 000

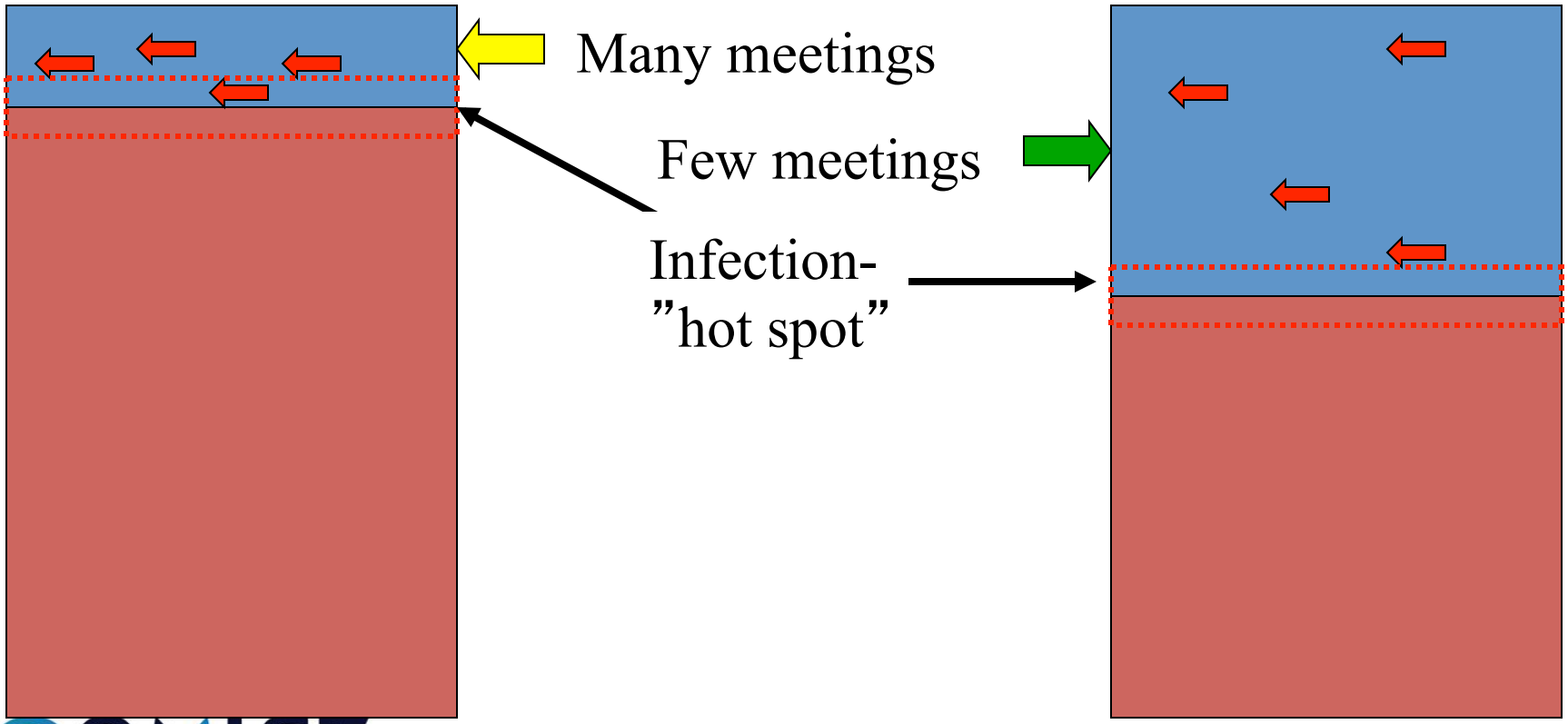


0.5 lice/fish

150 000 000 lice

20 000 000 lice

Hydrodynamic models: the amount of freshwater in a fjord has impact on the frequency of salmon-lice contact



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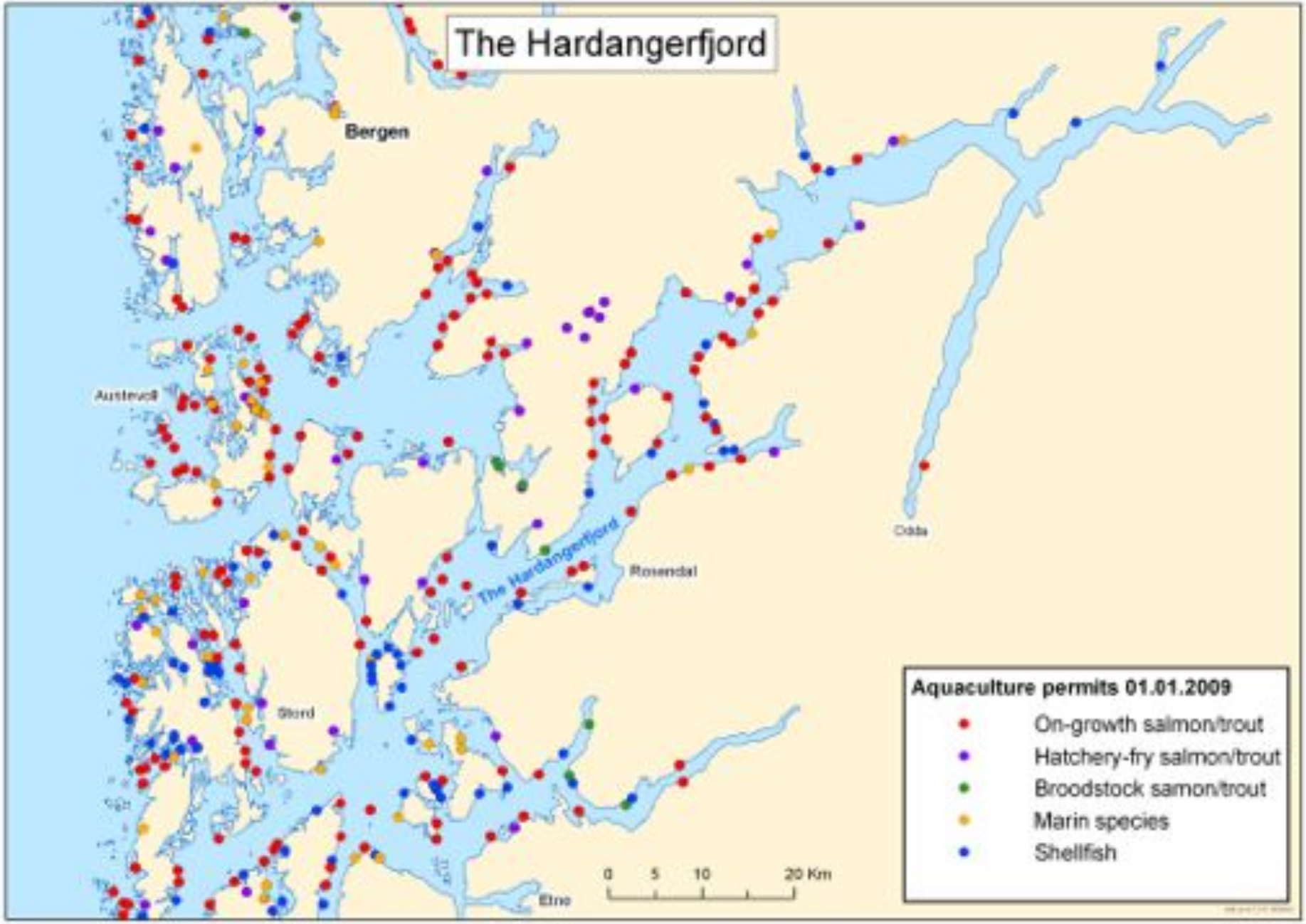
The Hardangerfjord
Bergen
Austevoll
Stord
Etne
Rosendal
Odda
The Hardangerfjord
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Aquaculture permits 01.01.2009
On-growth salmon/trout
Hatchery-fry salmon/trout
Broodstock salmon/trout
Marin species
Shellfish

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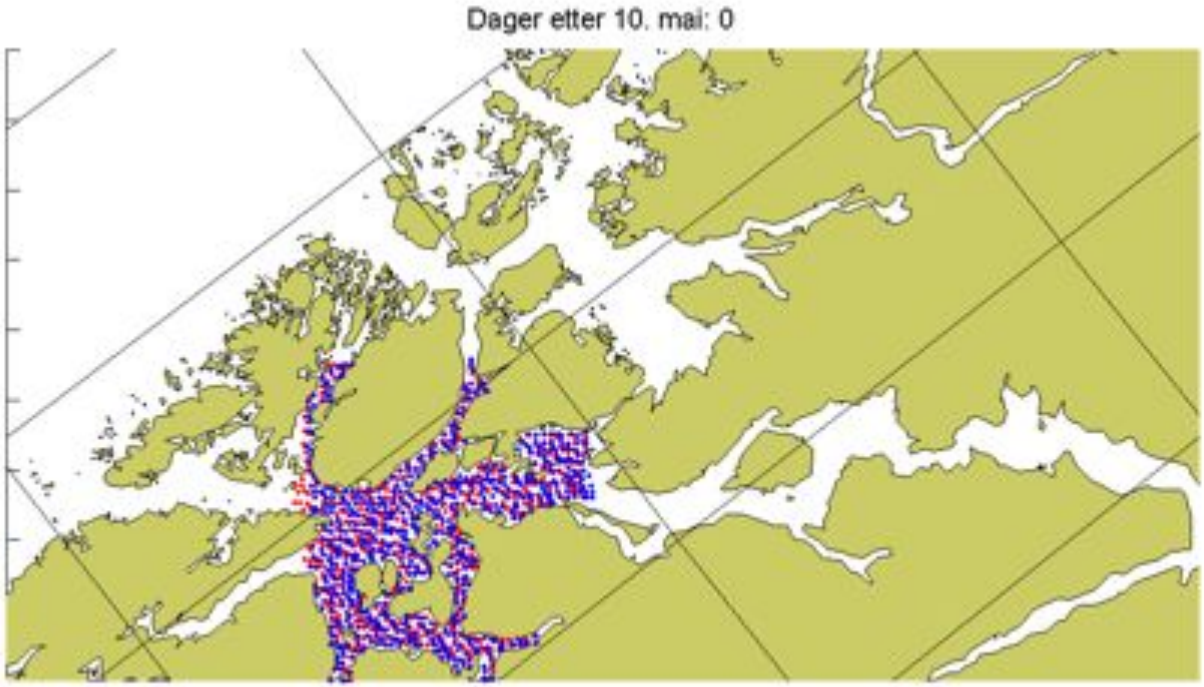
- 2003



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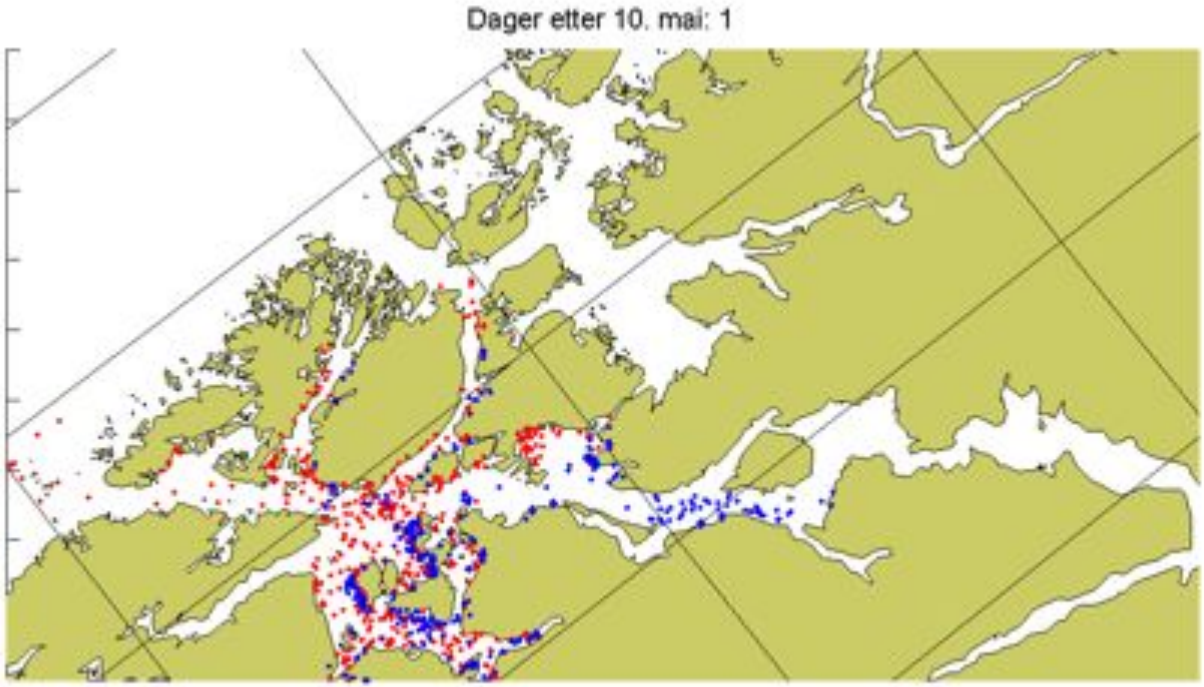

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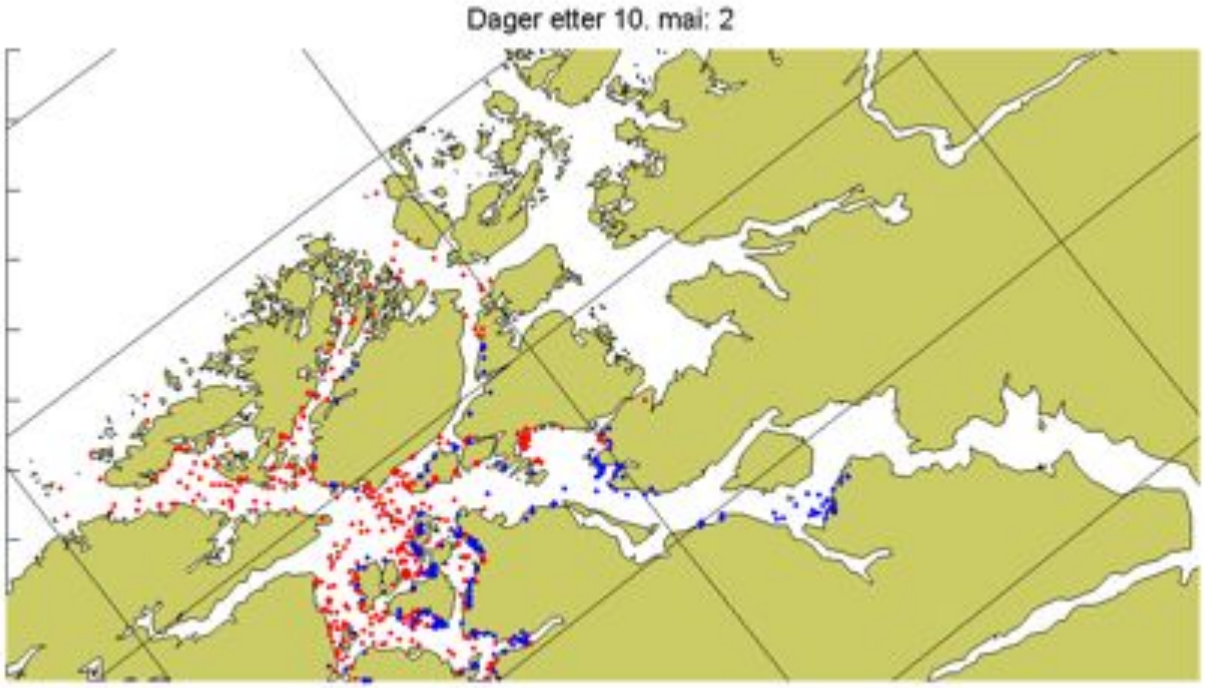

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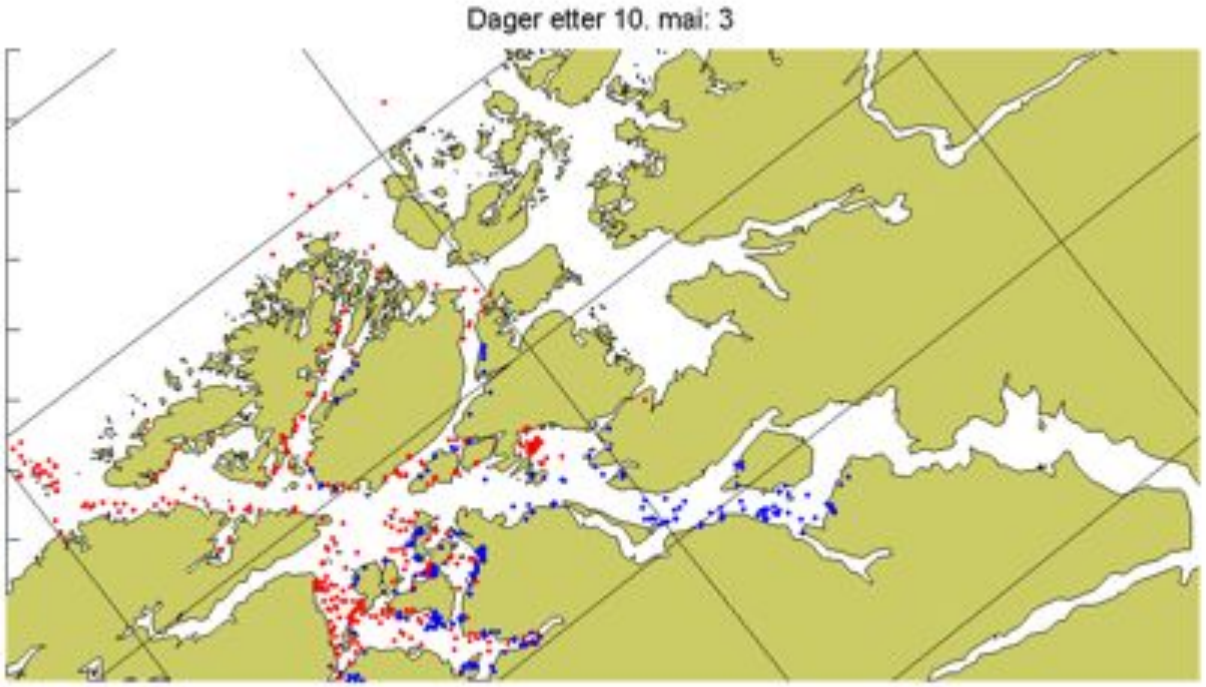

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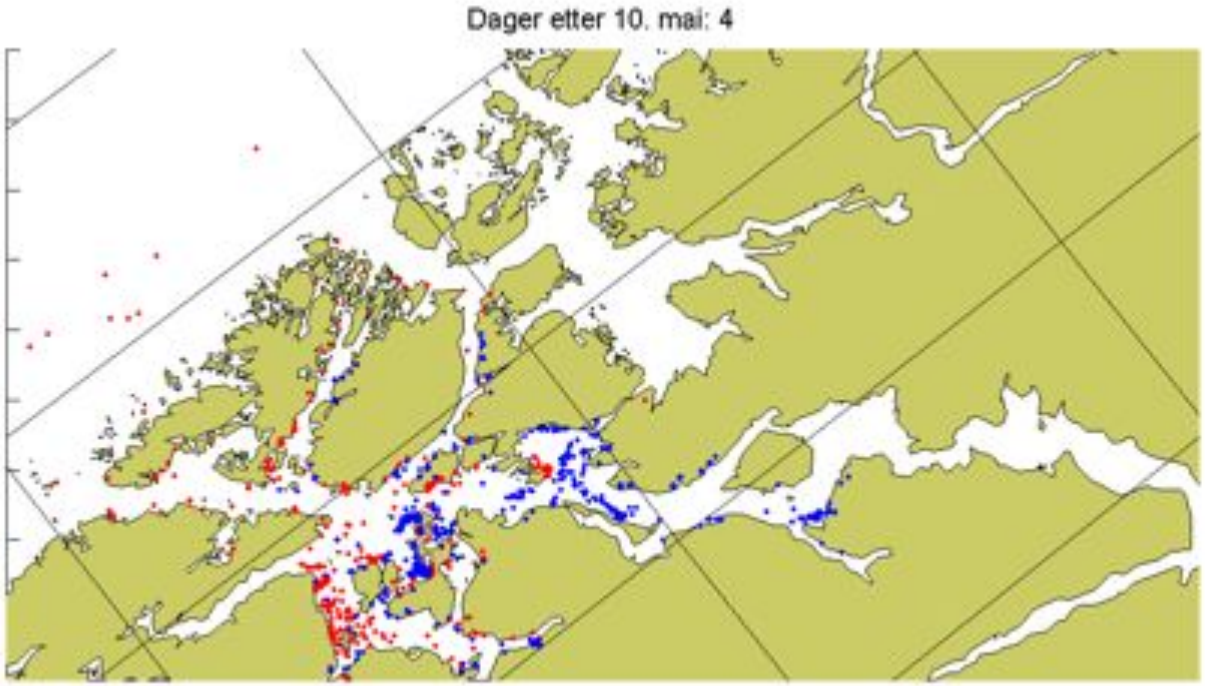

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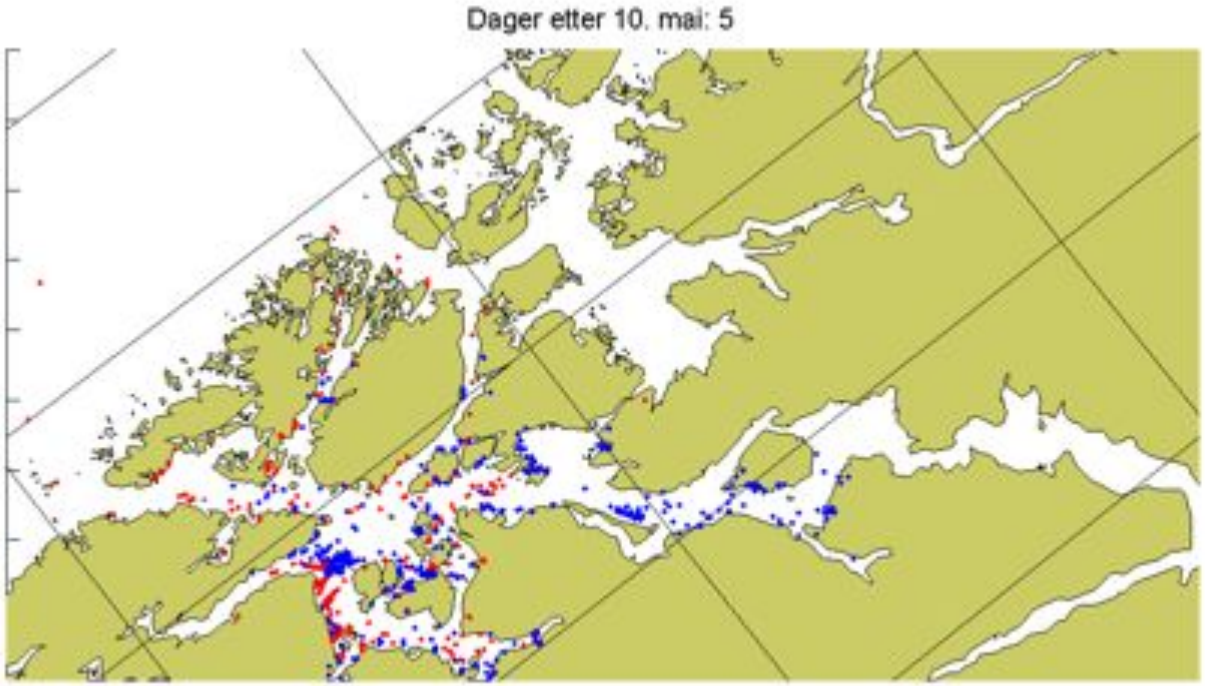

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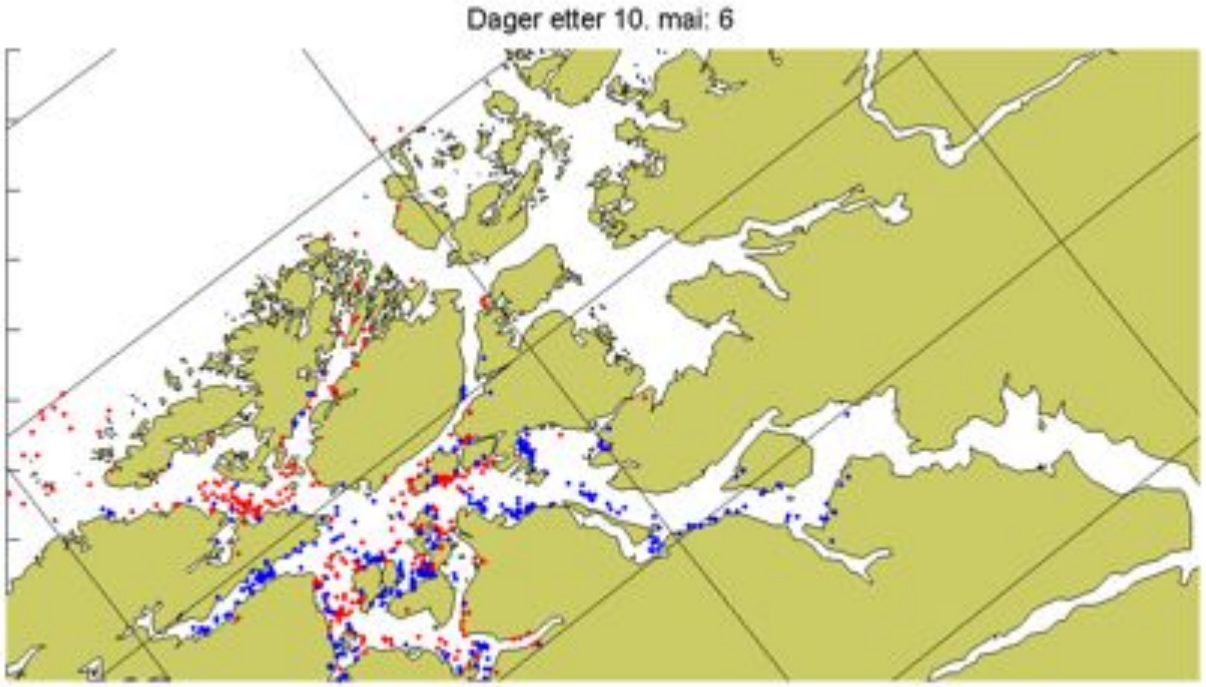

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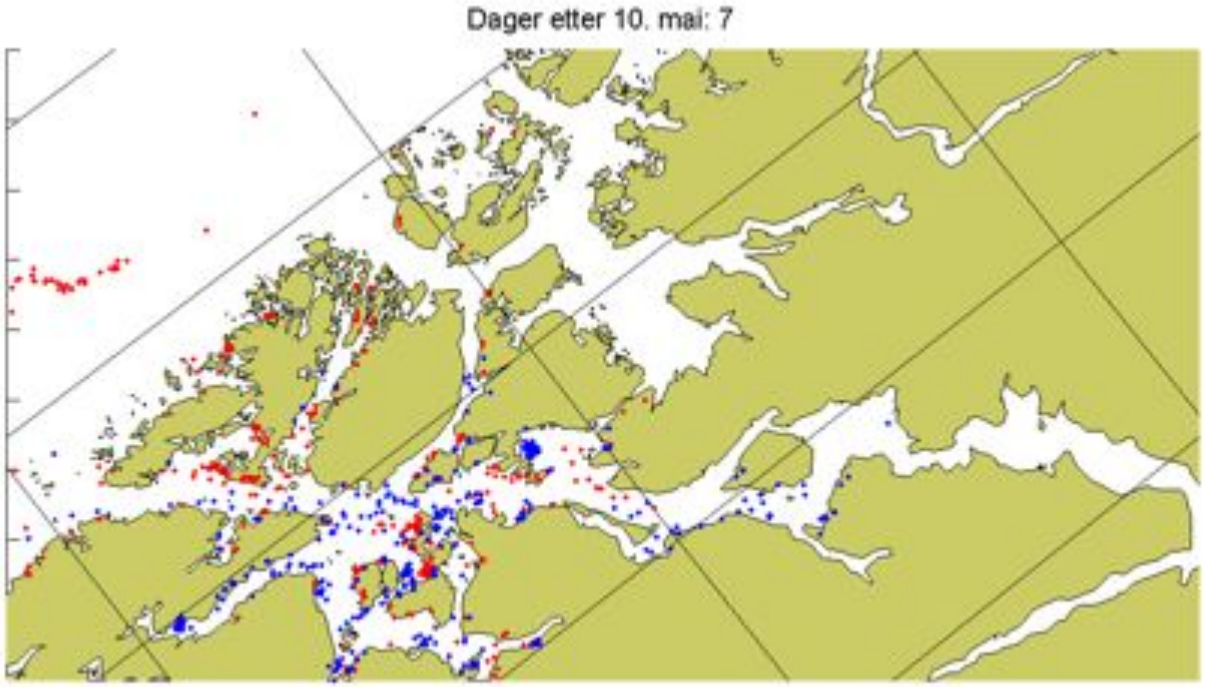

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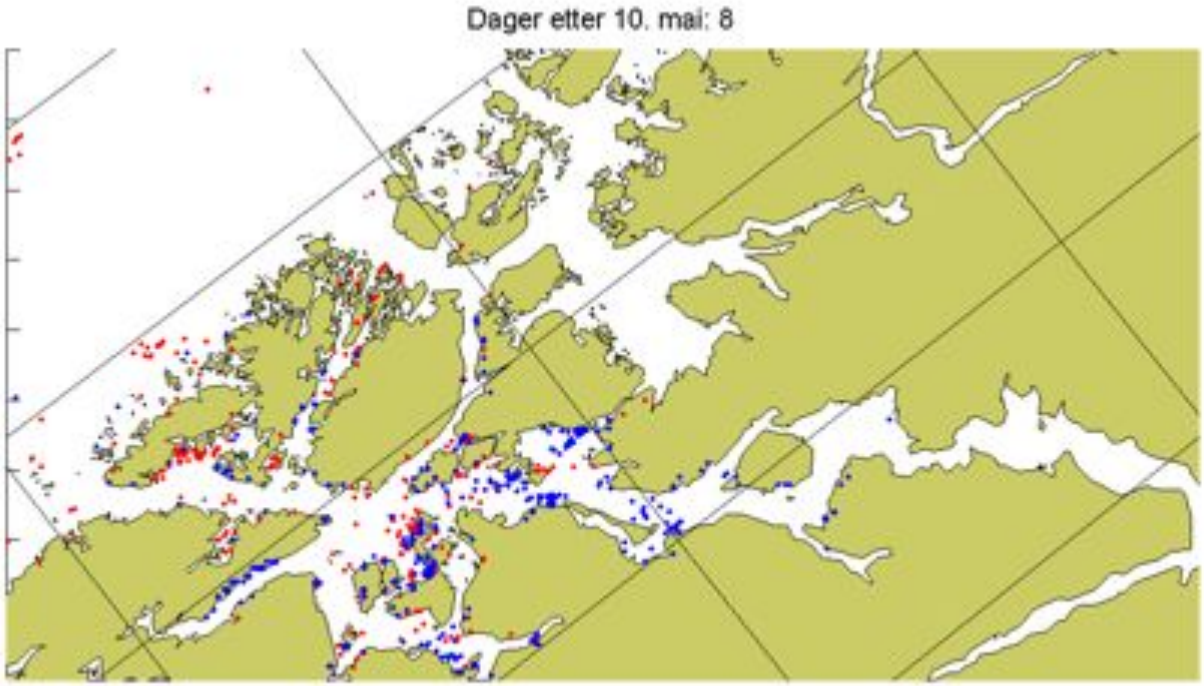

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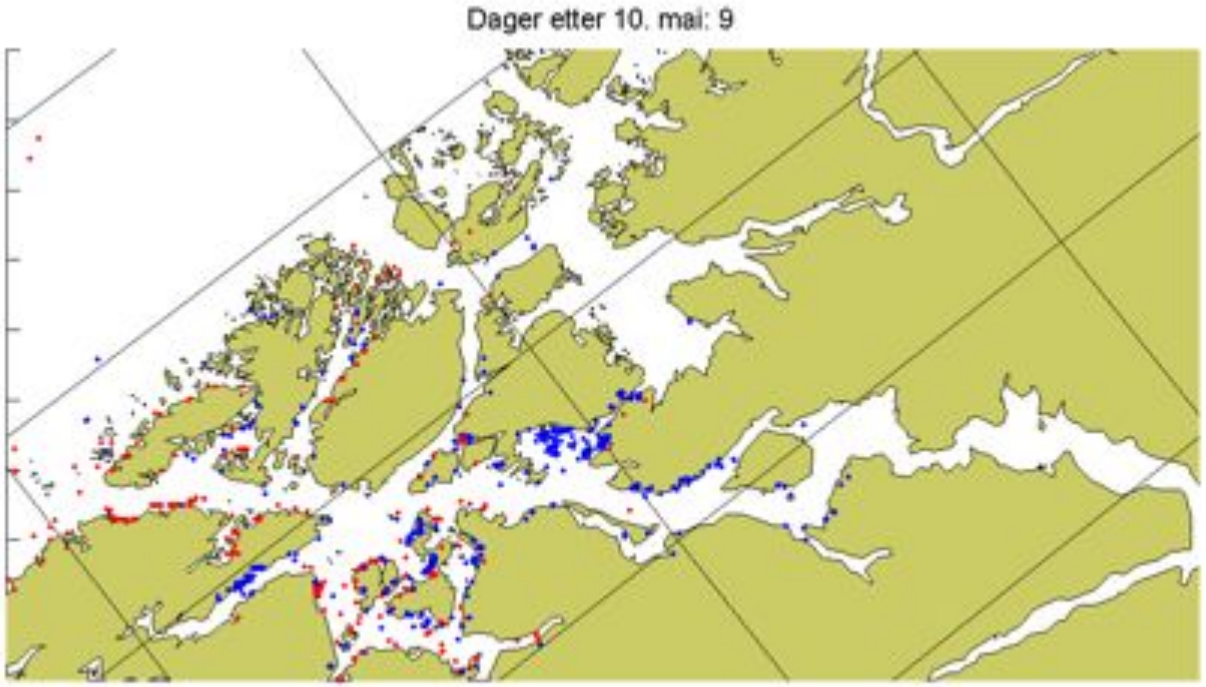

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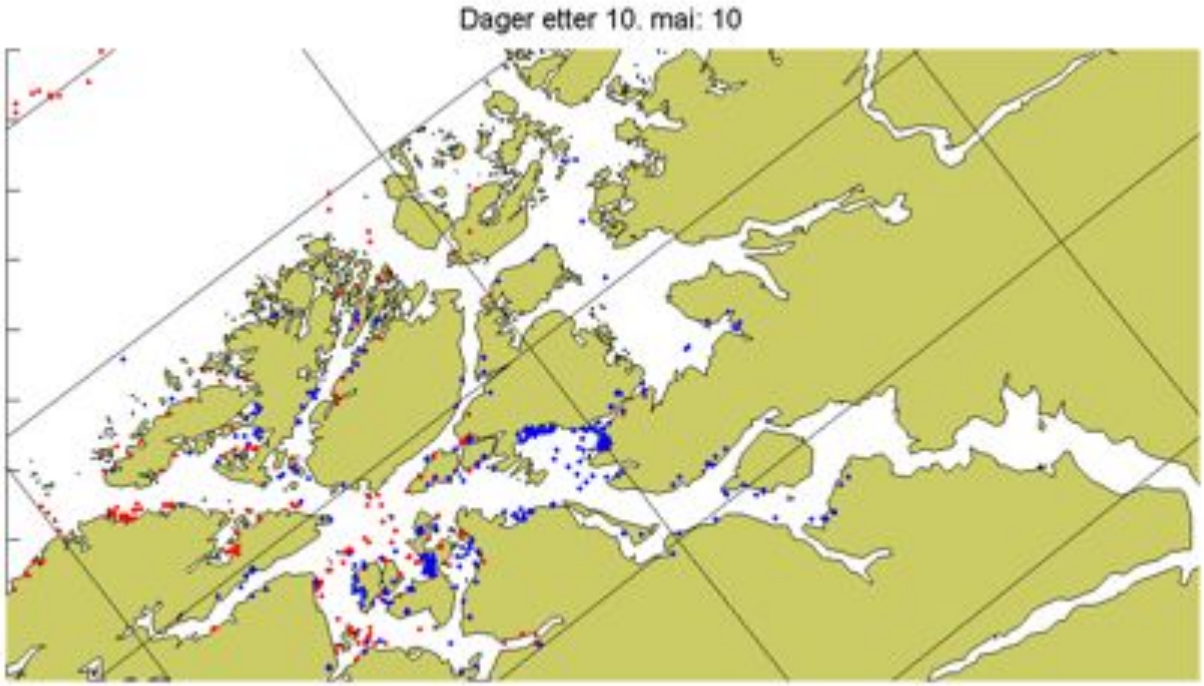

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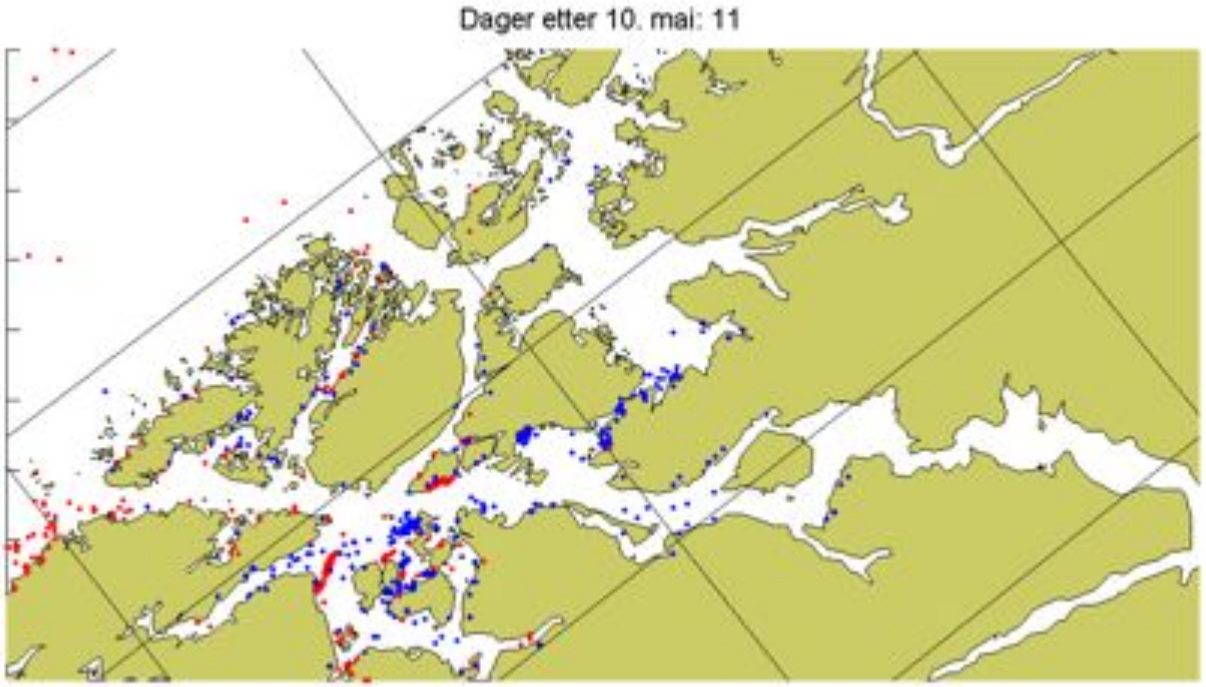

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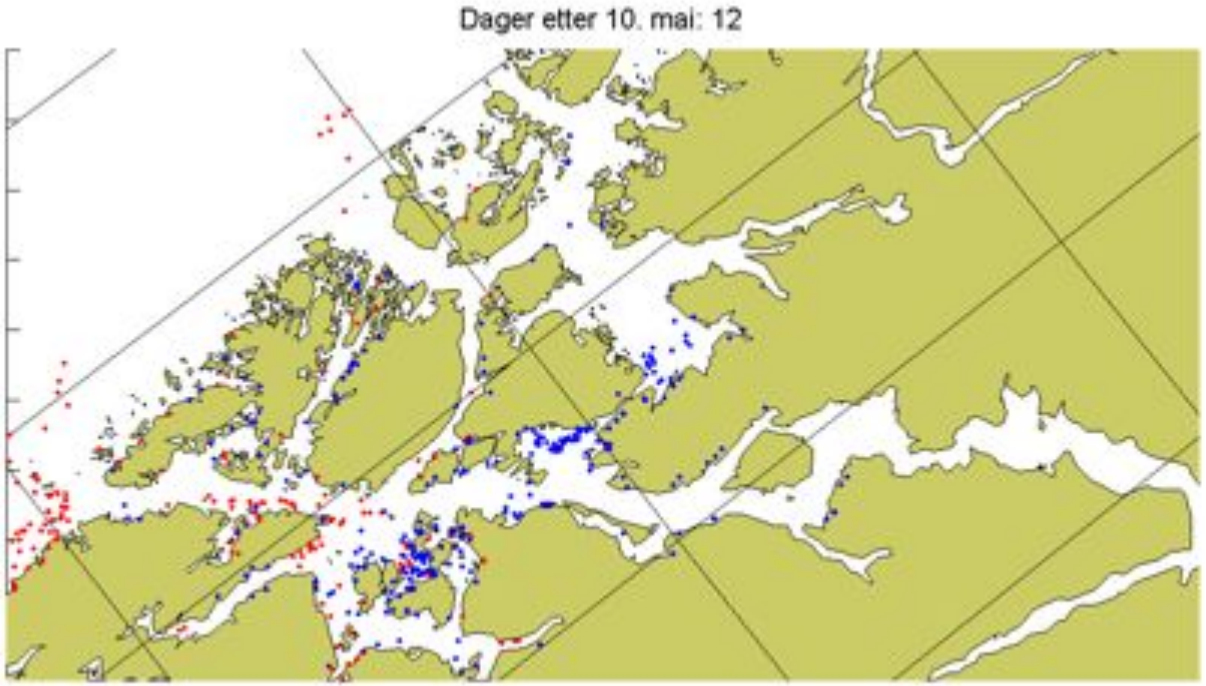

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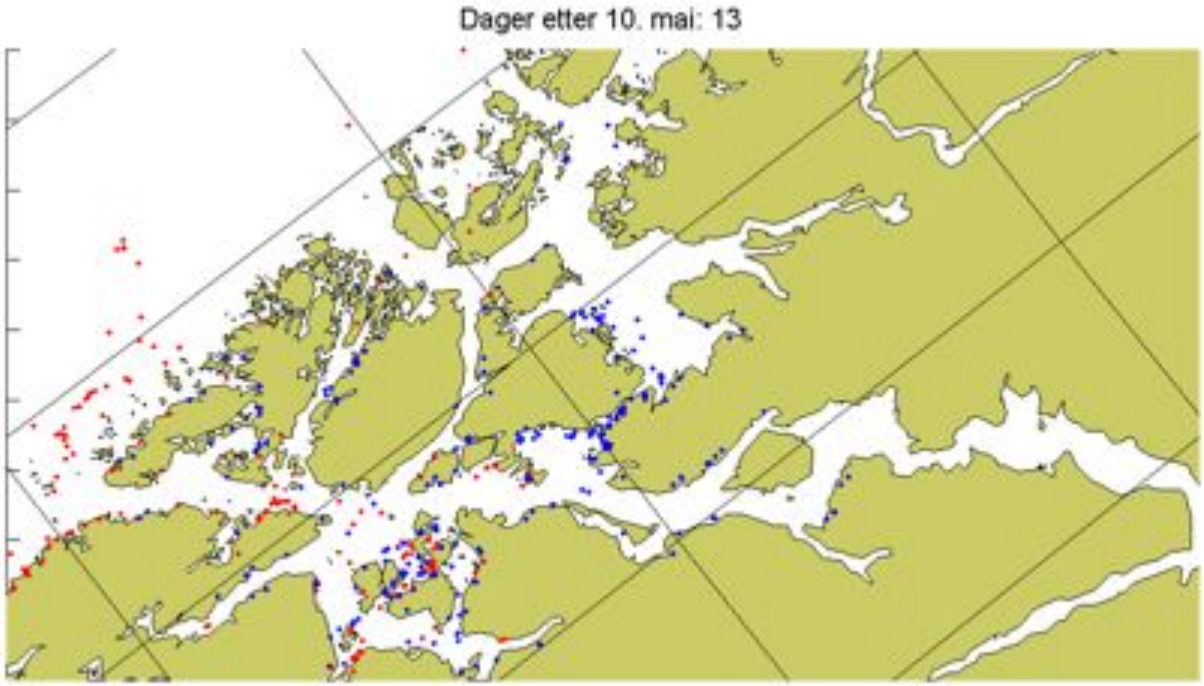

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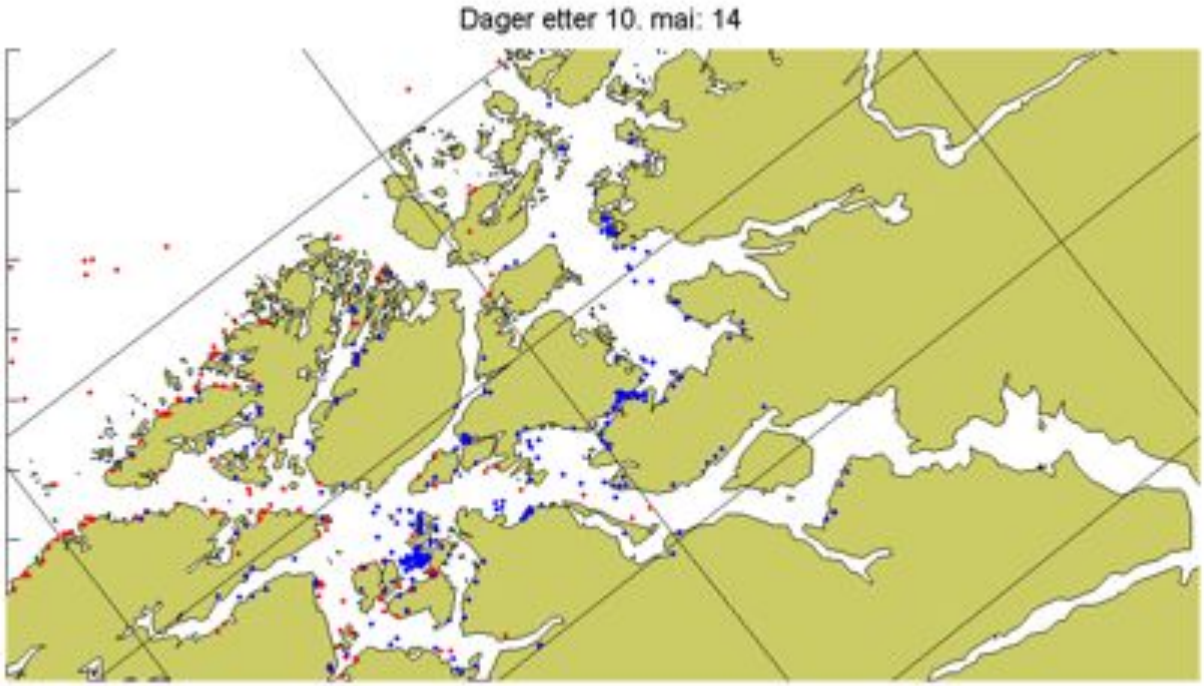

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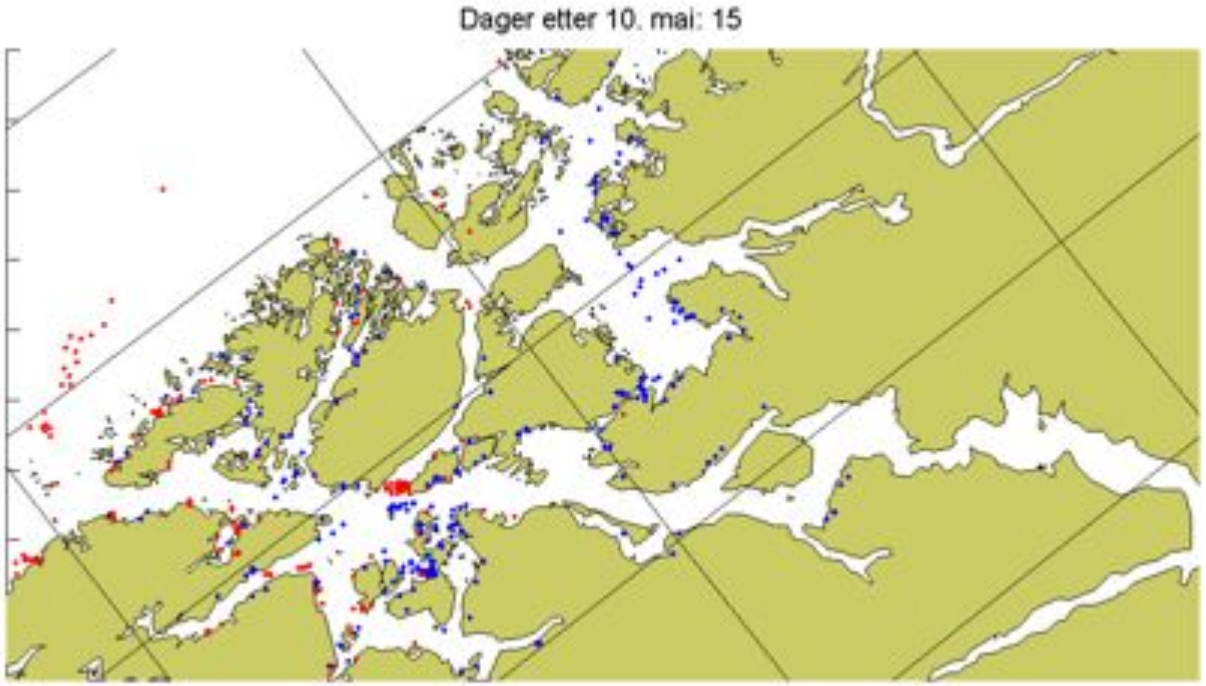

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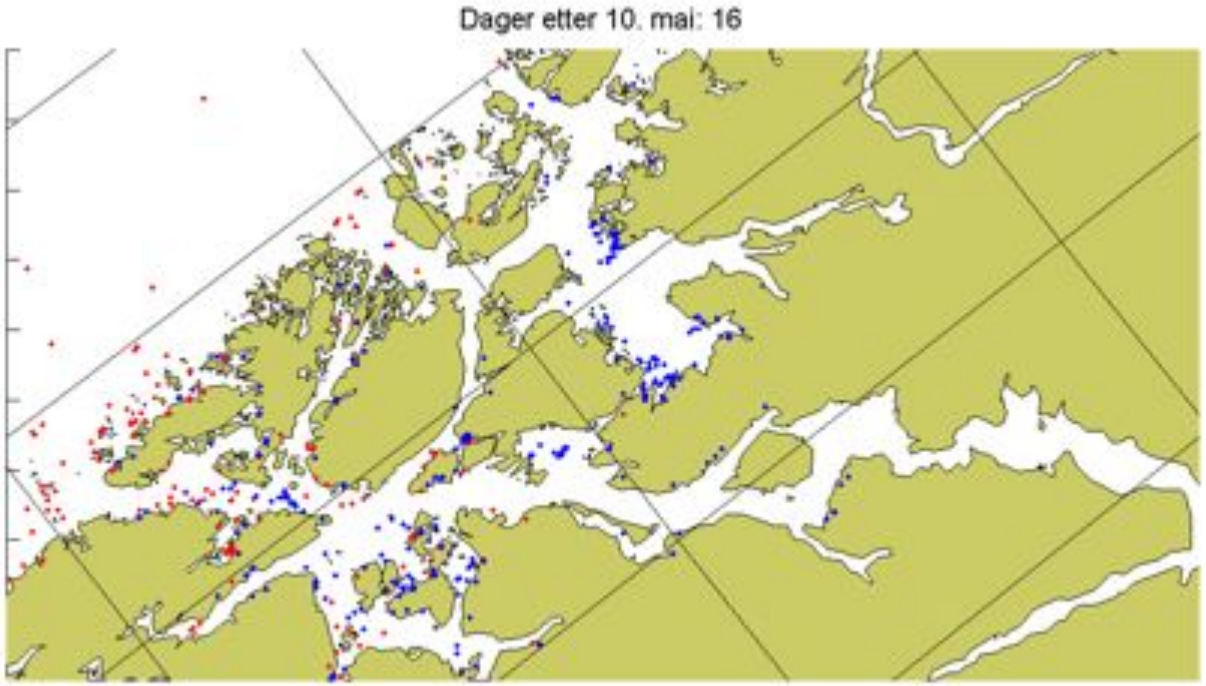

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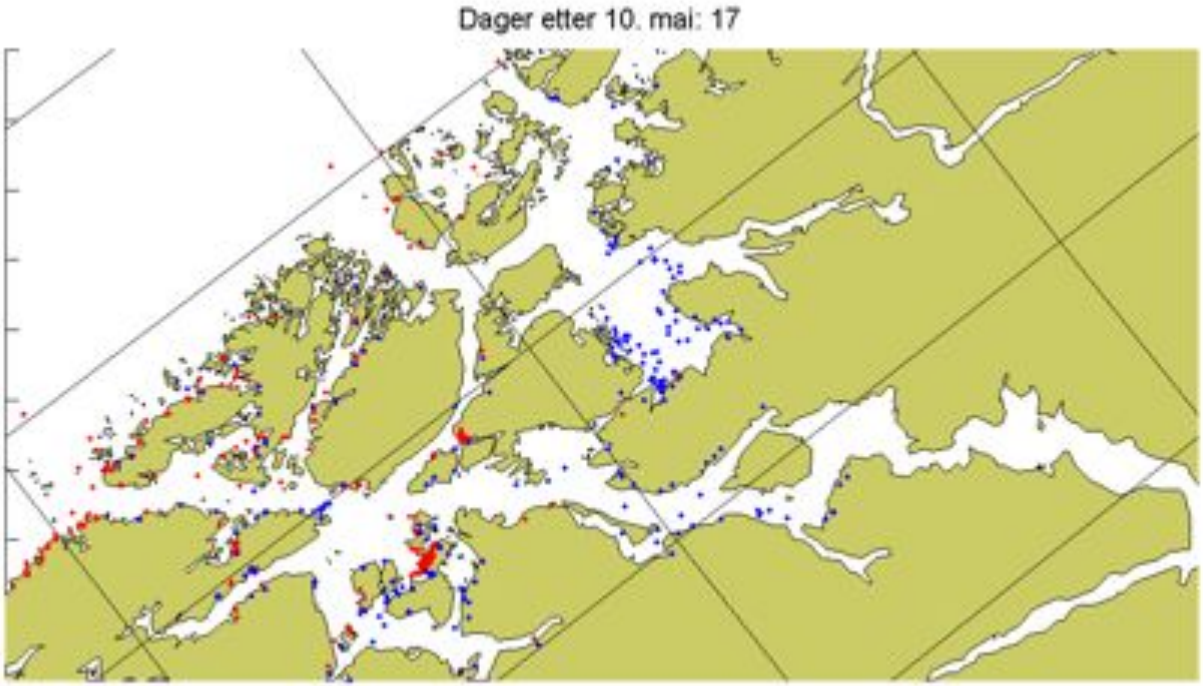

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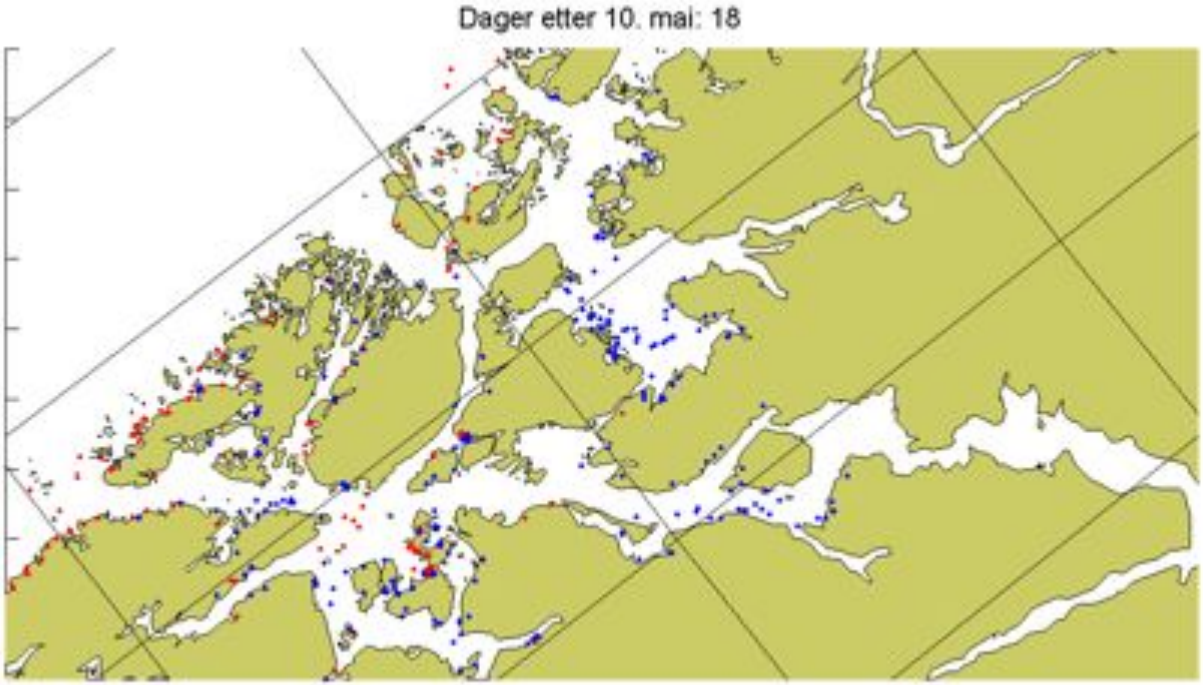

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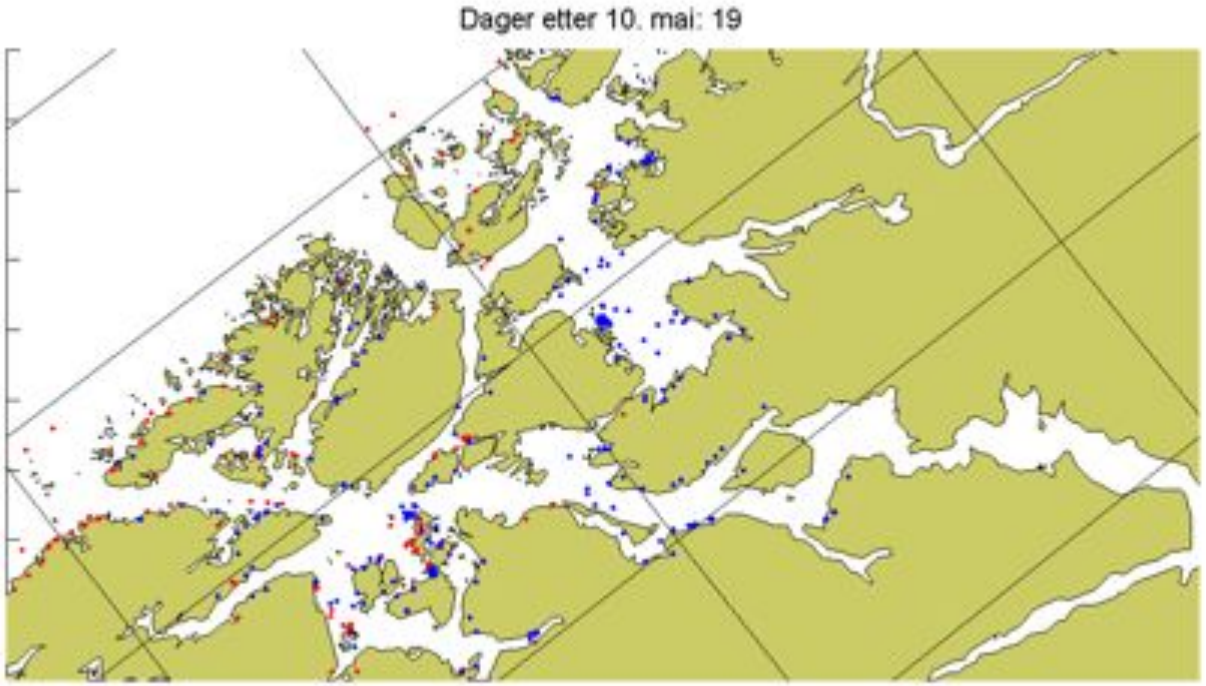

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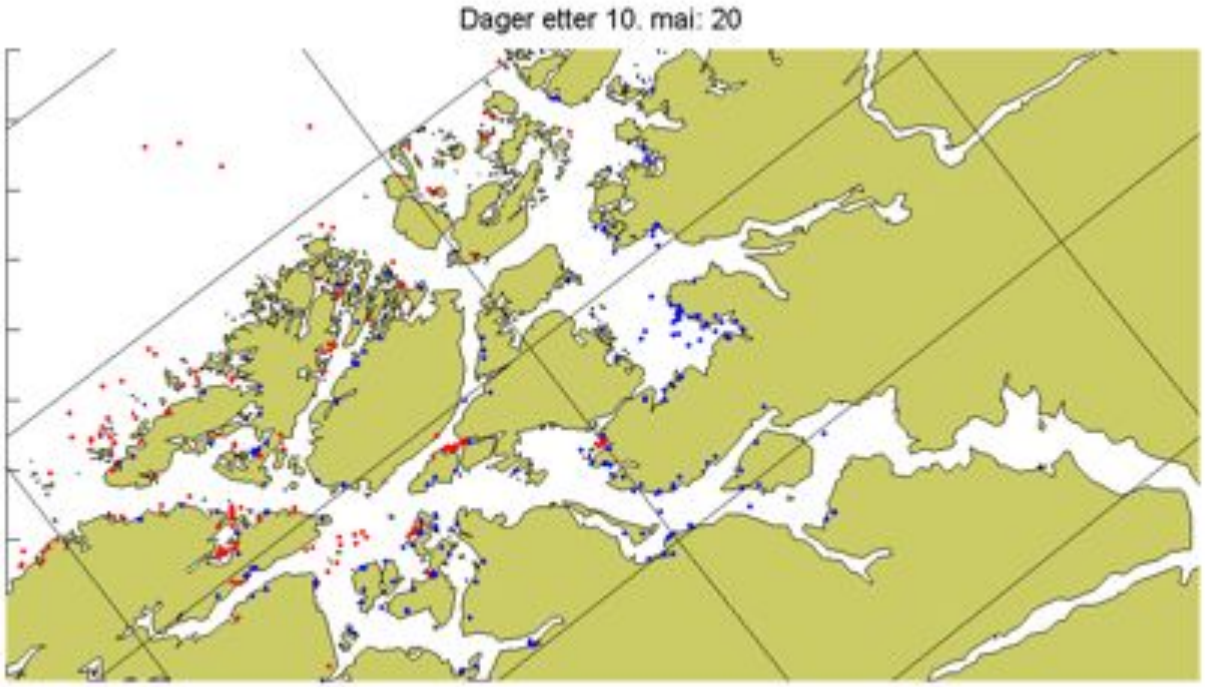

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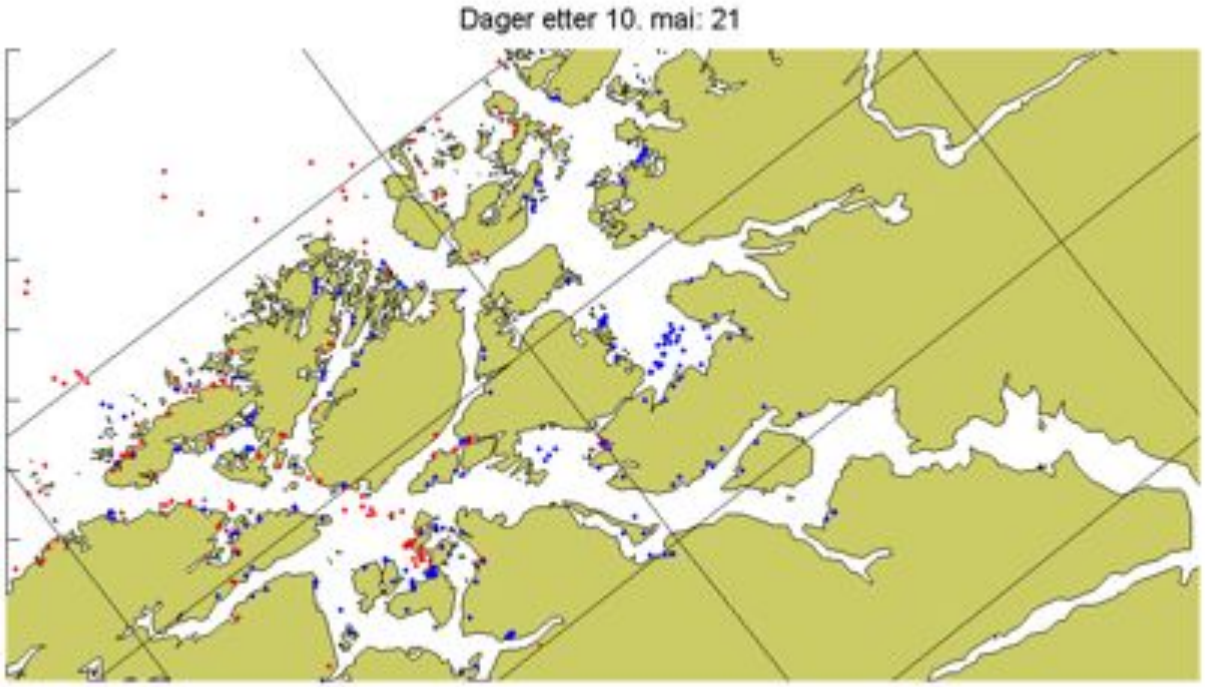

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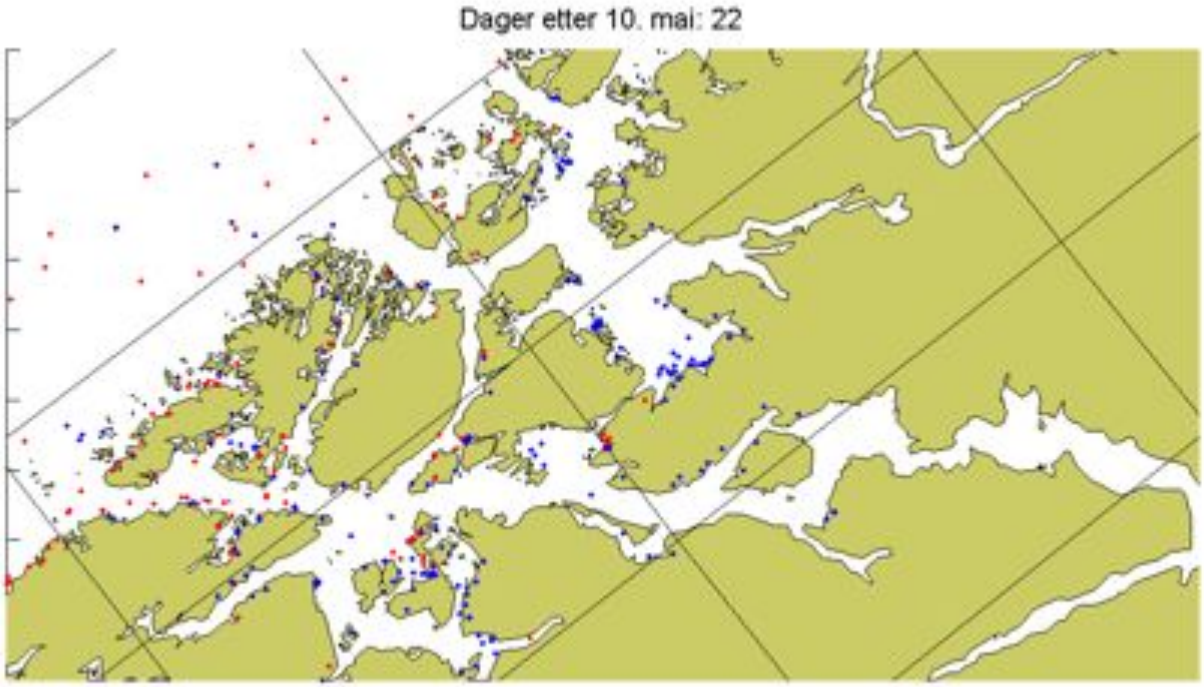

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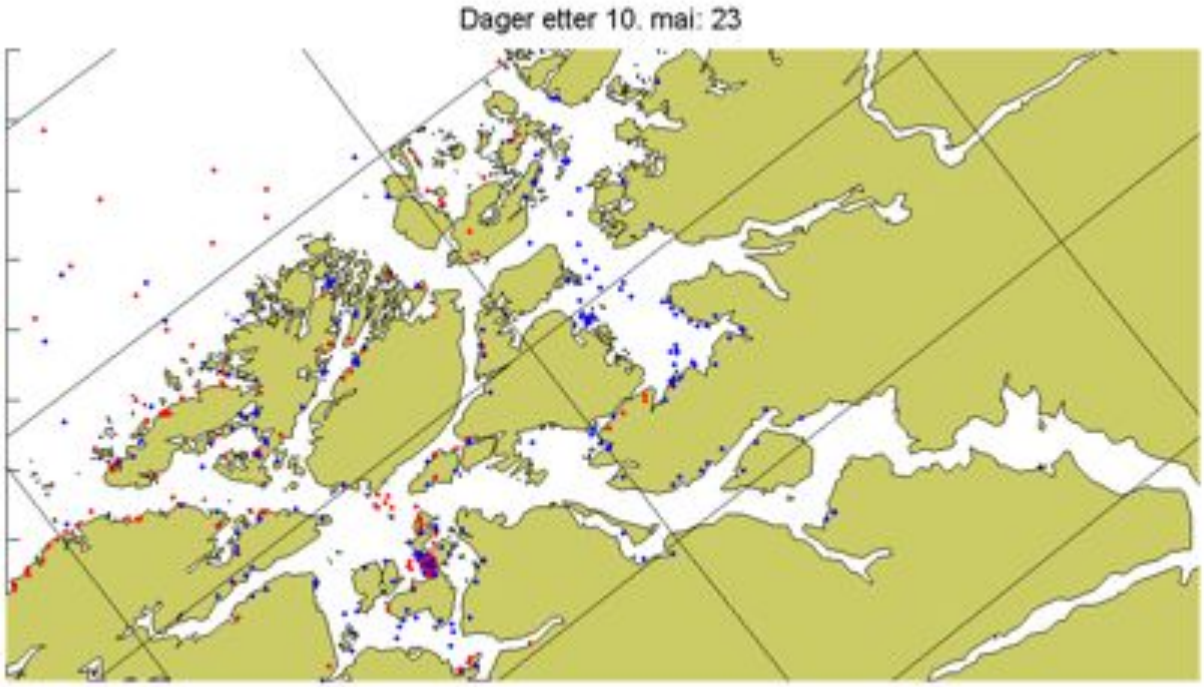

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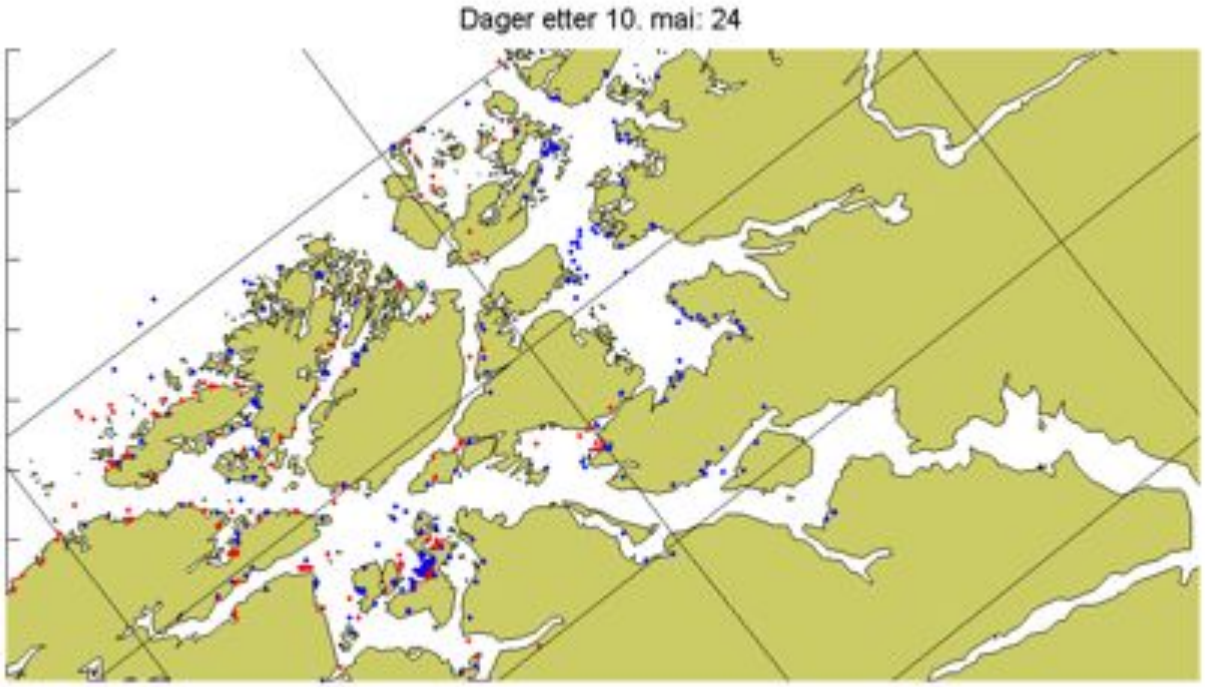

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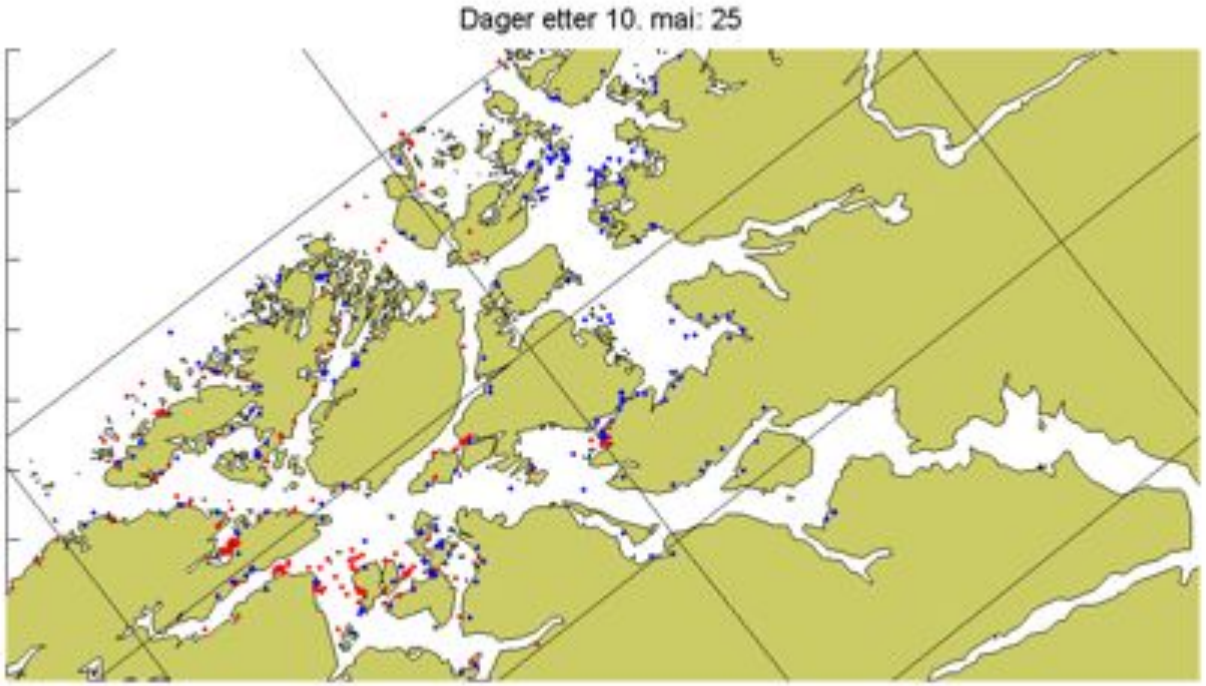

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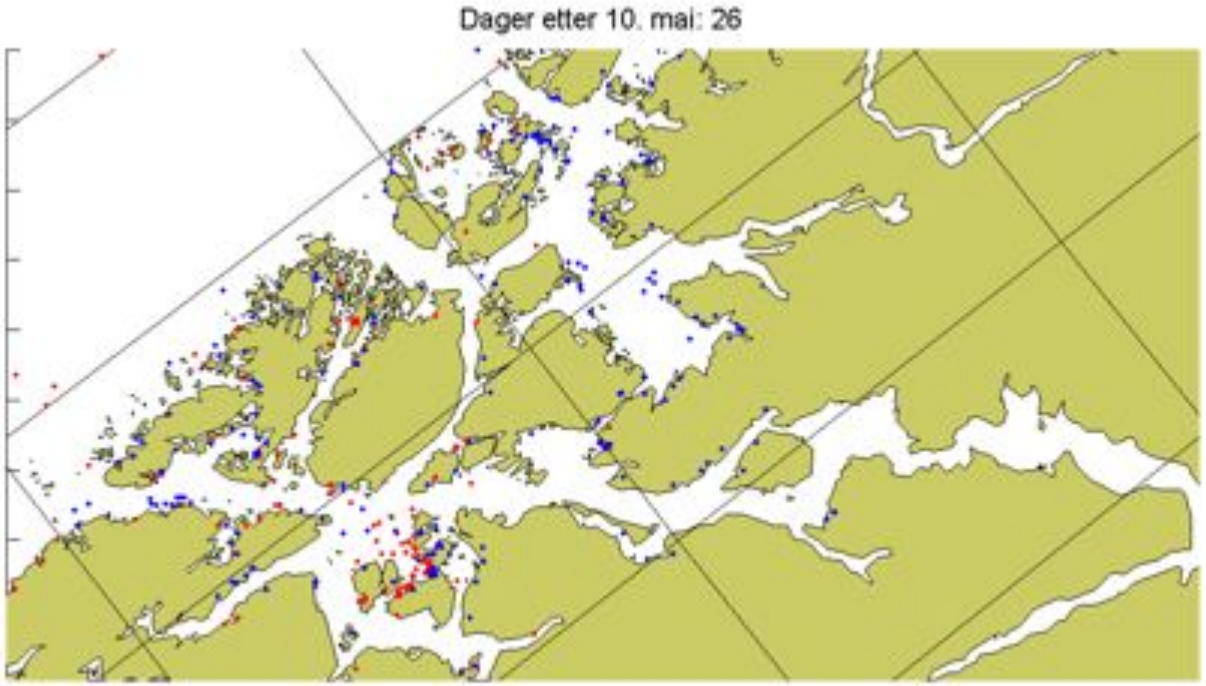

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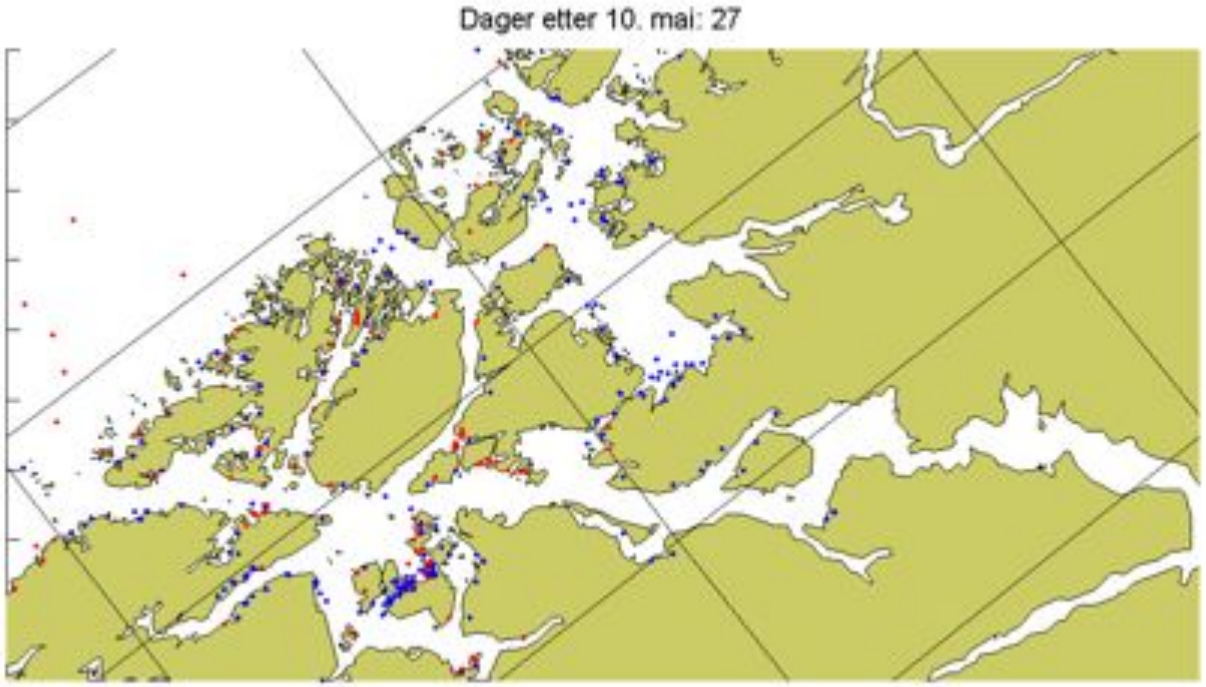

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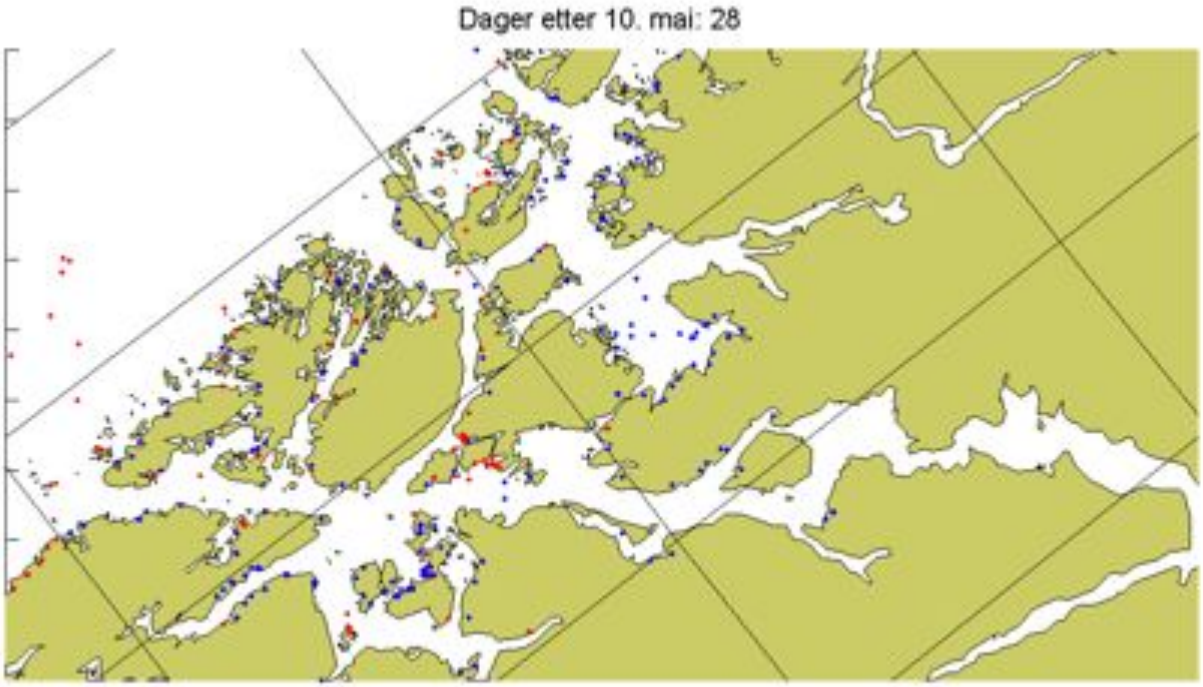

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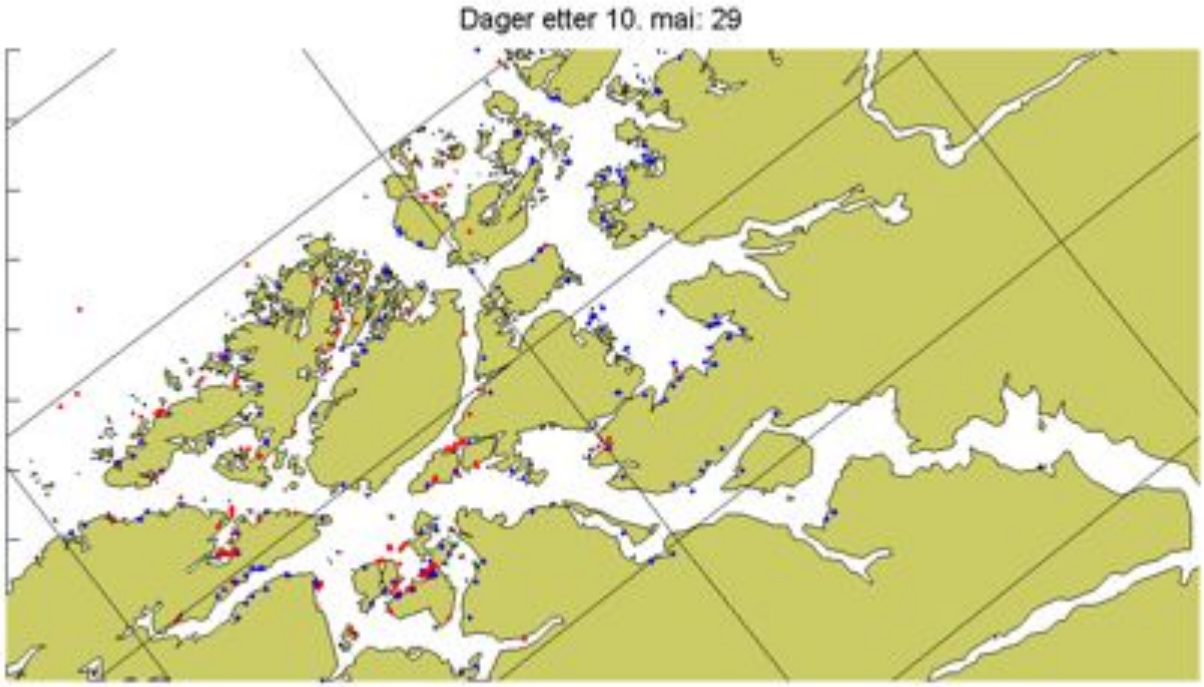
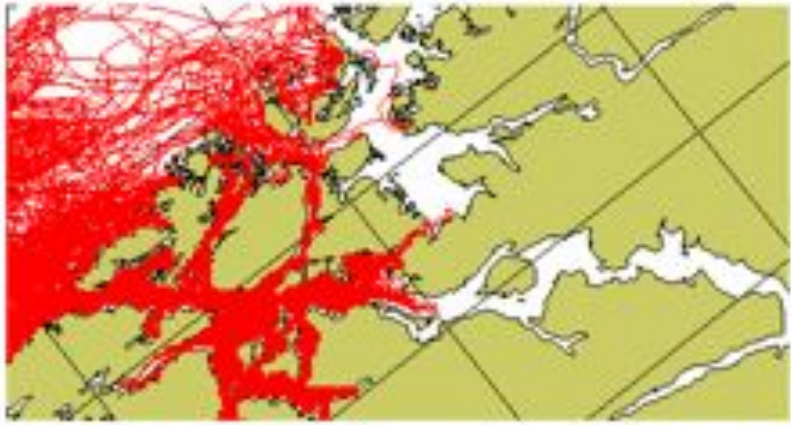
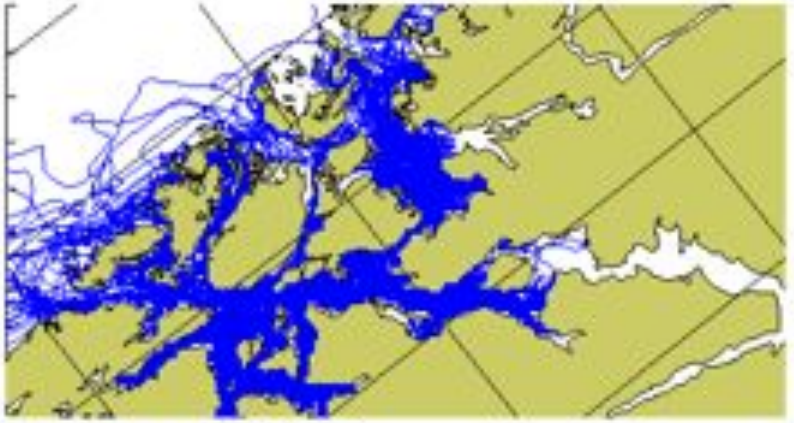


Trajectories for salmon lice movement from May 10 to June 10, 2001



Trajectories for salmon lice movement from May 10 to June 10, 2003



Consequences for management:

- ✓ Spreading of highly specialized pathogens may be very efficient
- ✓ Management plans om farm level are not sufficient
- ✓ Management plans must be extended to the level of municipalities or even counties.
  - synchronized treatments
  - Mandatory, synchrinized, prophylaxis
  - Synchronized fallowing
  - *”All in – all out*” principle

General considerations

- ✓ Appoint biosecutity managers
- ✓ Appoint veternary health contacts
- ✓ Provide staff training in animal health
- ✓ Identify risks for contact and spreading
    1. Movements
    2. Site procedures
- ✓ Risk limitation measures
- ✓ Monitor the plan
- ✓ Contingency planning

Thank you for your attention

Email: oivind.bergh@imr.no
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DISCLAIMER

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