

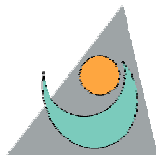
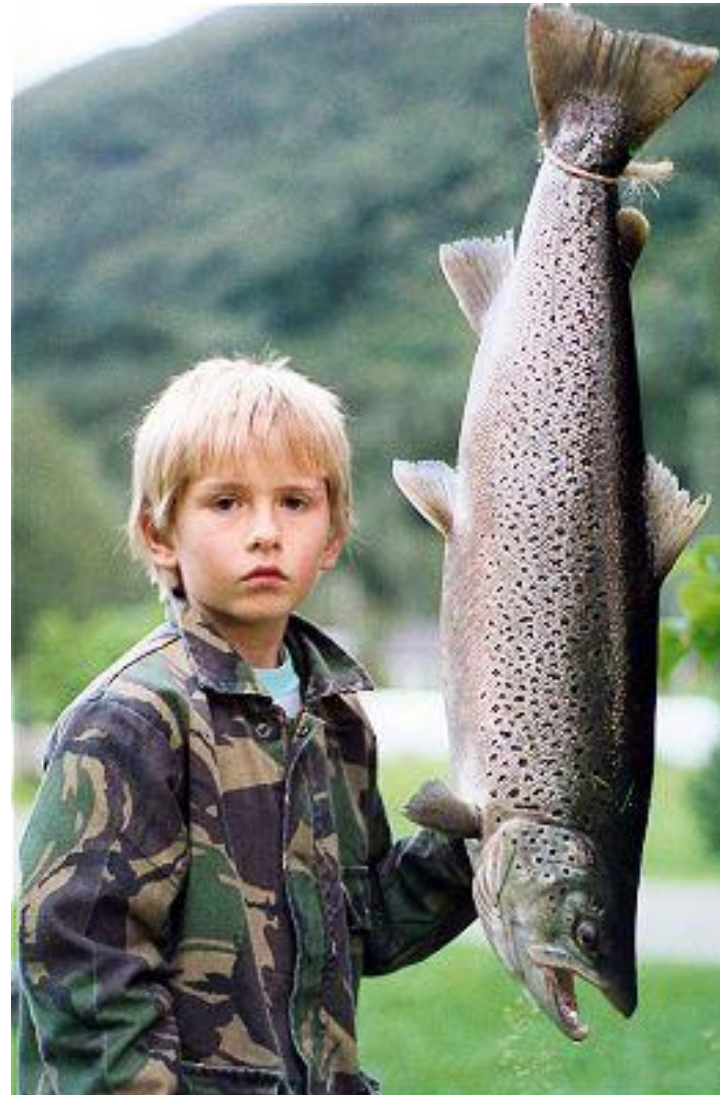
”Is the aquaculture production in the Hardangerfjord system beyond sustainable frames?”

**Bengt Finstad (NINA), Pål Arne Bjørn (IMR), Øystein Skaala
(IMR), Steinar Kålås (RB), Peter Andreas Heuch (VI), Lars Asplin
(IMR), Bjørn Barlaup (UiB), Reidar Borgstrøm (UiB), Rune Nilsen
(IMR) and Karin Boxaspen (IMR)**

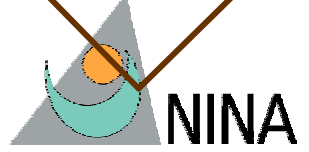
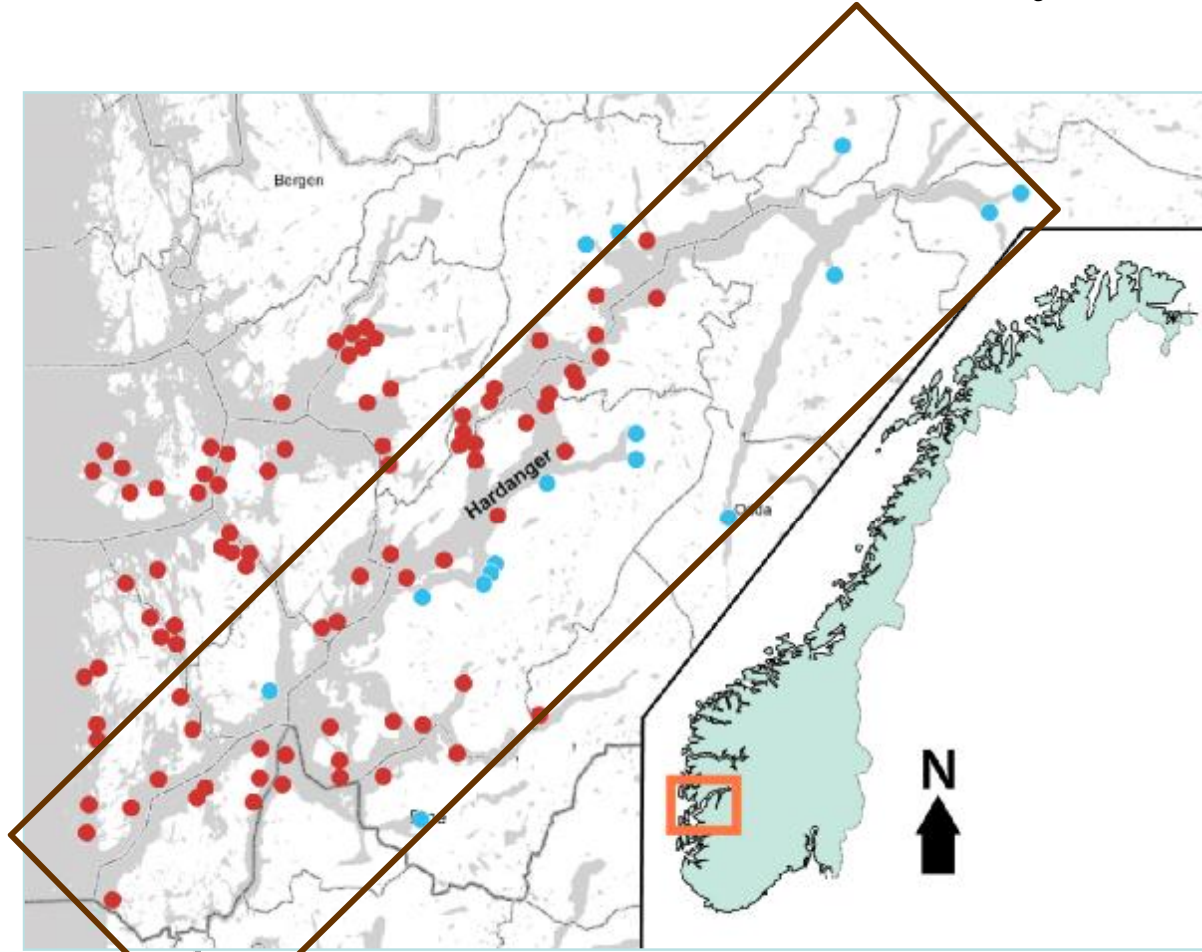
**SeaLice 2010,
Victoria, May 2010**



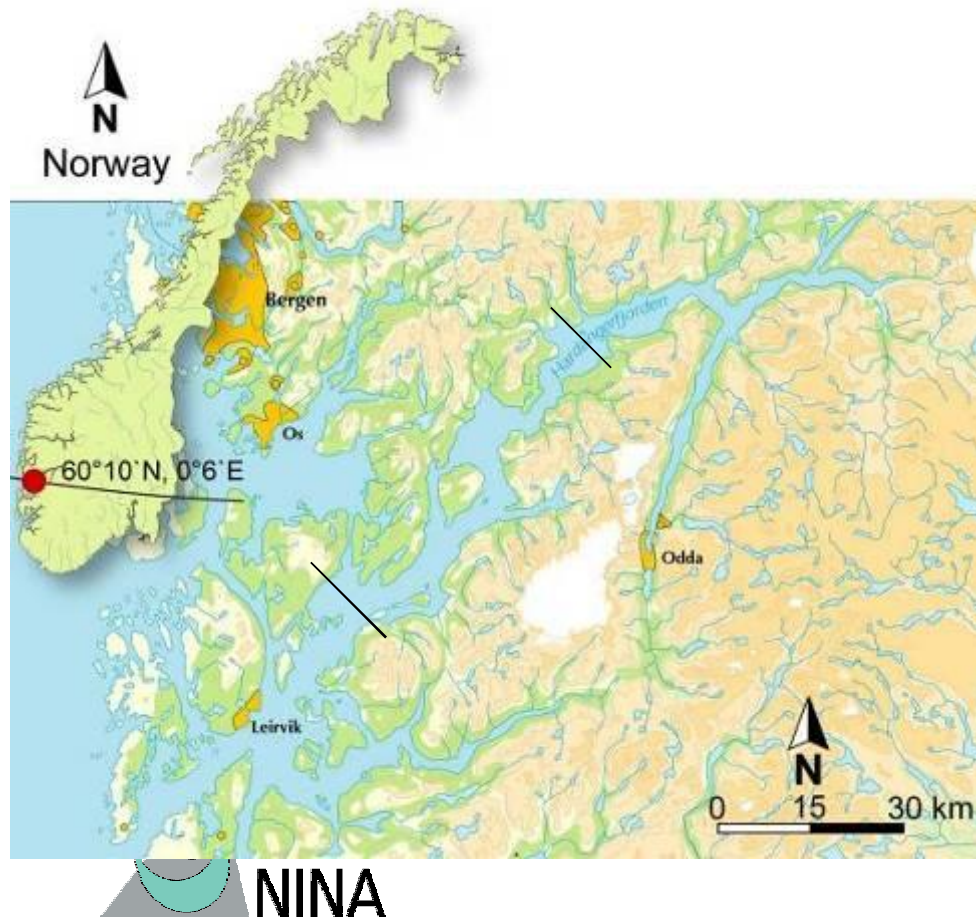
The Hardangerfjord system: a very close relationship between the fjord and the people living along the fjord



The Hardangerfjord system: also base for "an industrial revolution" and now inhabits the largest density of fish farms in Norway



**The Hardangerfjord salmon lice project:
A research program of 14 million NOK financed by the Norwegian
Fisheries and Aquaculture Industry Research Fund (FHF), The
Norwegian Research Council, The Norwegian Directorate of Nature
Management, IMR and AquaNet Canada 2004-2009.**



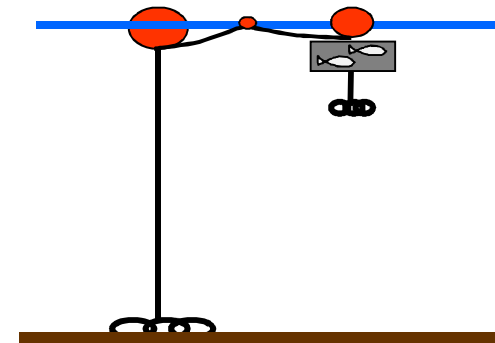
- 1. Delousing strategies**
 - 2. Wild fish studies**
 - 3. Migratory studies**
 - 4. Spread of lice larvae**
 - 5. Physical oceanographical factors**
 - 6. Mathematical modelling**
- can wild fish interests and the
aquaculture industry operate in the
same fjord?**

The Hardangerfjord salmon lice project: methods

1) Counting of salmon lice in fish farms and synchronized and strategic delousing programmes



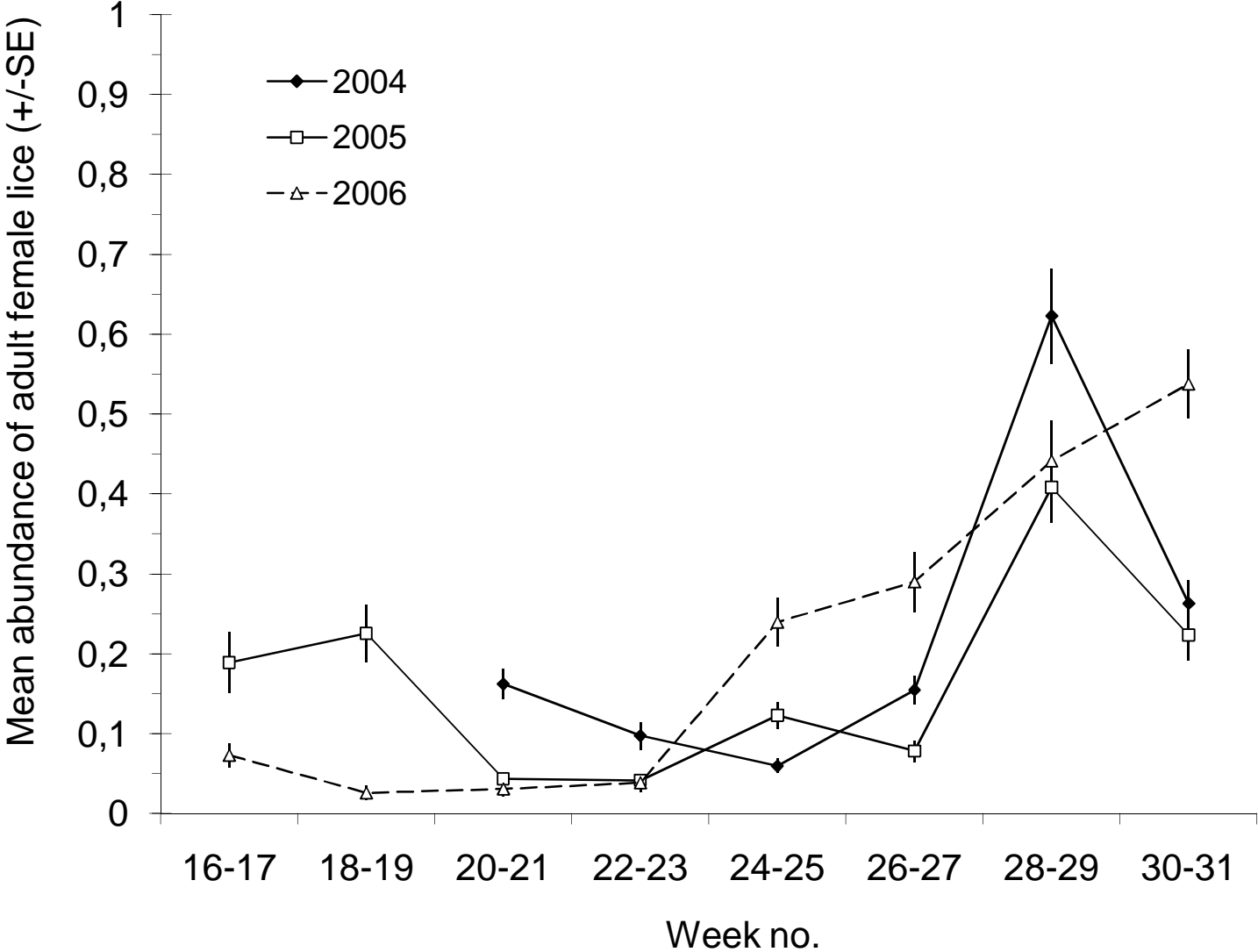
2) Measuring the effects of the delousing programme on the infection pressure on wild salmonids



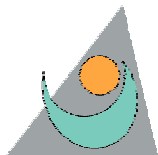
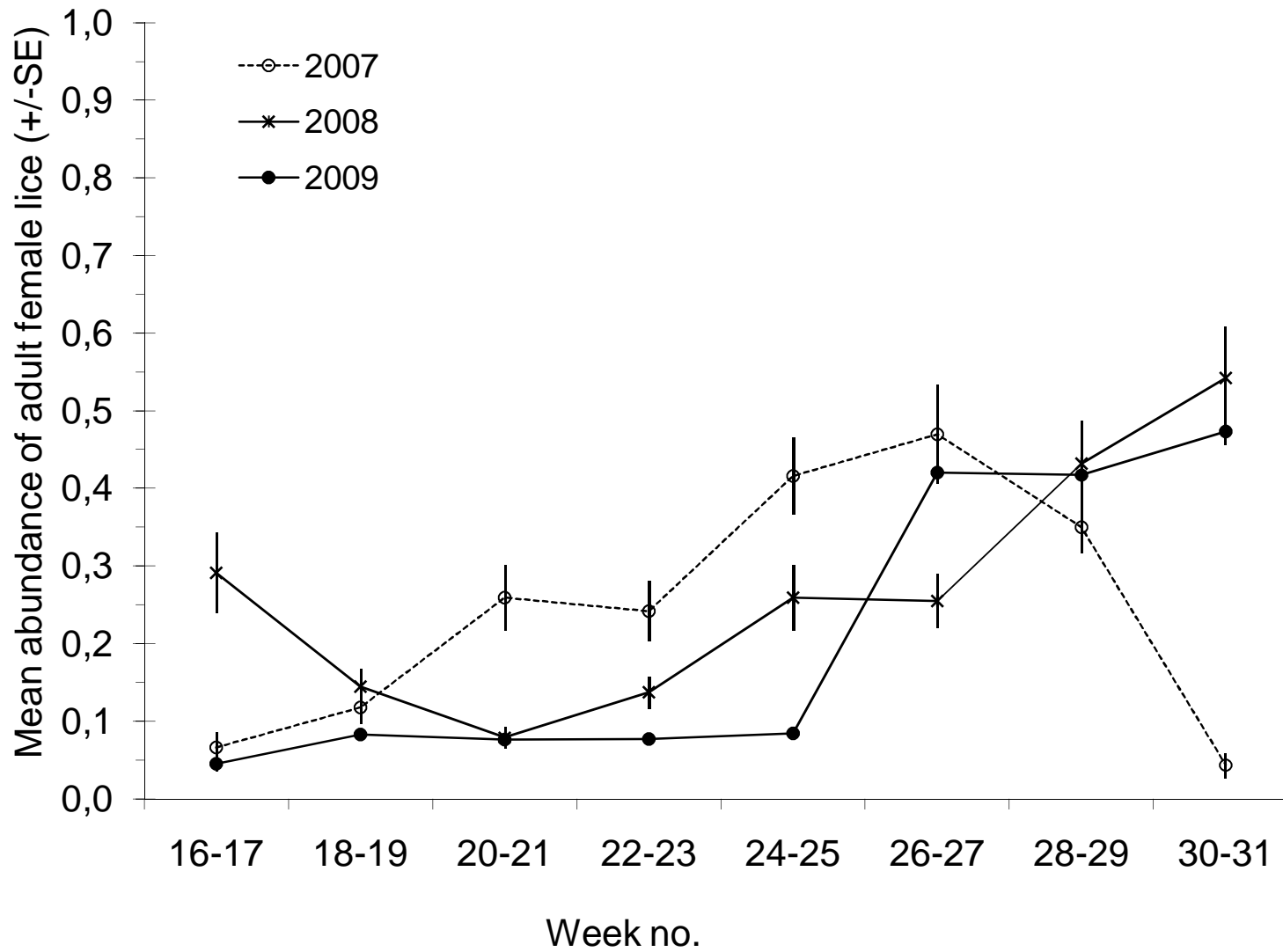
3) Measuring the effects of the delousing programme on river populations of wild salmonids



1) The Hardangerfjord salmon lice project: Results of the strategic delousing programme in fish farms 2004 (before) - 2009

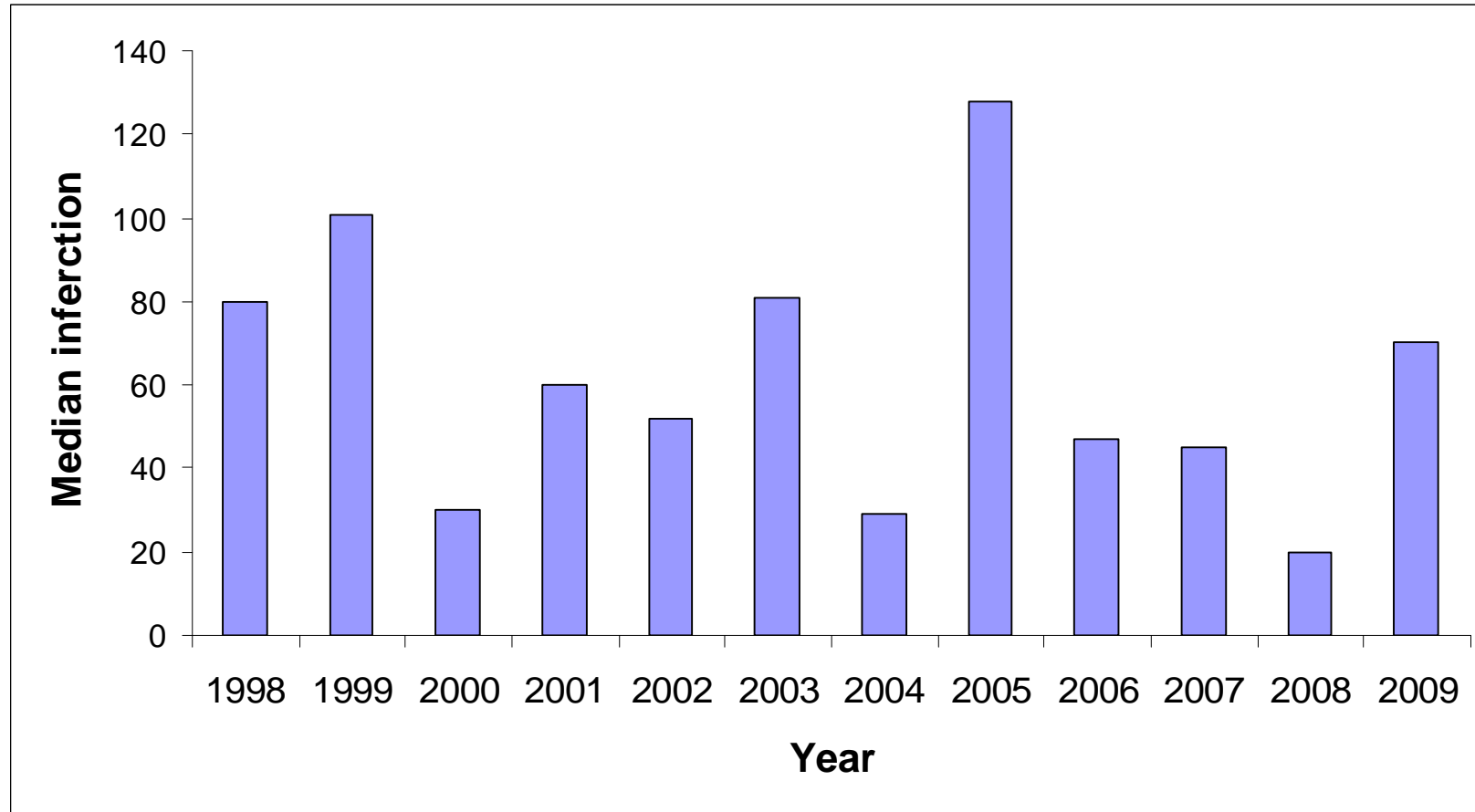


1) The Hardangerfjord salmon lice project: Results of the strategic delousing programme in fish farms 2004 - 2009



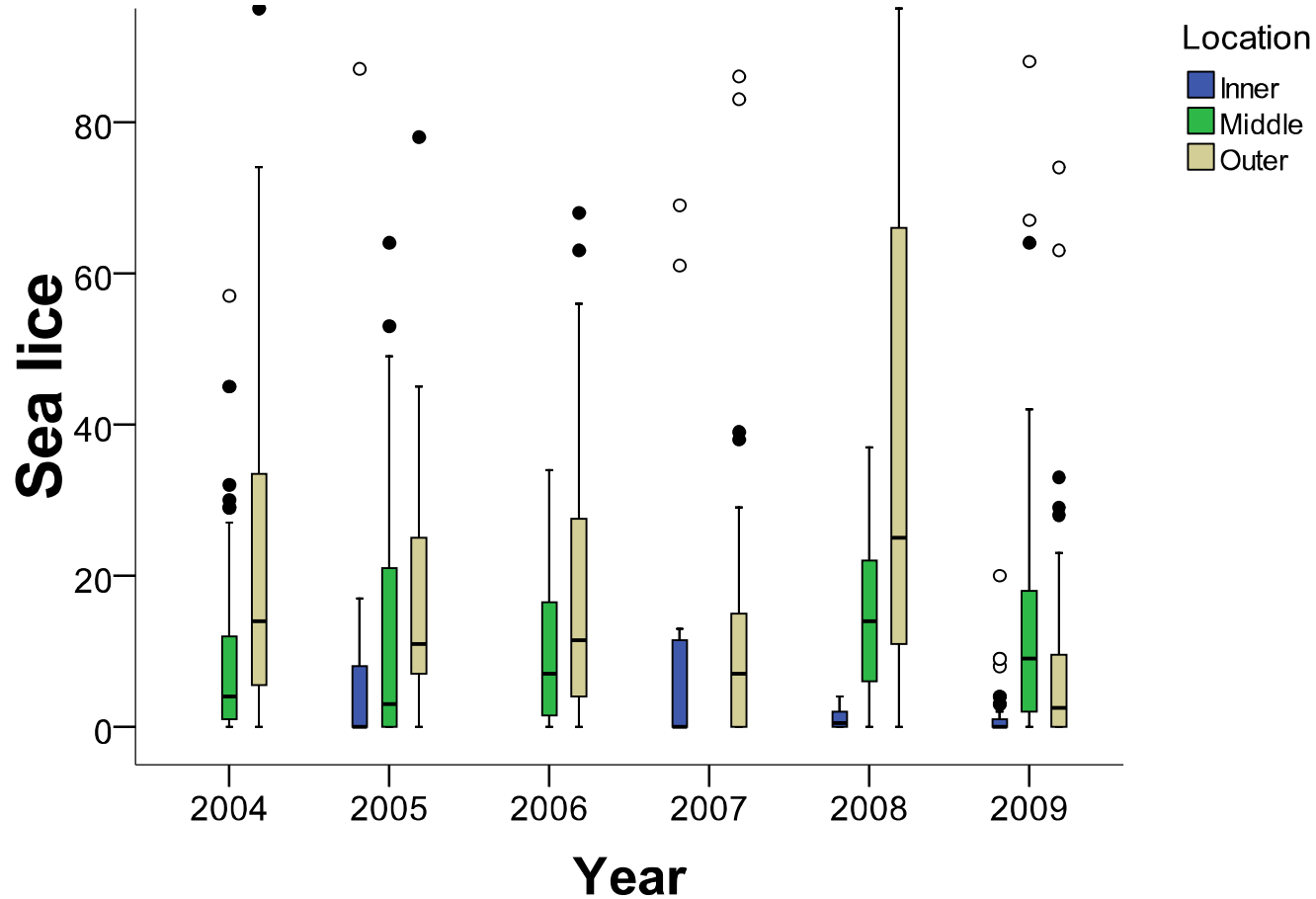
2) The Hardangerfjord salmon lice project.

Salmon lice infection in all premature returned sea trout to five pooled Hardangerfjord rivers (inner, middle and outer fjord) 1998-2009



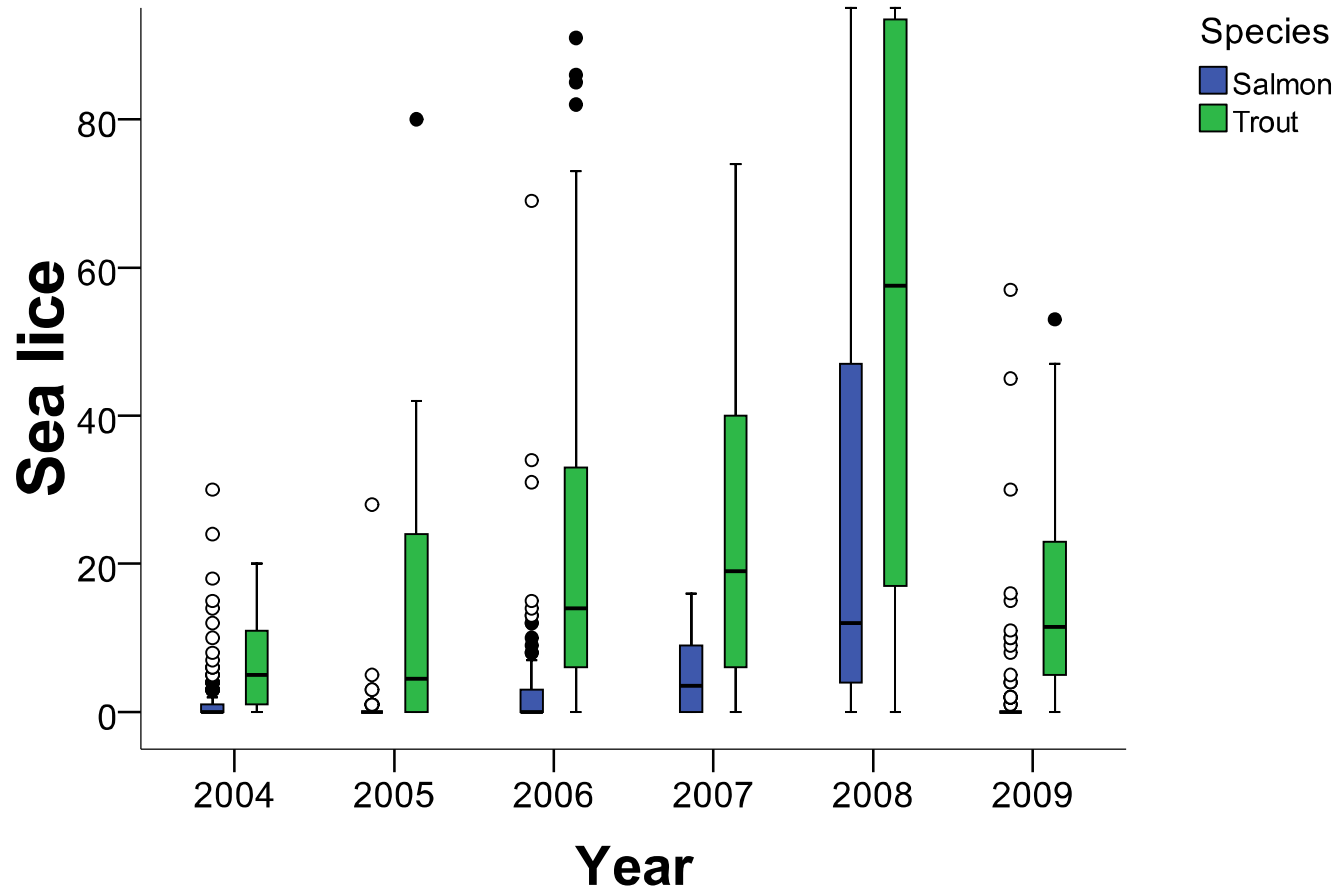
2) The Hardangerfjord salmon lice project.

Median salmon lice infection in all (abundance) wild sea trout captured by gill nets in inner, middle and outer Hardangerfjord 2004-2009



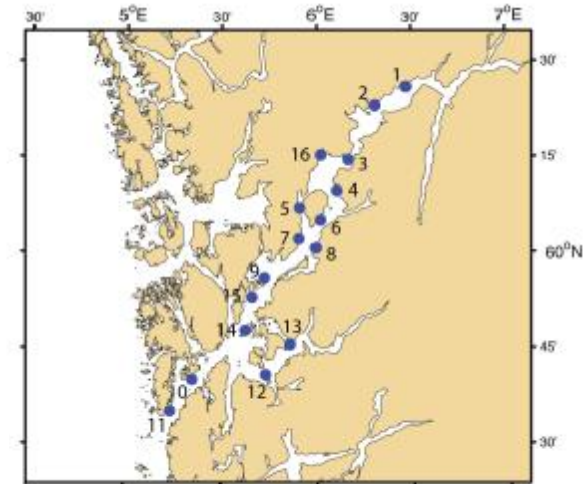
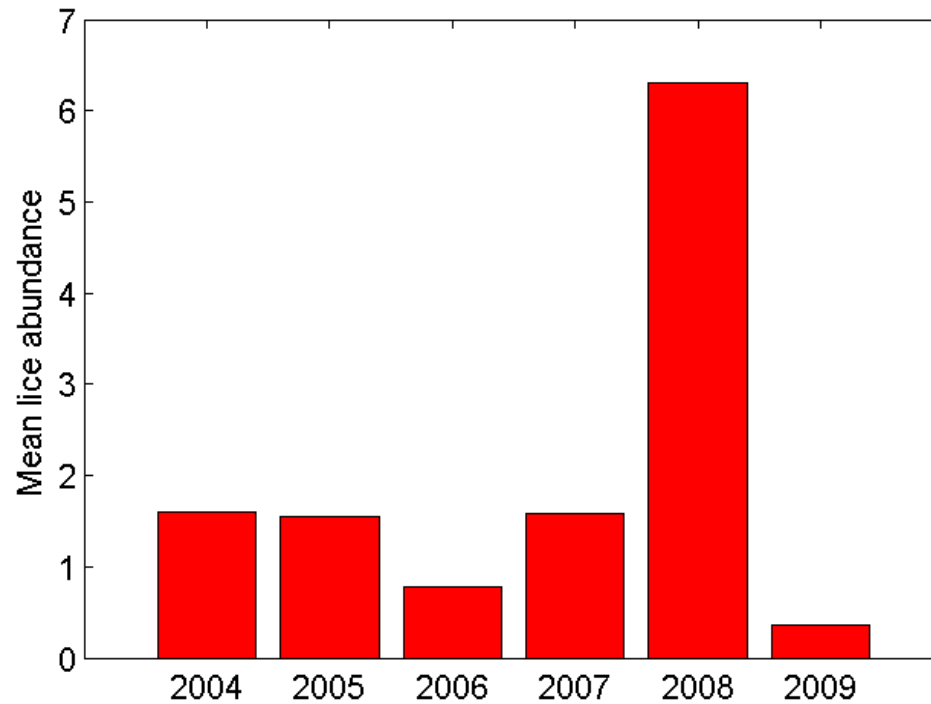
2) The Hardangerfjord salmon lice project.

Median salmon lice infection in all (abundance) salmon and sea trout smolts captured by trawl in middle and outer Hardangerfjord 2004-2009



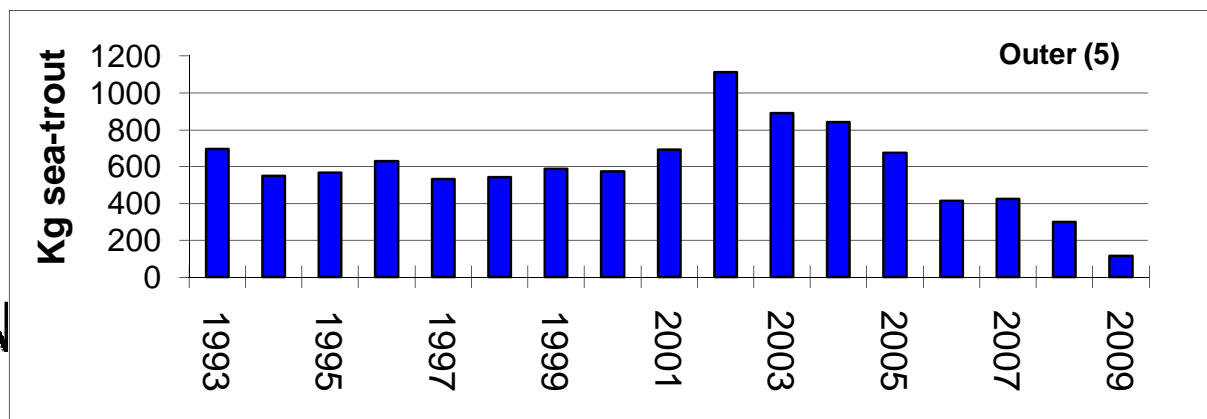
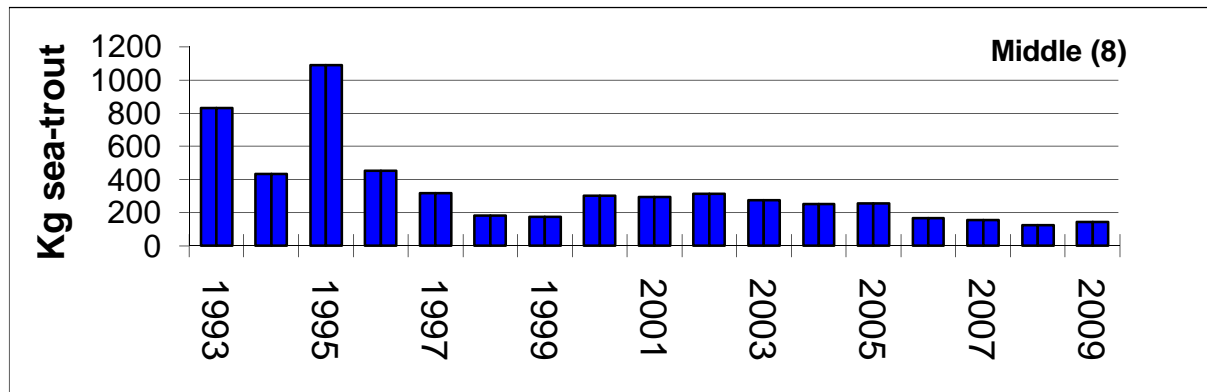
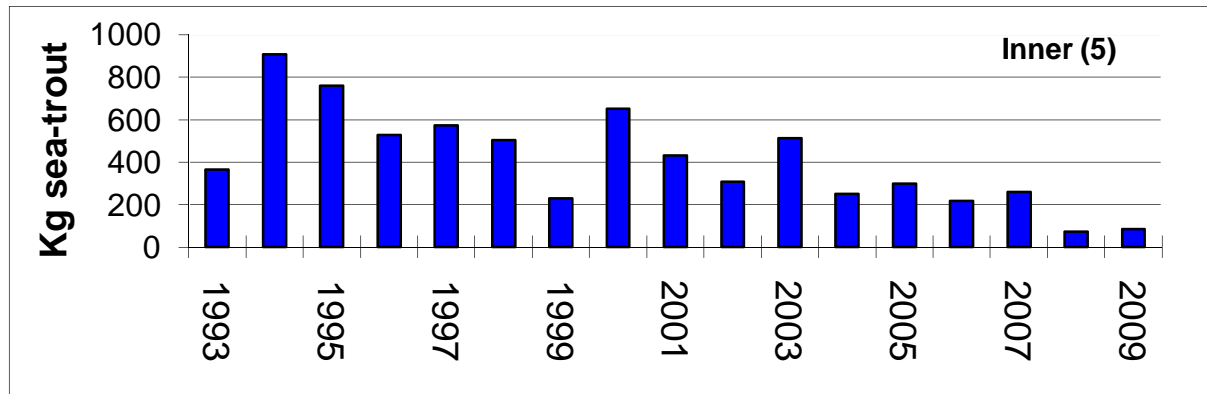
2) The Hardangerfjord salmon lice project.

Mean salmon lice infection (abundance) in cages with hatchery reared salmon smolts in Hardangerfjord 2004-2009



3) The Hardangerfjord salmon lice project.

Capture statistics in inner, middle and outer Hardangerfjord rivers 1993 -2009



3) The Hardangerfjord salmon lice project.

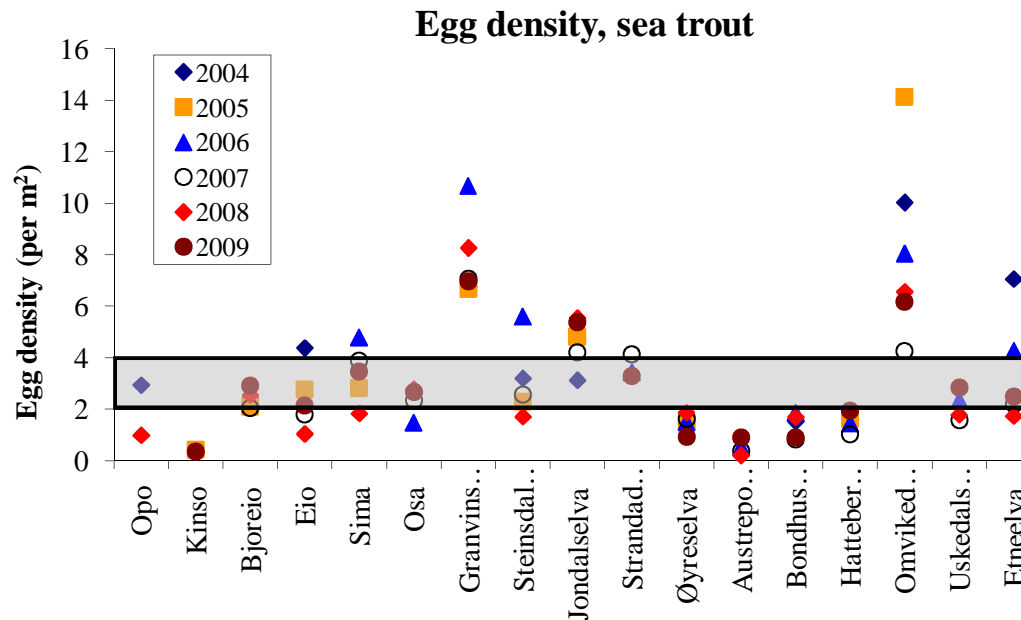
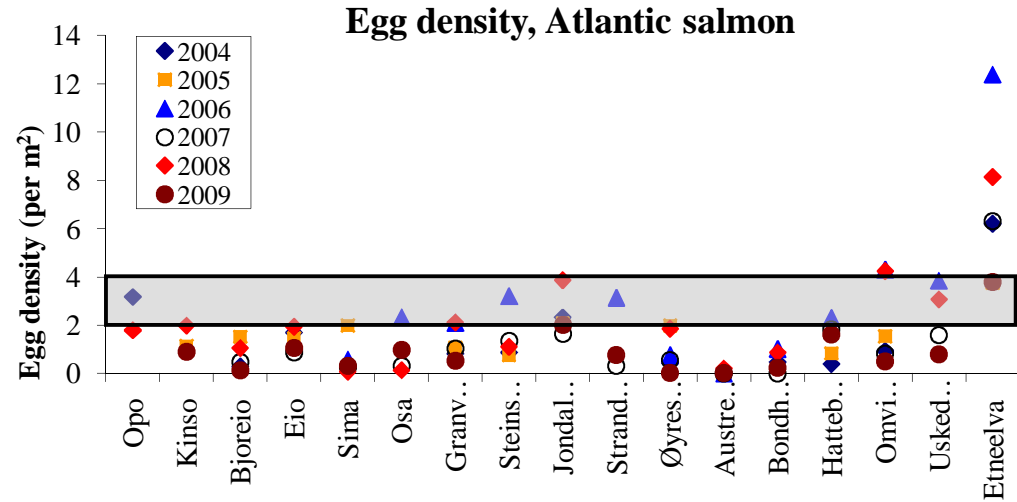
Return rates to the river Guddal trap, middle Hardangerfjord 2004 -2009 in lice protected and control groups



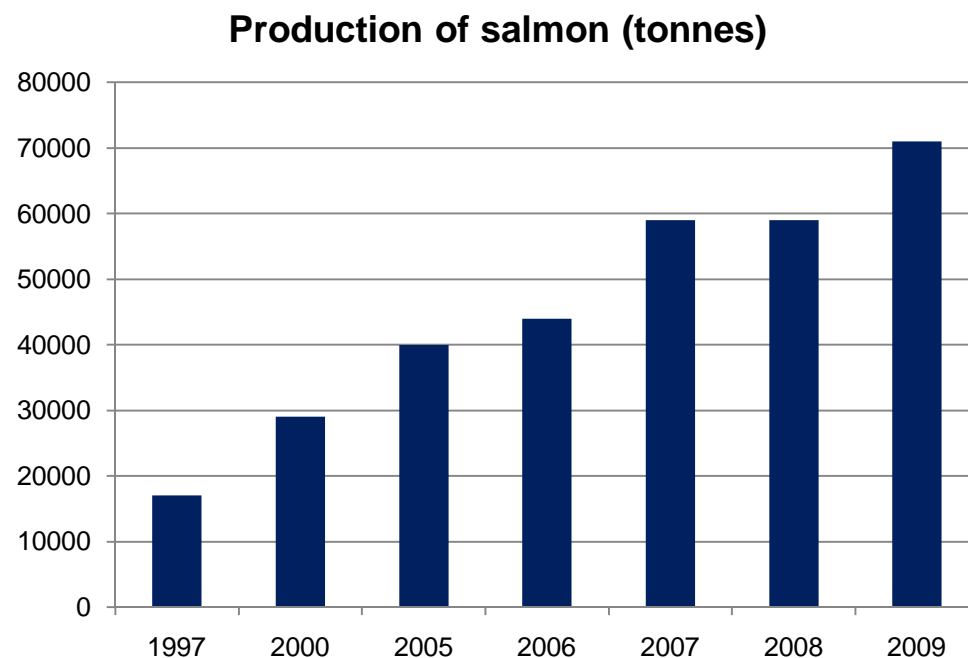
	Released	Recapture (%)
Protected	705	21 (3.0)
Control	1132	20 (1.8)

3) The Hardangerfjord salmon lice project.

Egg density in inner, middle and outer Hardangerfjord rivers 2004 -2009



The Hardangerfjord salmon lice project: Overall conclusion:



The positive effects of the strategic delousing programme, have been “eaten up” by the increase in production between 2004-2009
At the moment, it is difficult to see how this level of salmon production (especially in worst years) can coexists with sustainable populations of wild salmonids (especially sea trout)

Modellert spredning i Hardangerfjorden

200 lakselus er sluppet ut i samme posisjon ved tre tidspunkt i 2007. 10 dagers spredning er simulert:

1.-10. mai ●

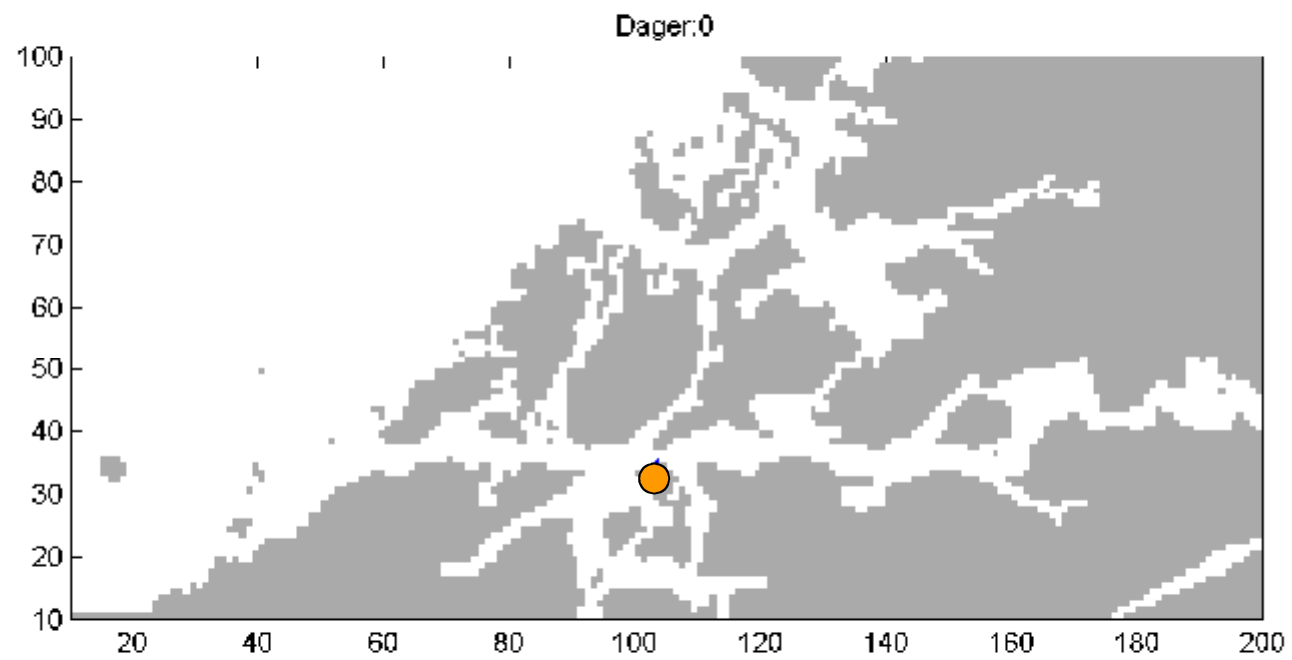
5.-15. mai ●

10.-20. mai ●

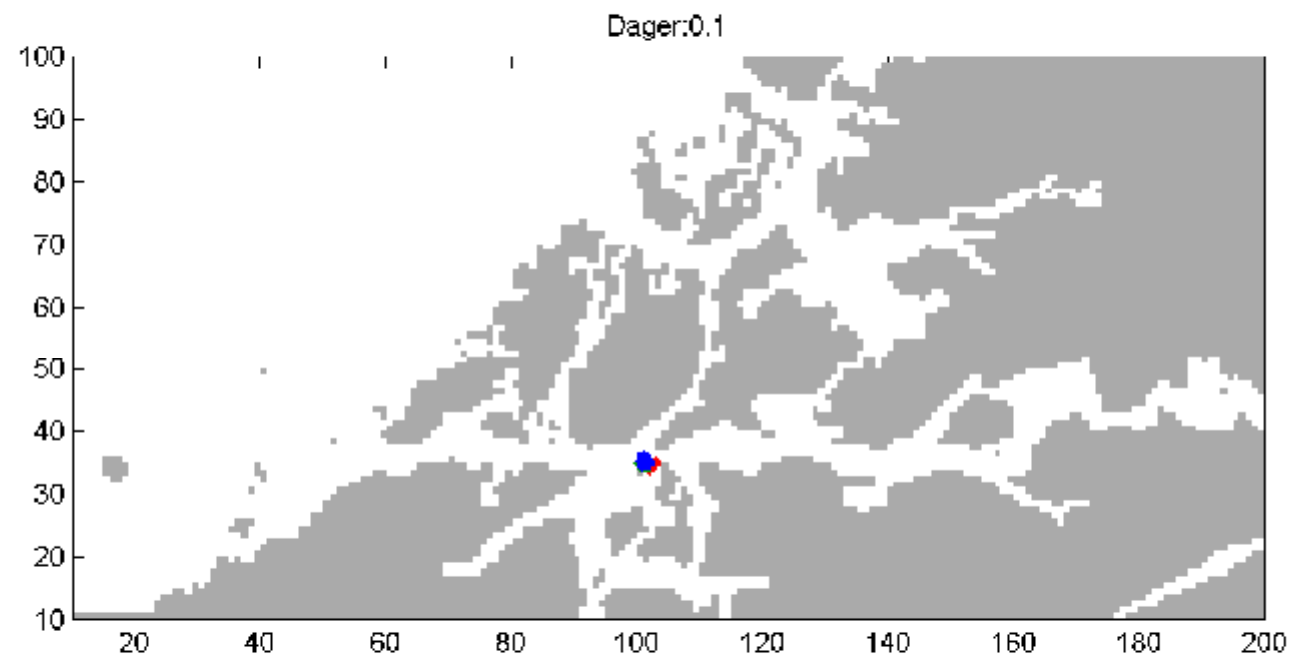
Den modellerte lakselusen spres basert på realistisk strøm for den aktuelle 10-dagers perioden.

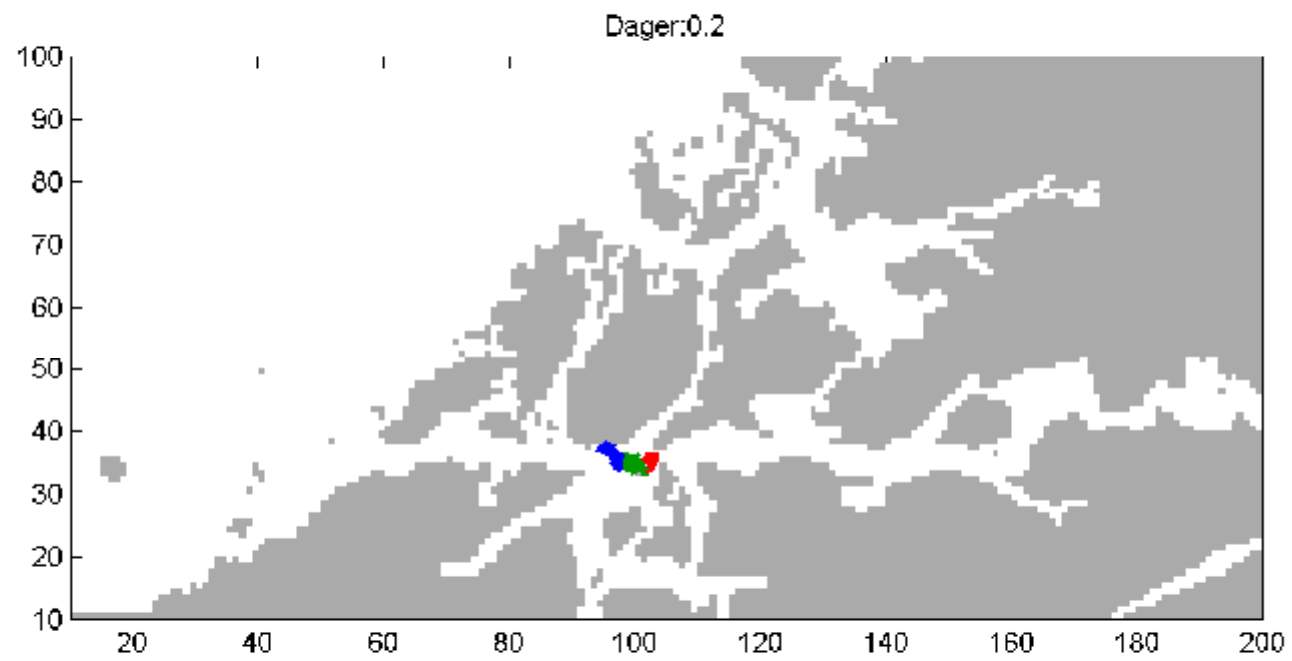
Dette illustrerer den store naturlige variabiliteten i tid

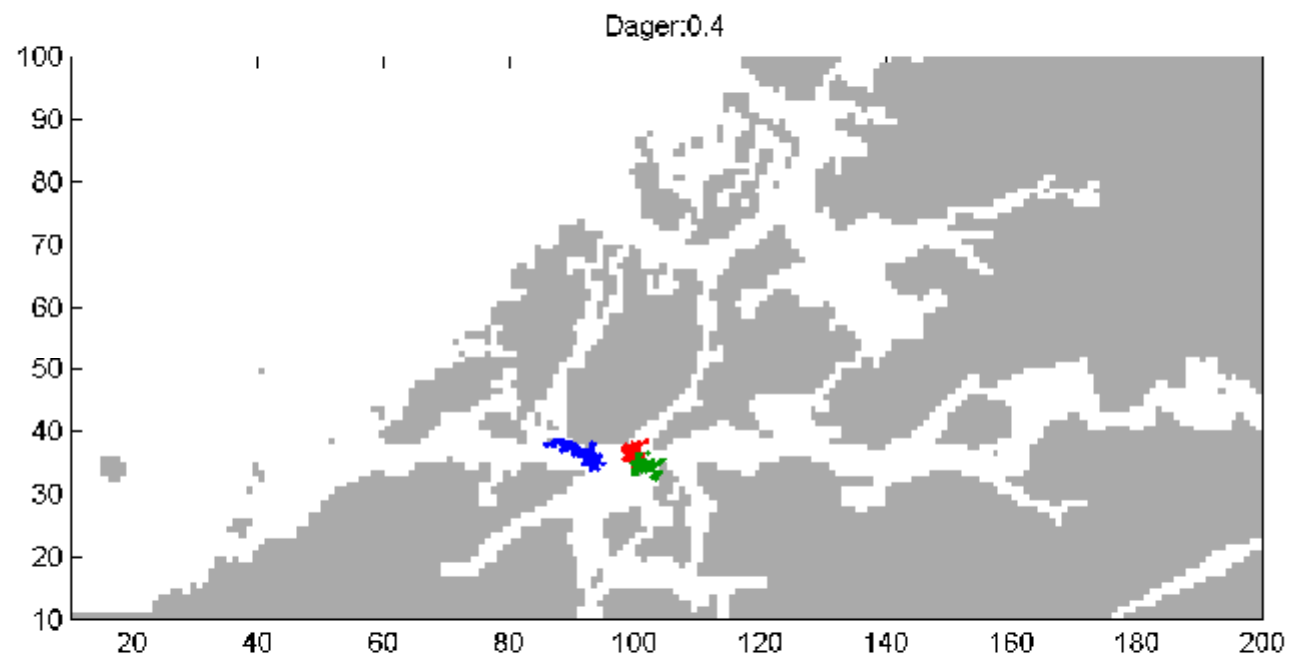


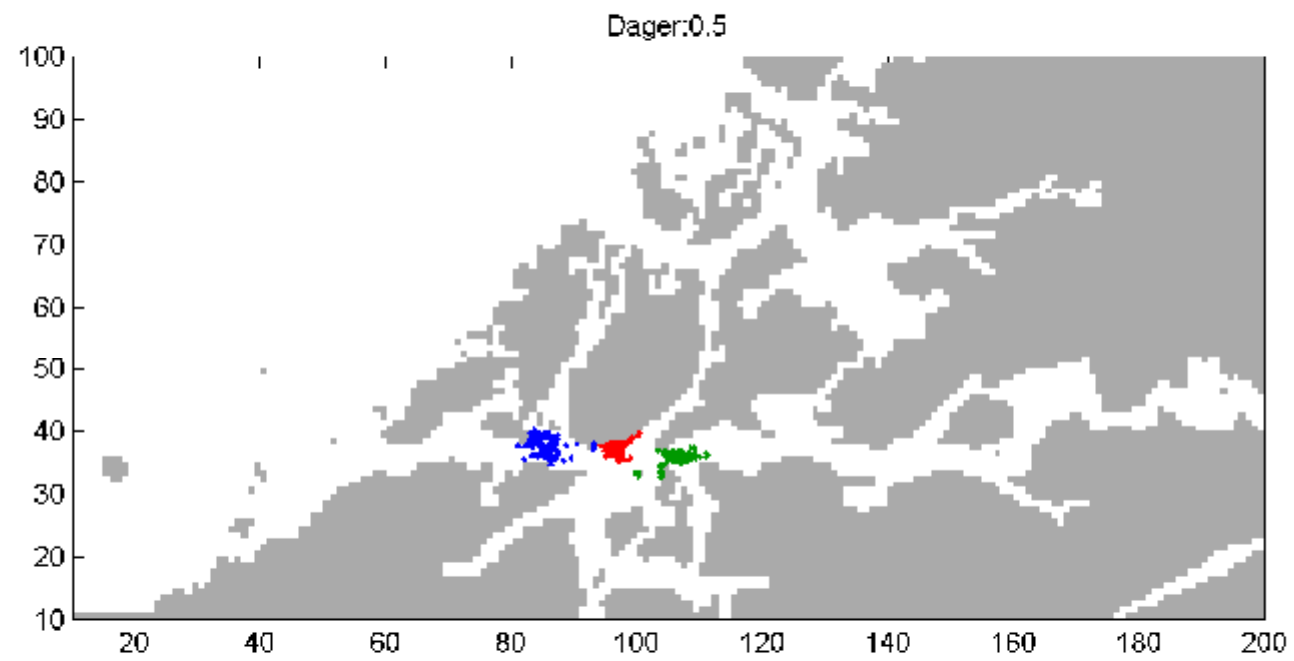


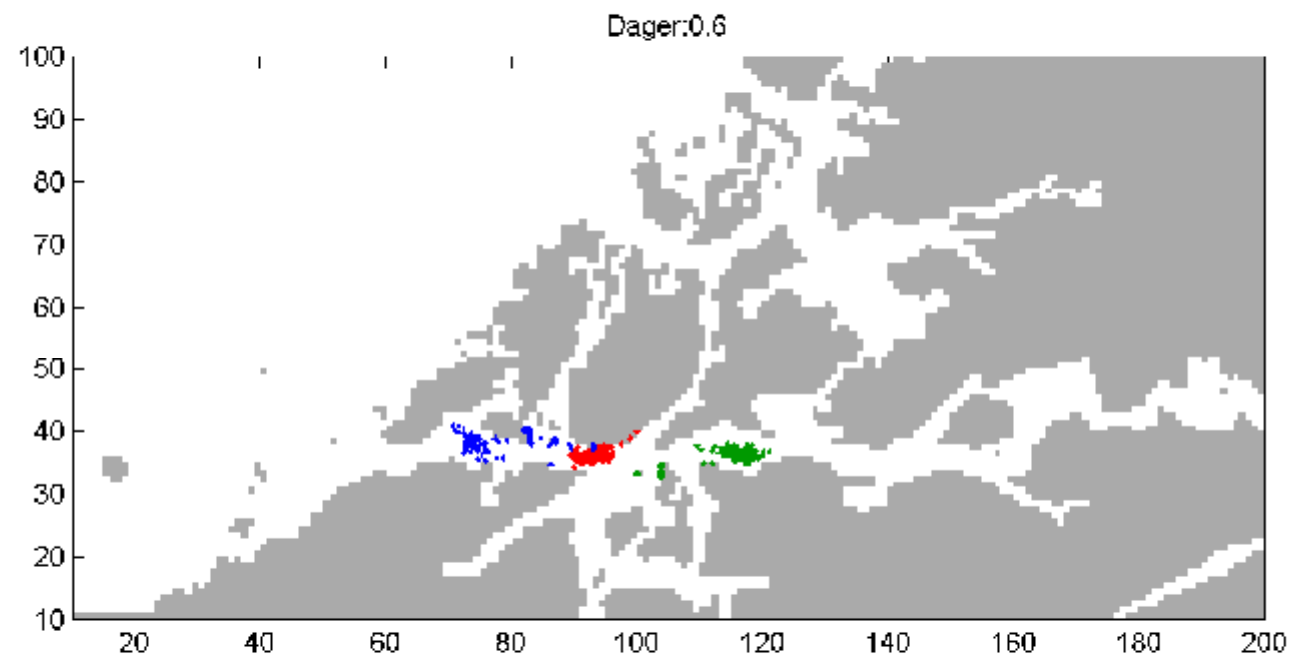
● **Utslippspunkt**

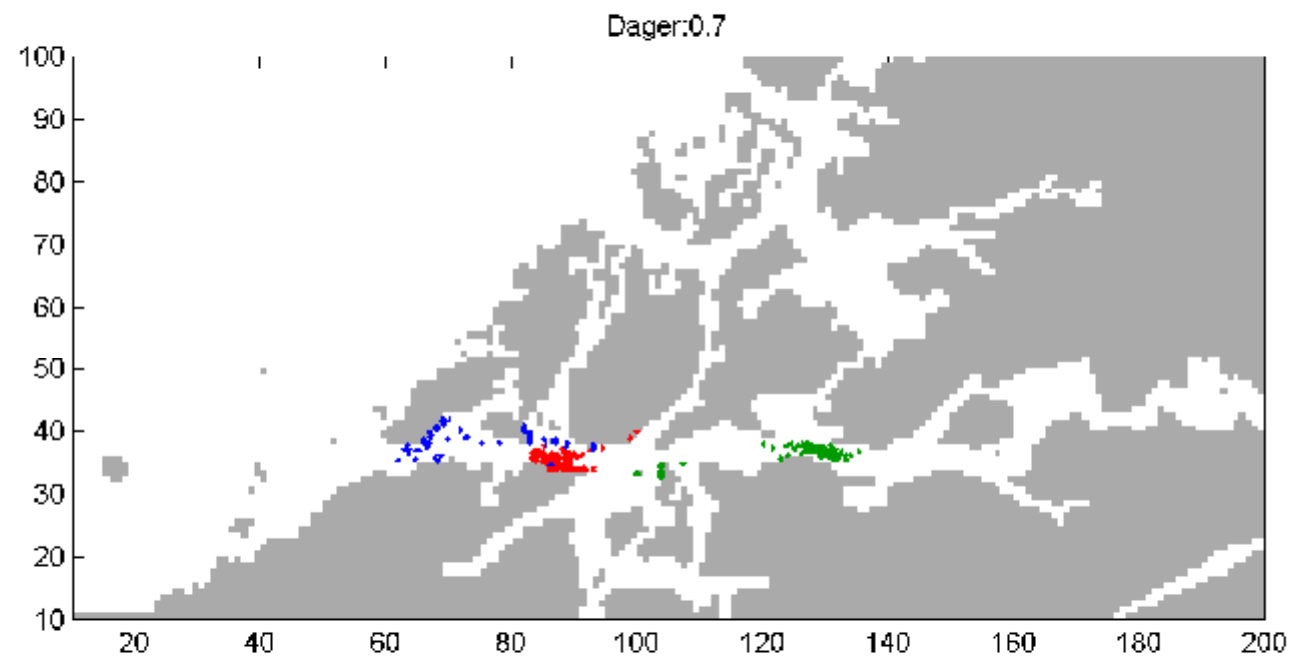


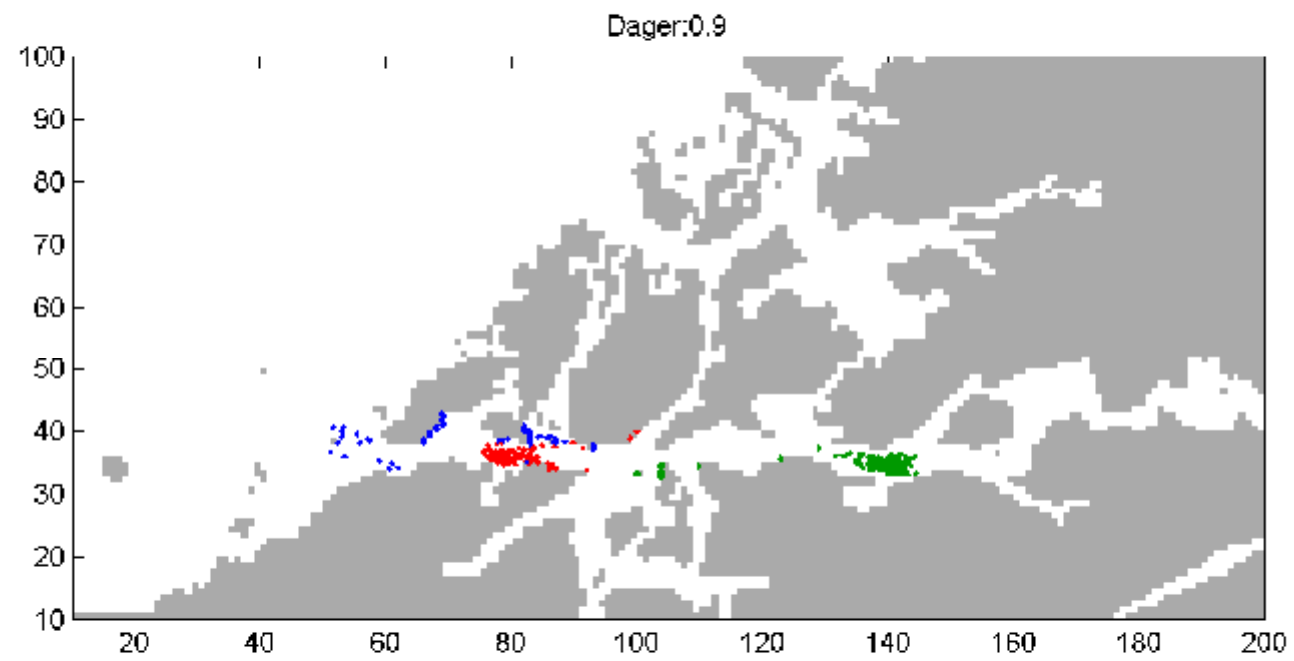






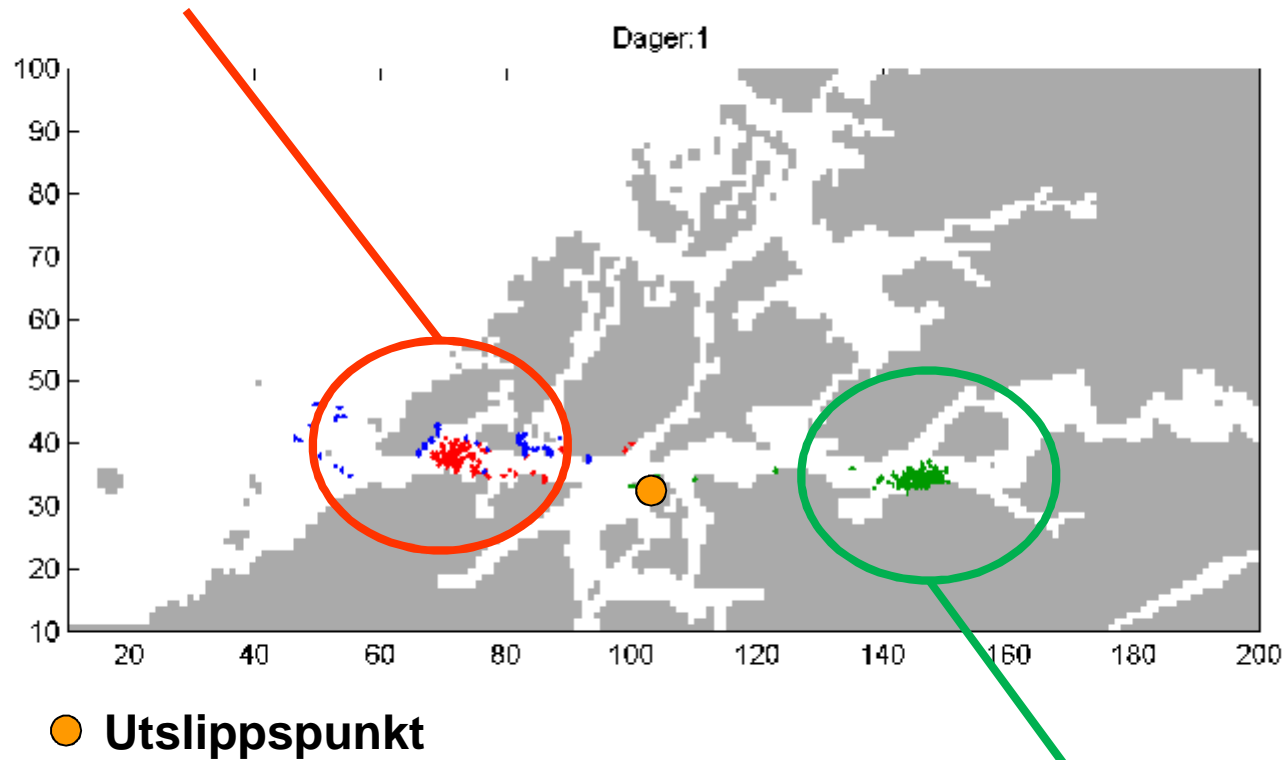






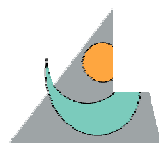
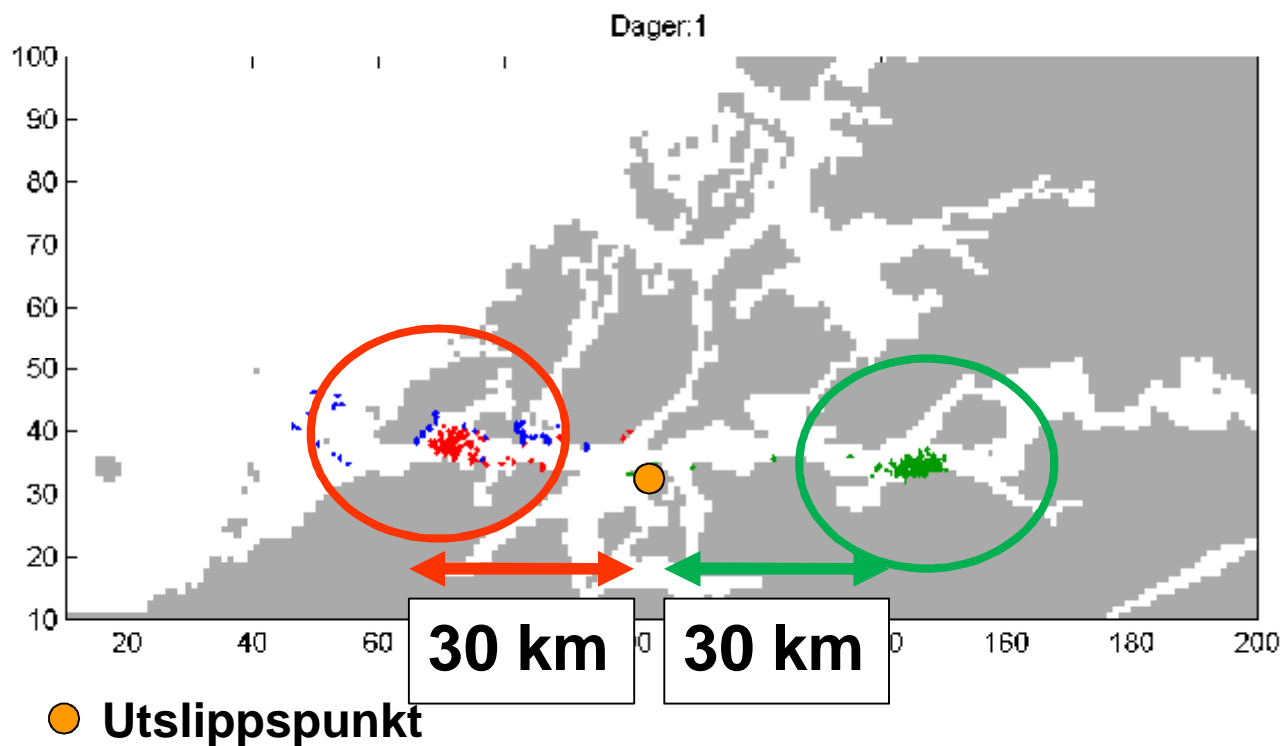
Spredning etter 1 dag fra samme posisjon

Lakselus sluppet **1. mai 2007** og **10. mai 2007**



Lakselus sluppet **5. mai 2007**

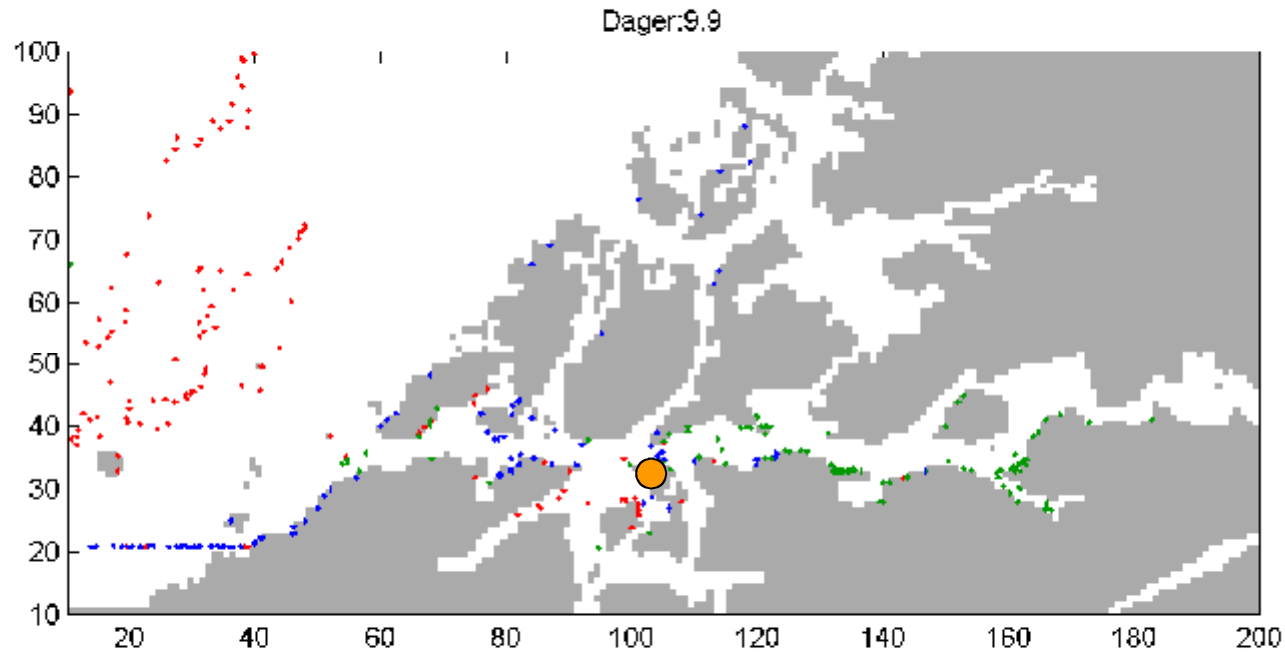
Spredning etter 1 dag fra samme posisjon



Lakselusa har spredt seg ca. 30 km på 24 timer som gir en adveksjonshastighet på 0.35 m/s.

NINA

Spredning etter 10 dager fra samme posisjon



● Utslippspunkt

Lakselus sluppet 1. og 10. mai 2007 fordeler seg utover fjorde
Lakselus sluppet 5. mai 2007 fordeler seg innover fjorden.

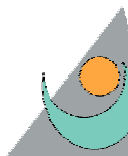
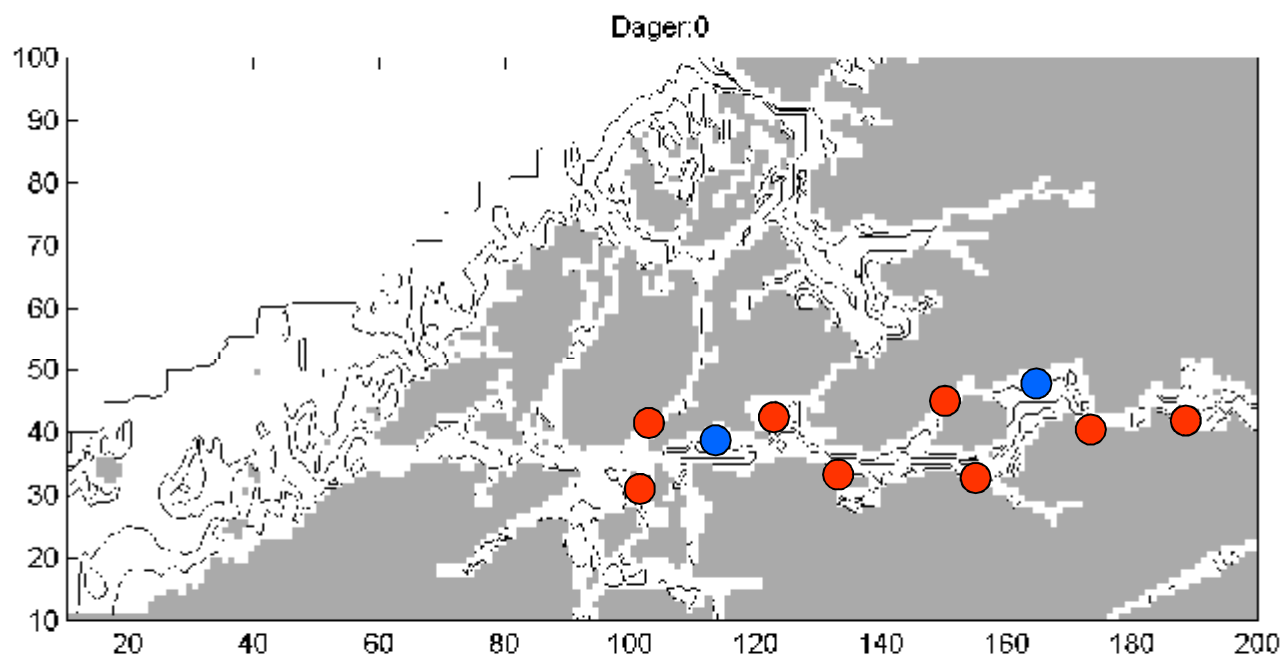
Resultater fra lakselusmodell 2

Illustrasjon av effekten ved å lage klynger av oppdrettsanlegg.



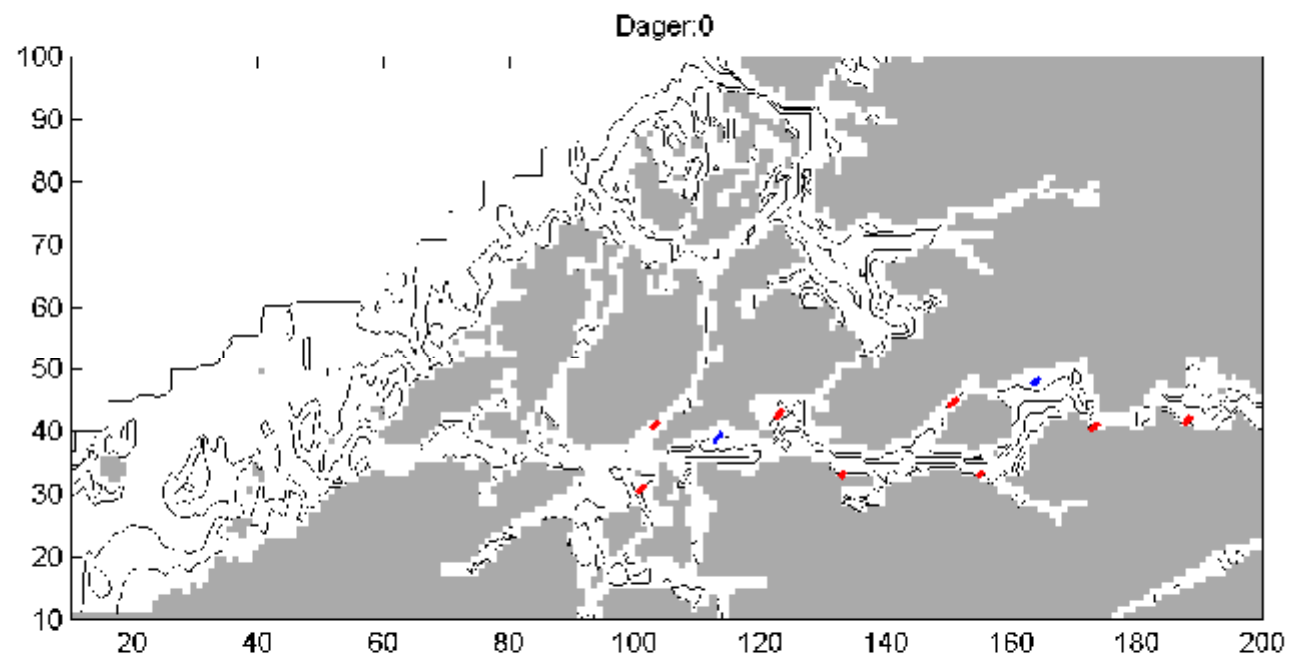
Modellert spredning i Hardangerfjorden

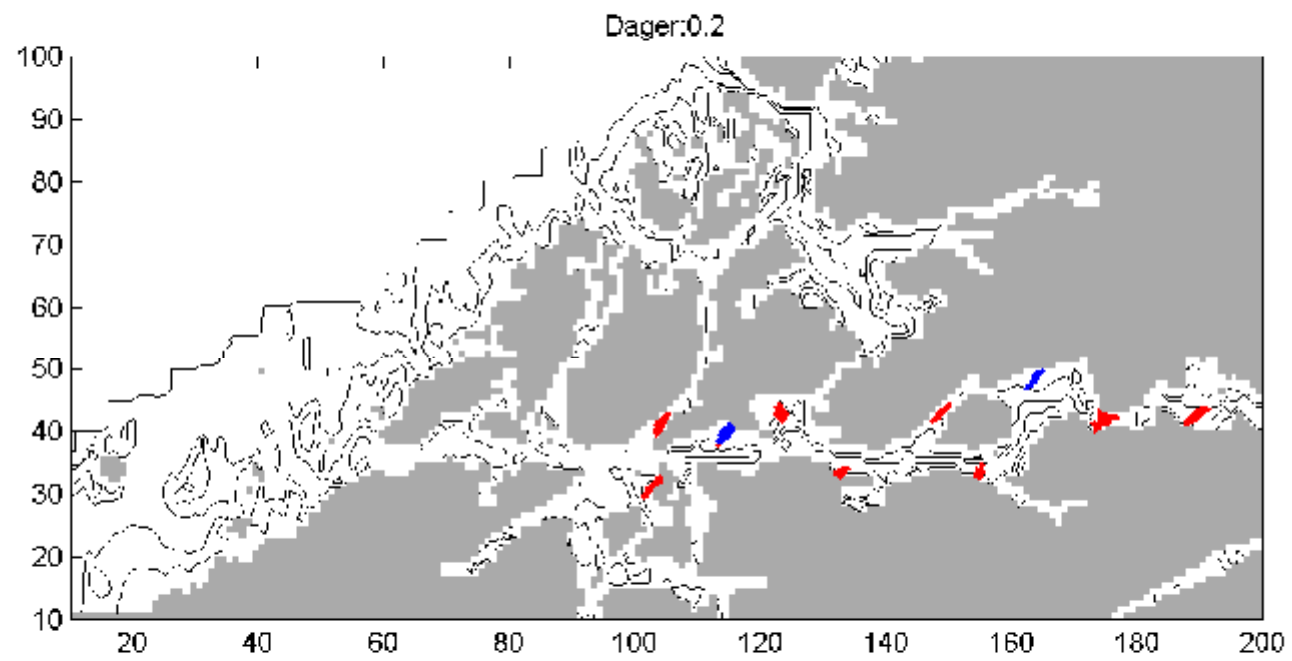
Totalt 2000 lakselus er spredt med realistisk strøm for period 1.– 20. mai 2007 fra henholdsvis 10 mindre anlegg eller 2 store klynger av anlegg.

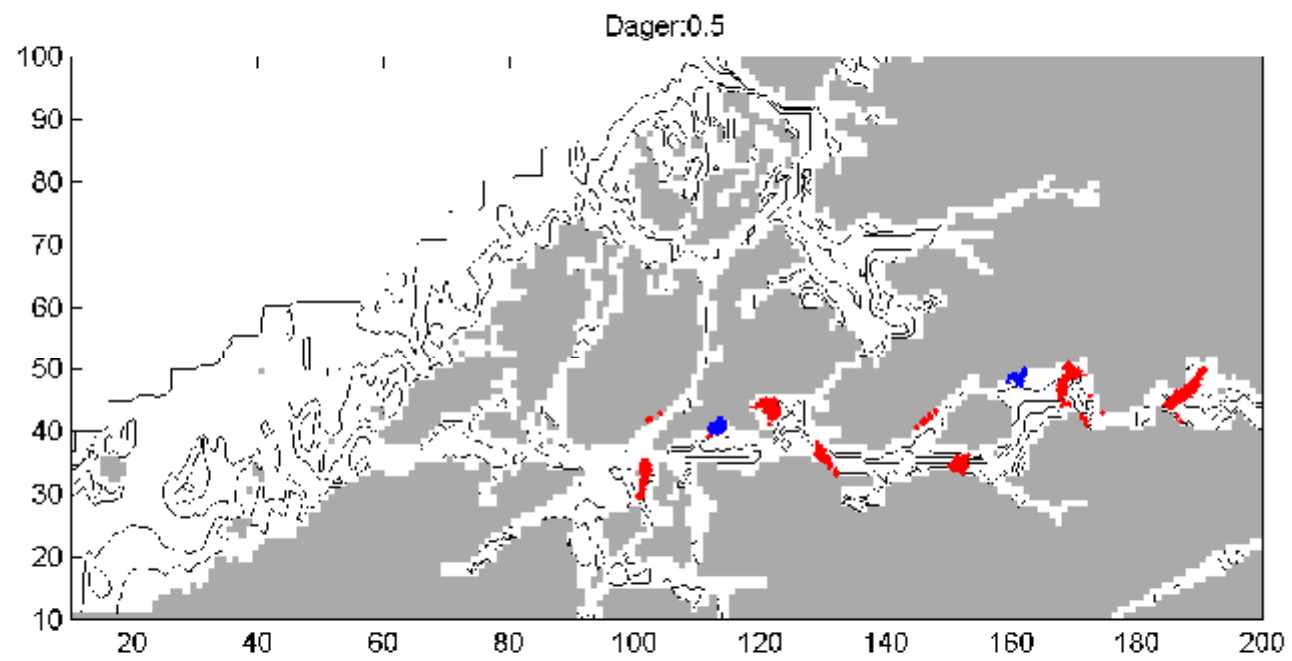


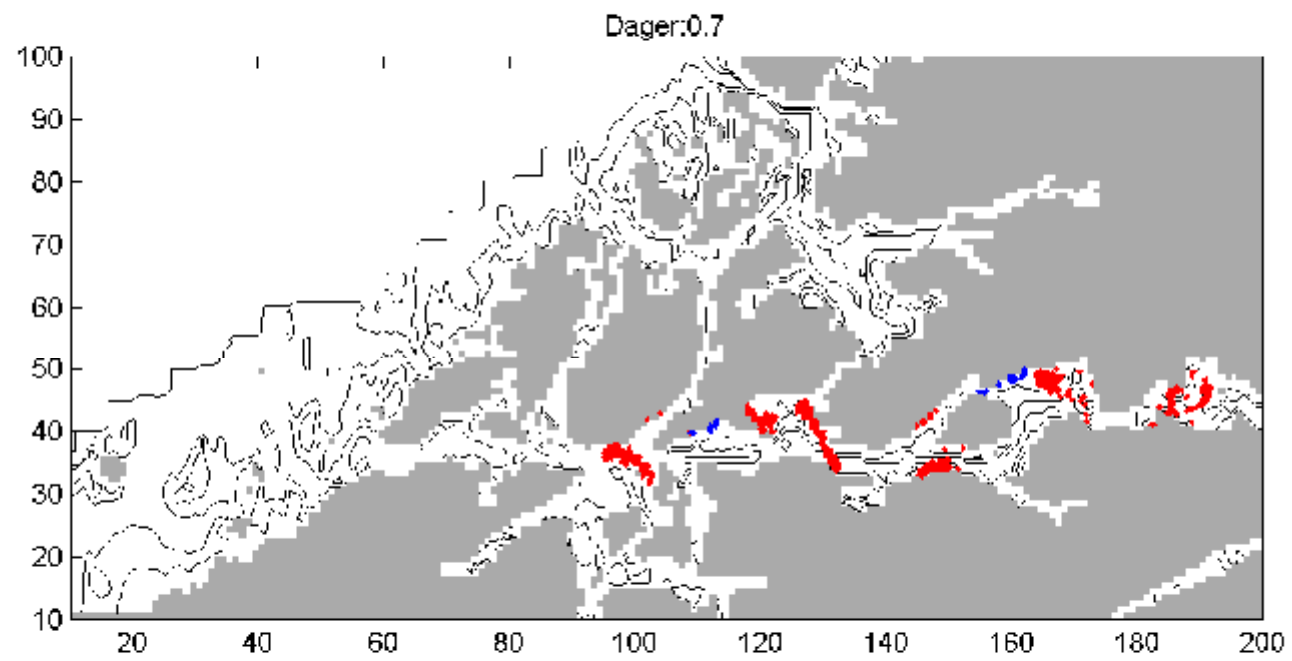
● Klynge (1000 lus)

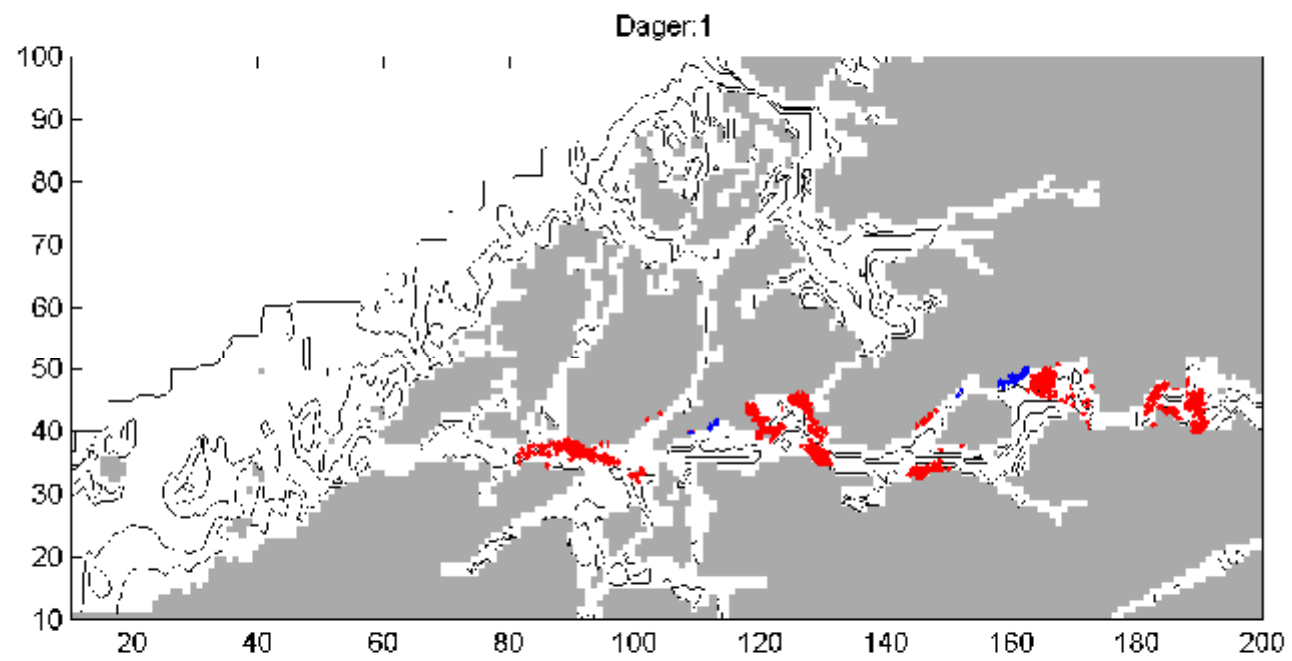
● Mindre anlegg (200 lus) + lite anlegg i klyngeposisjonene

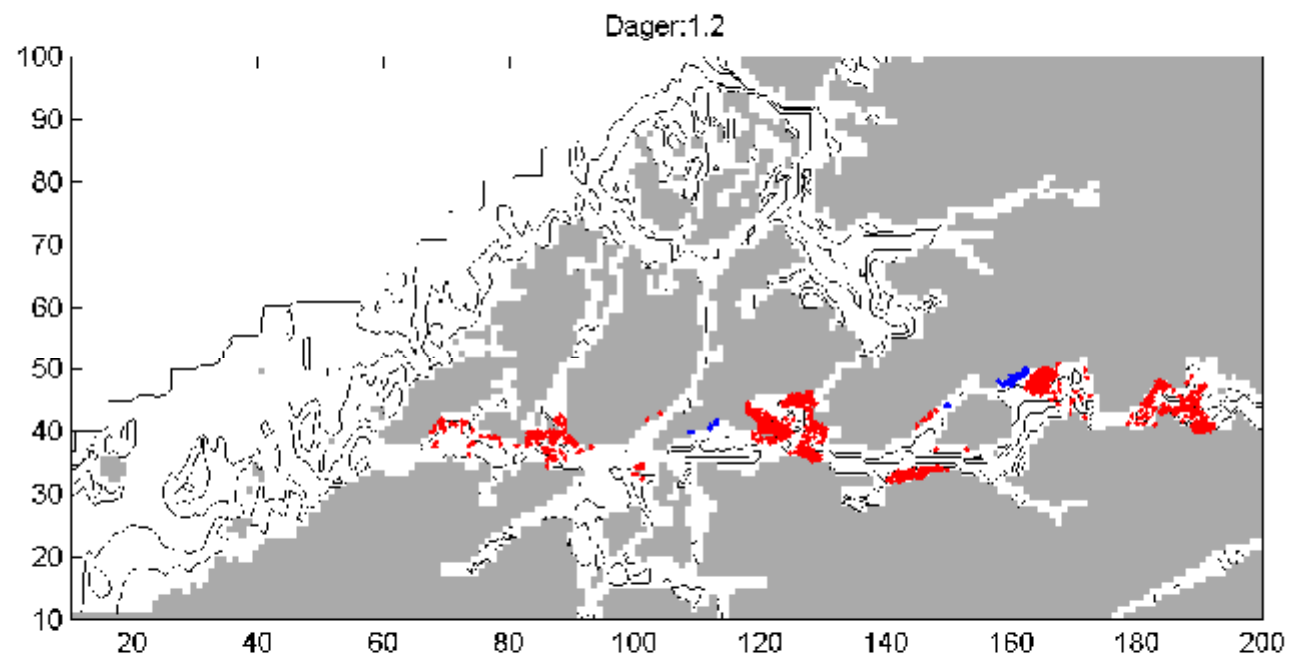


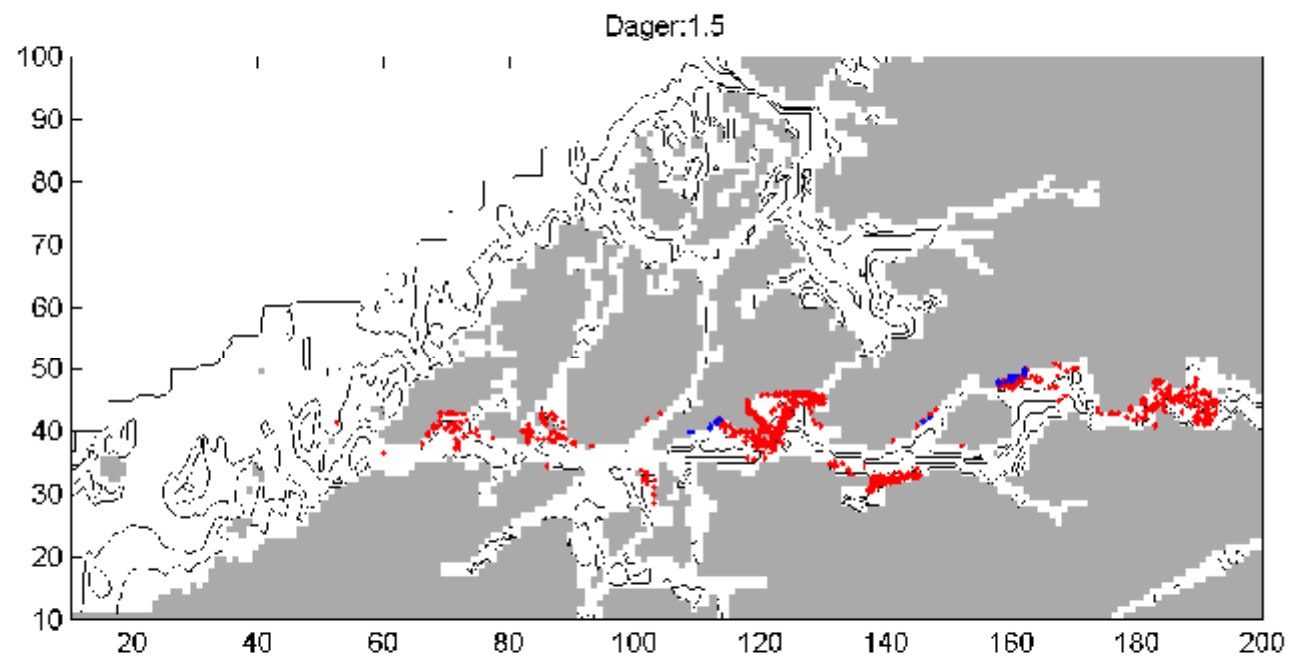


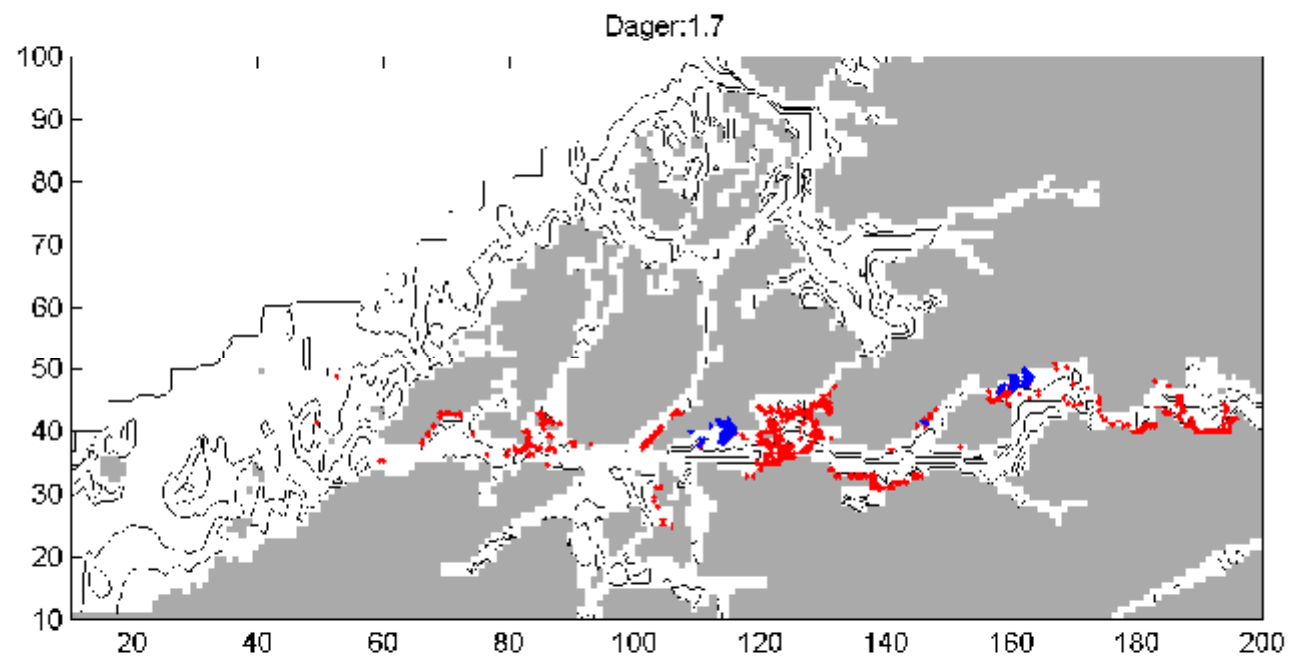


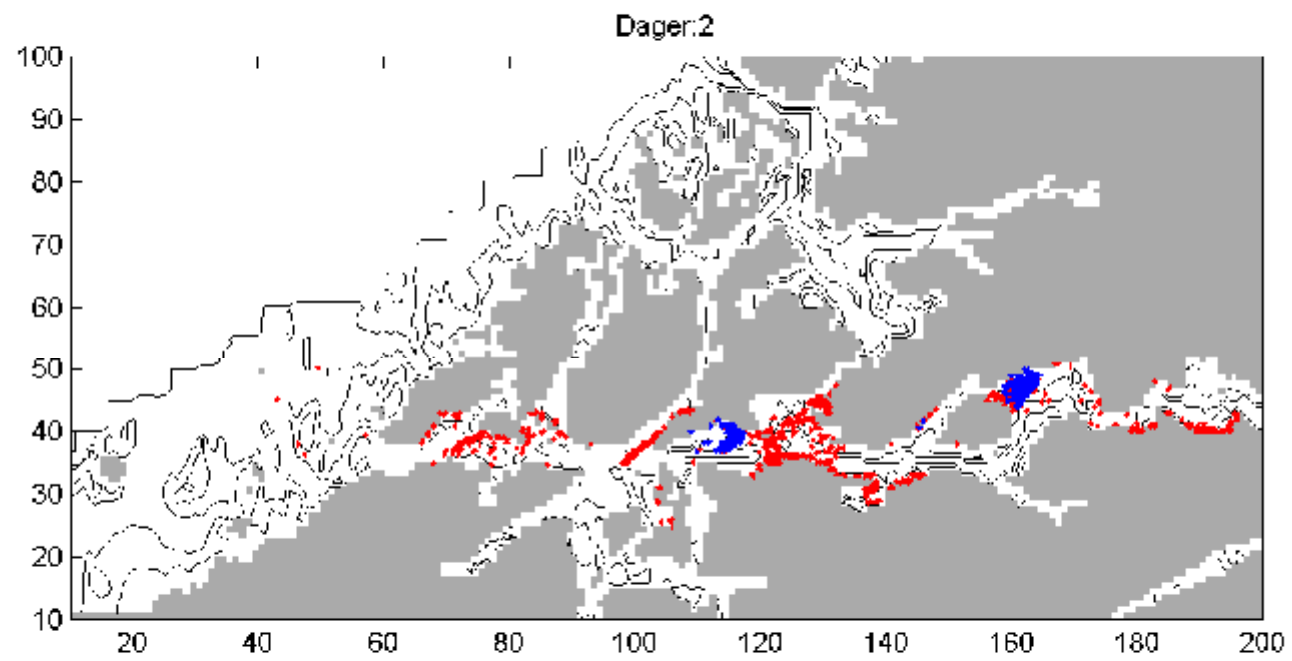


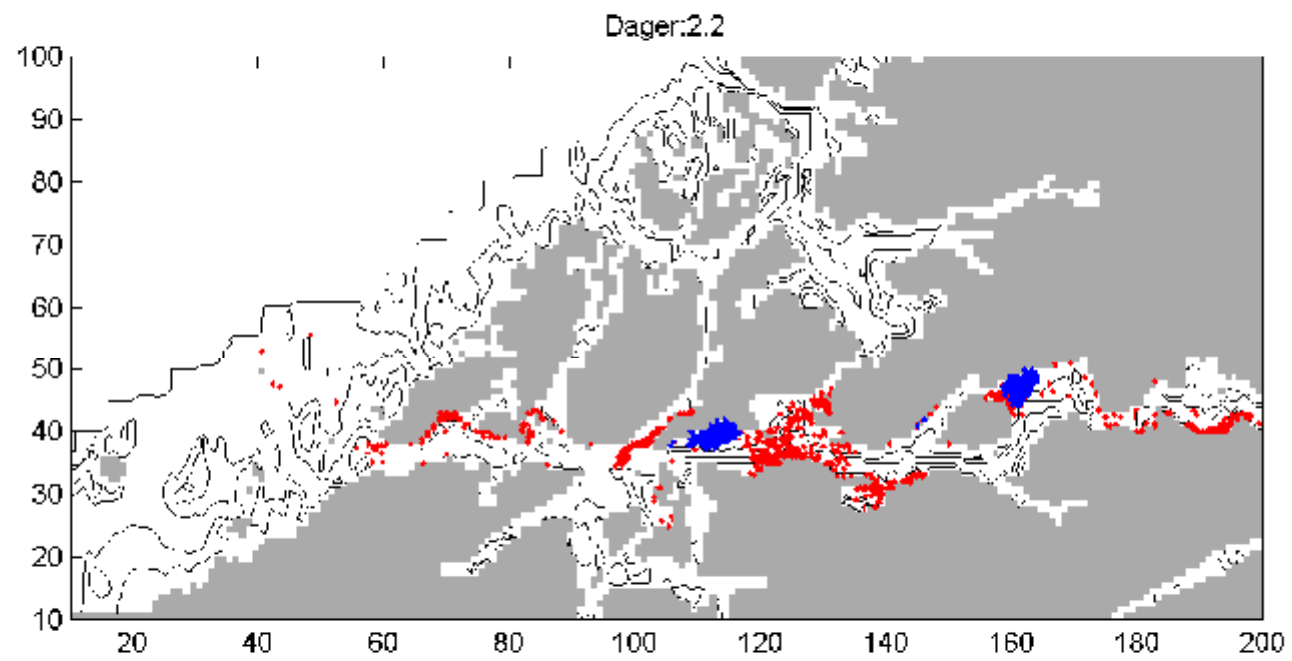


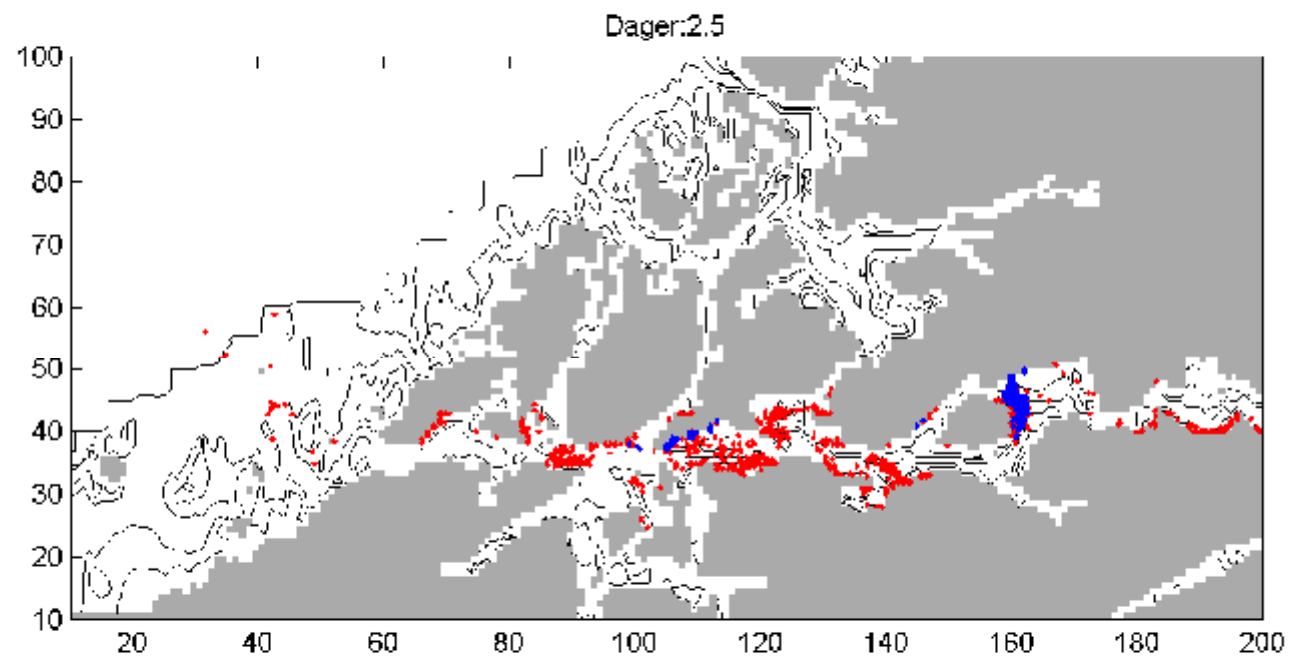


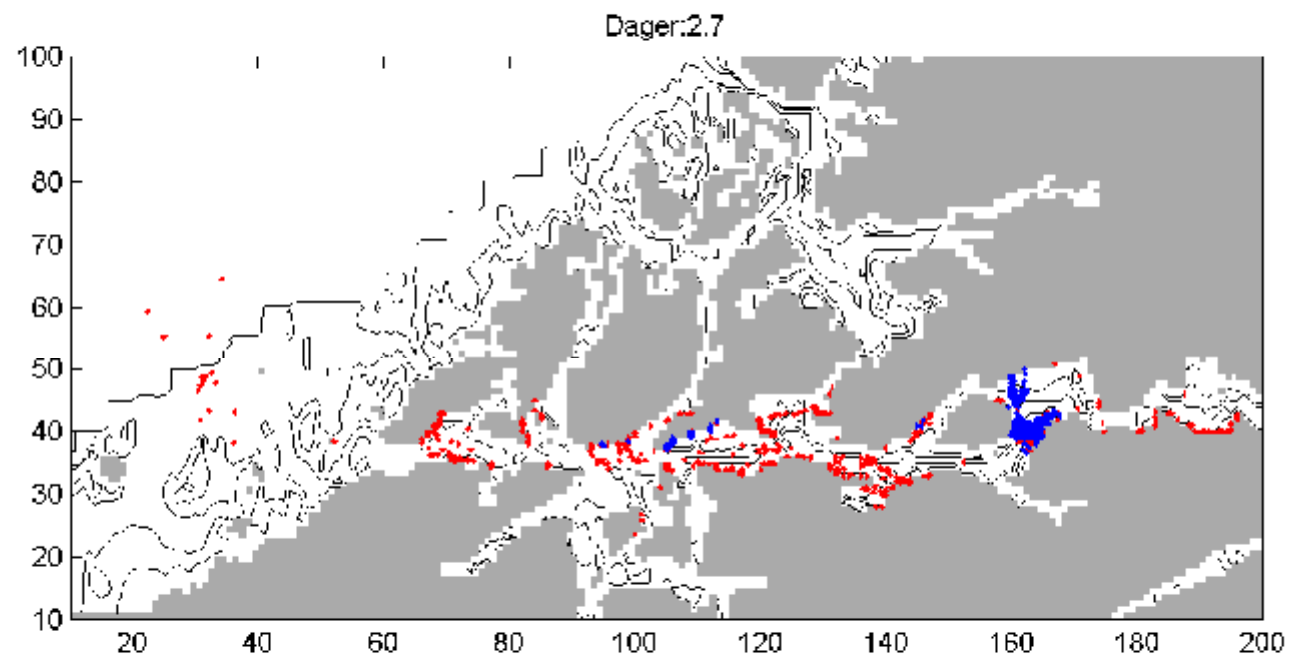


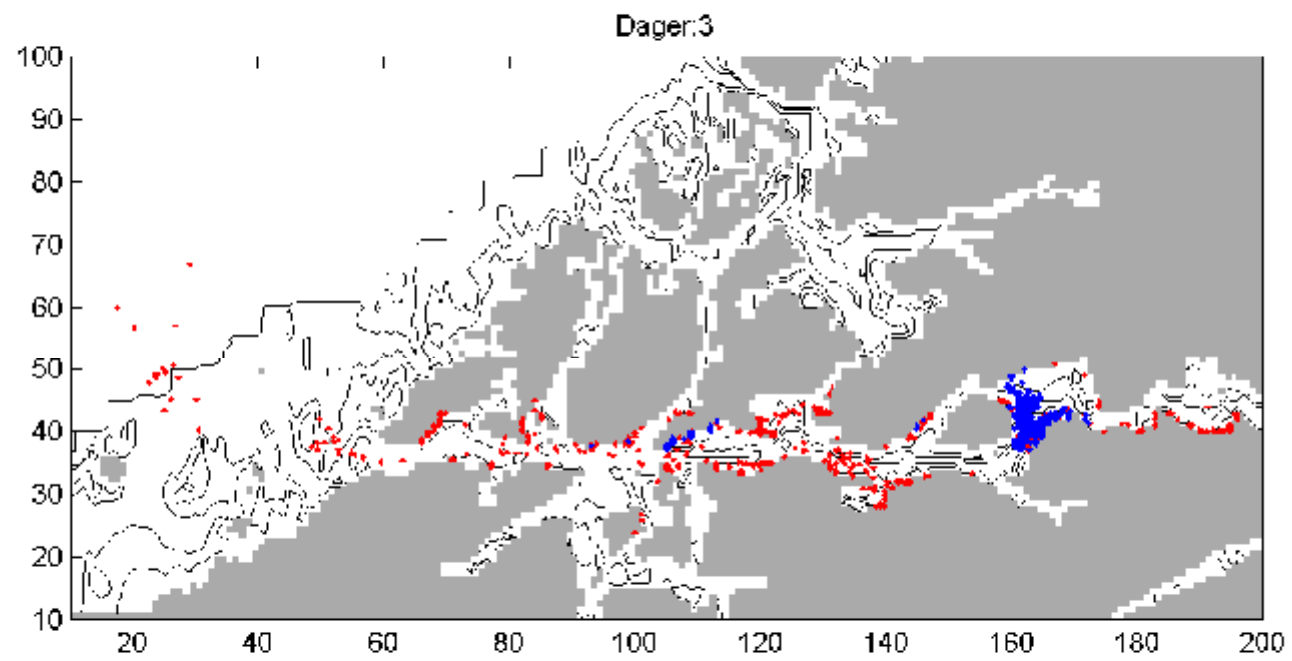


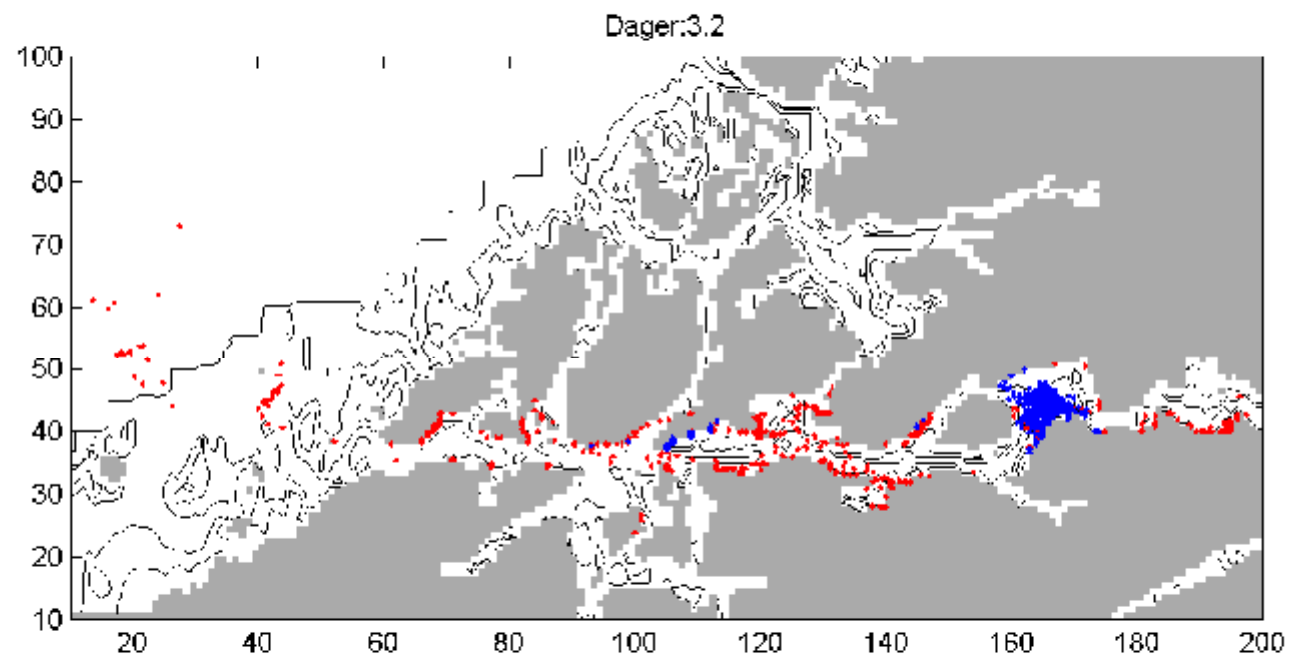


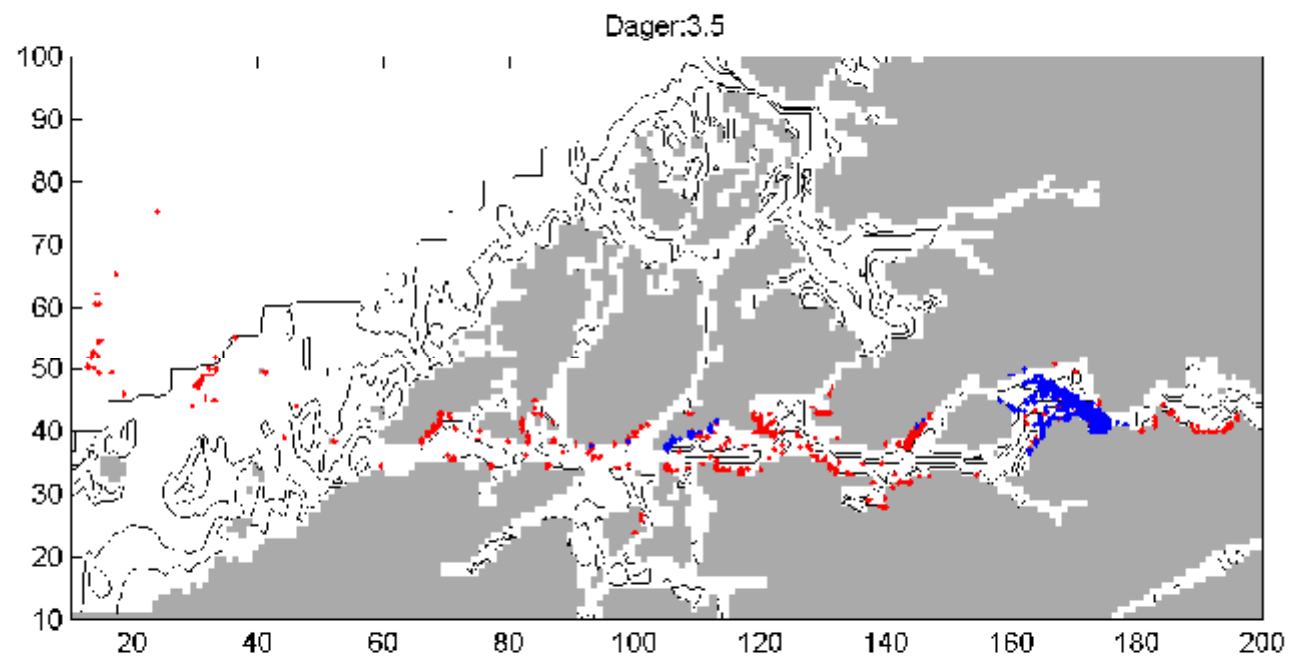


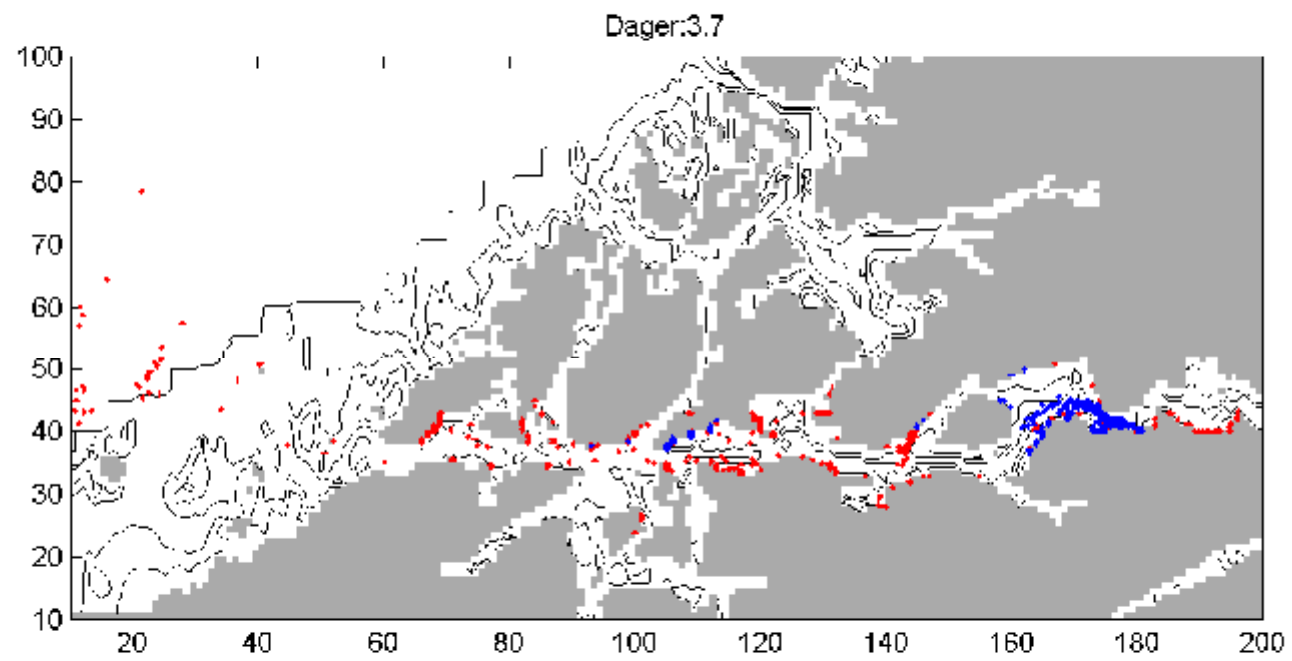


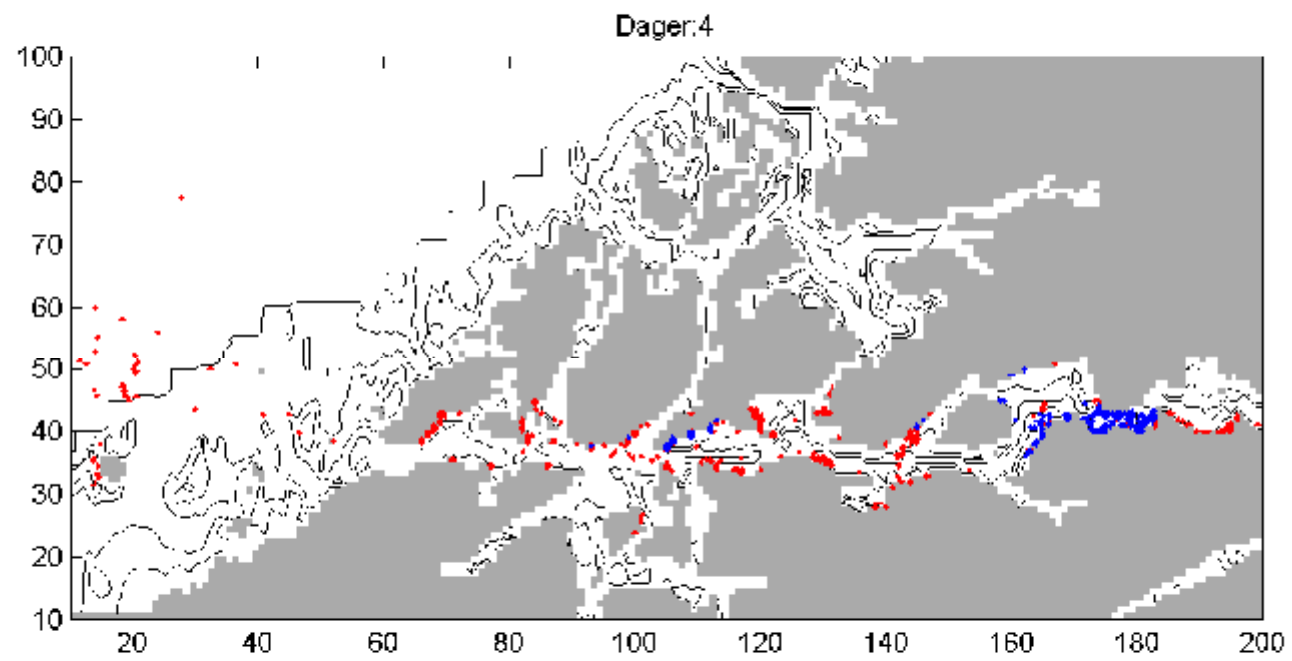


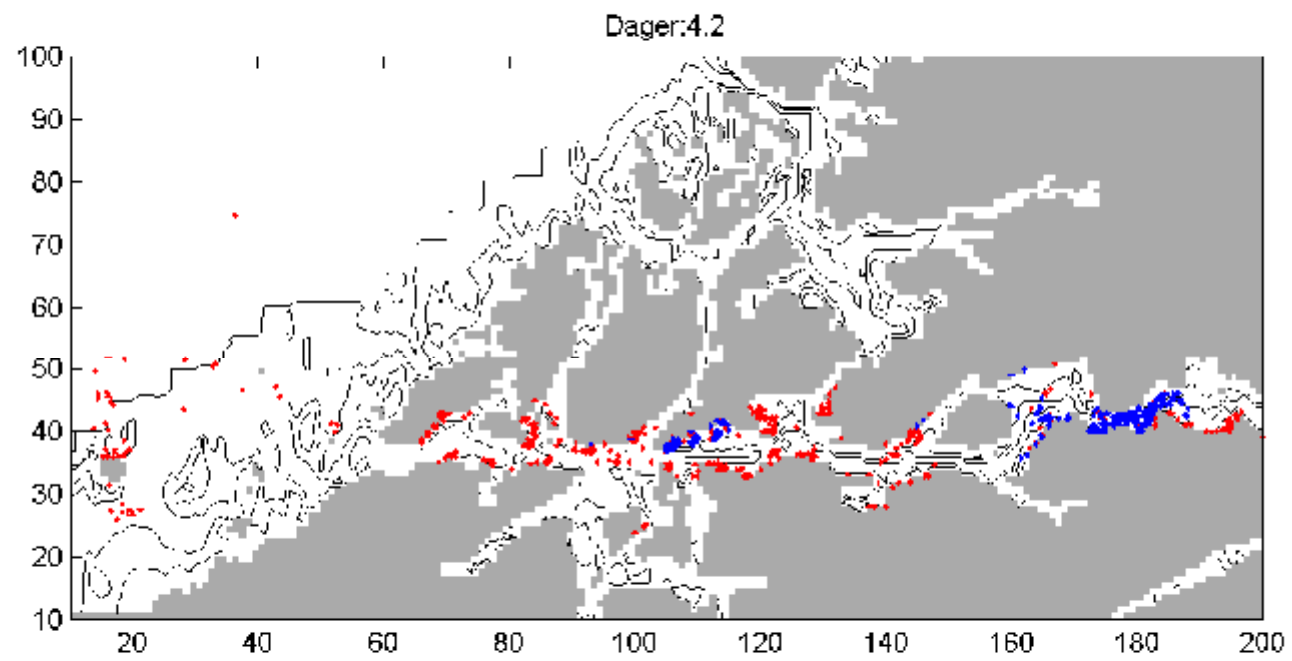


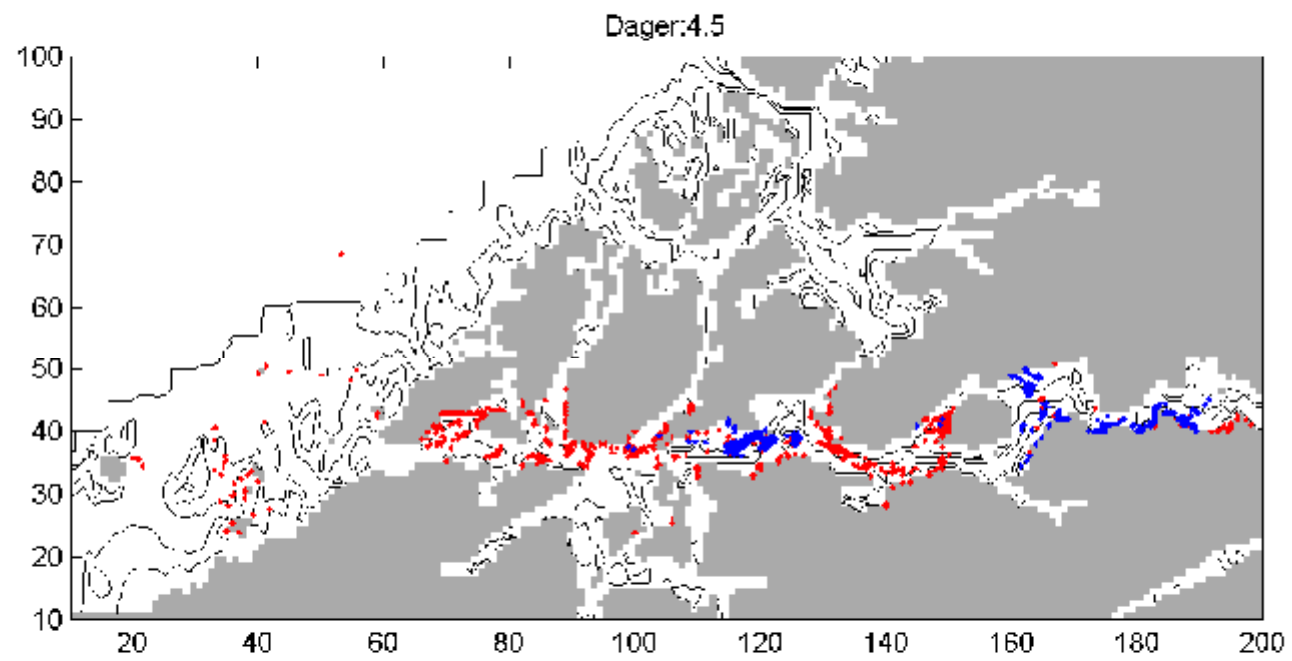


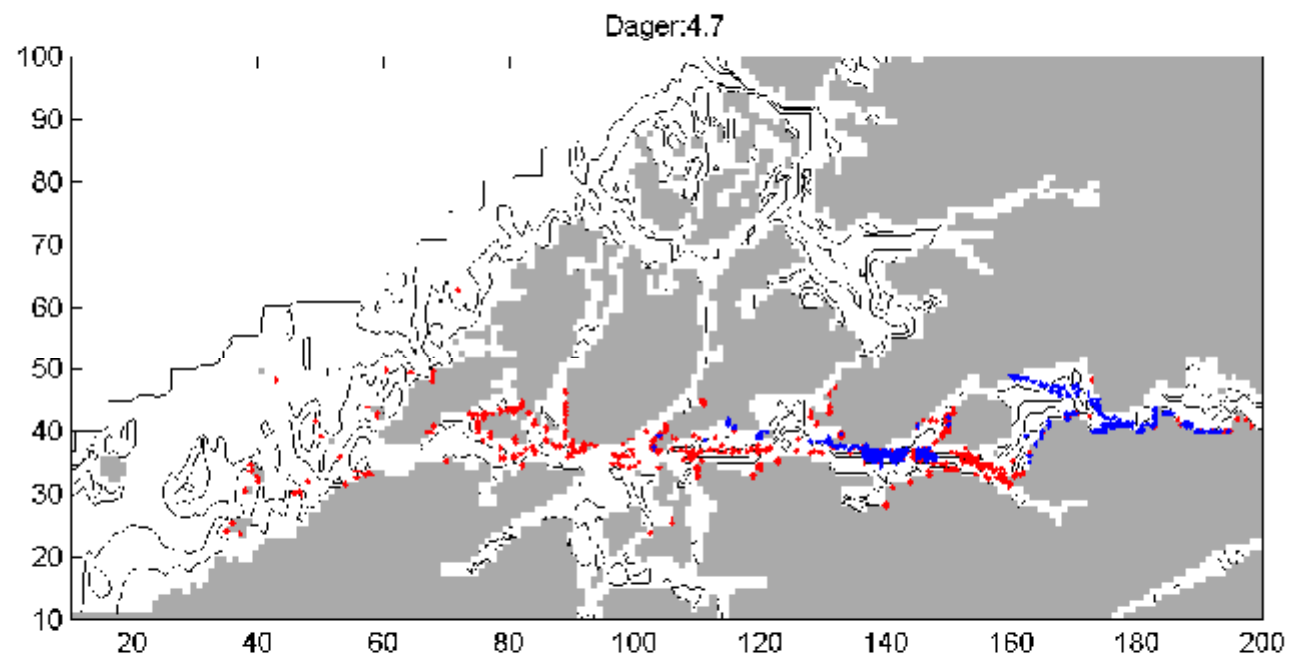


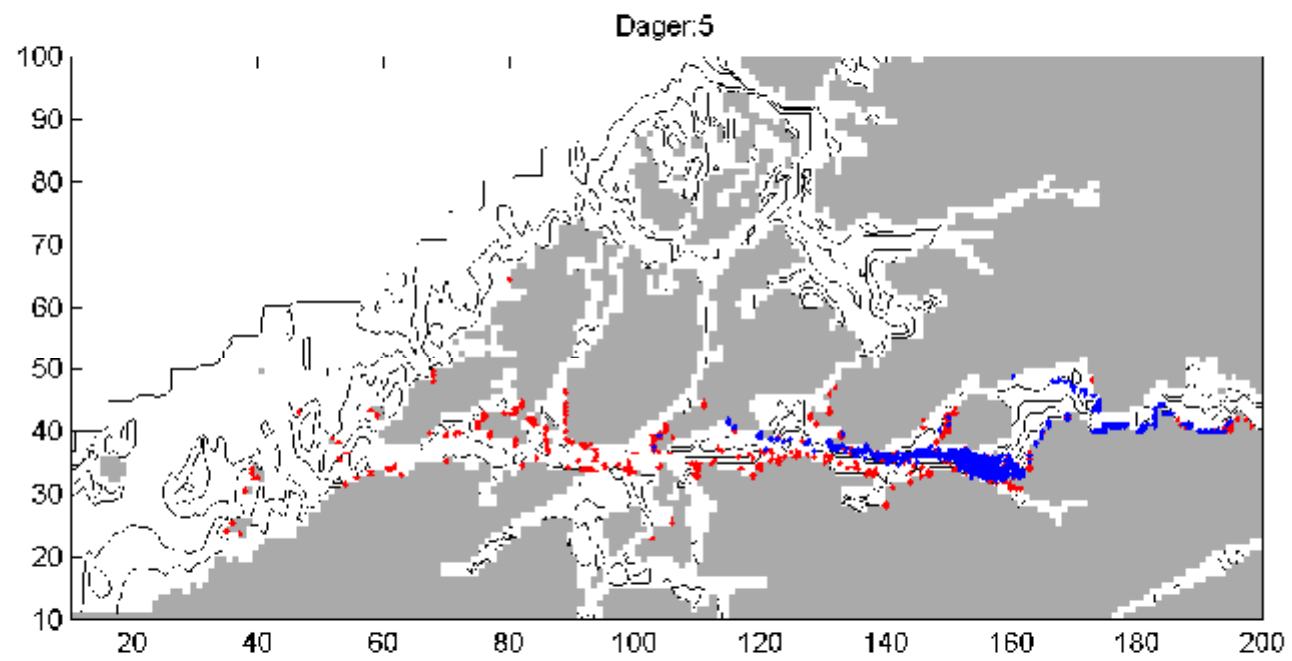


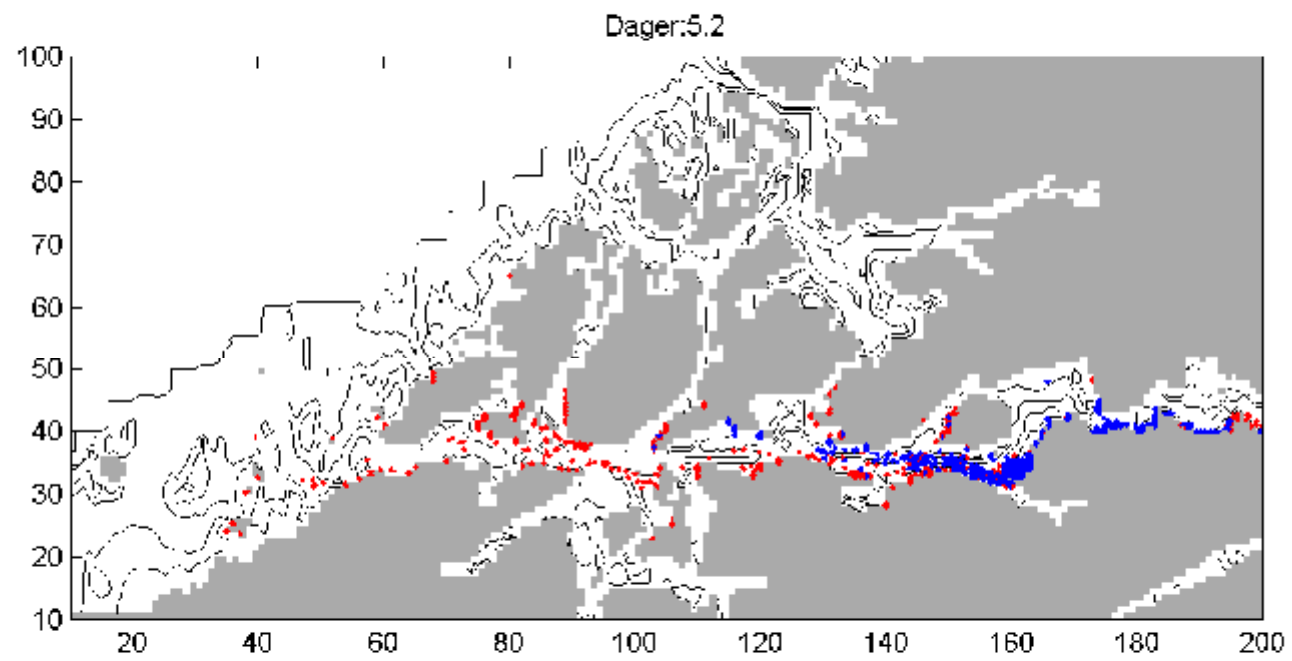


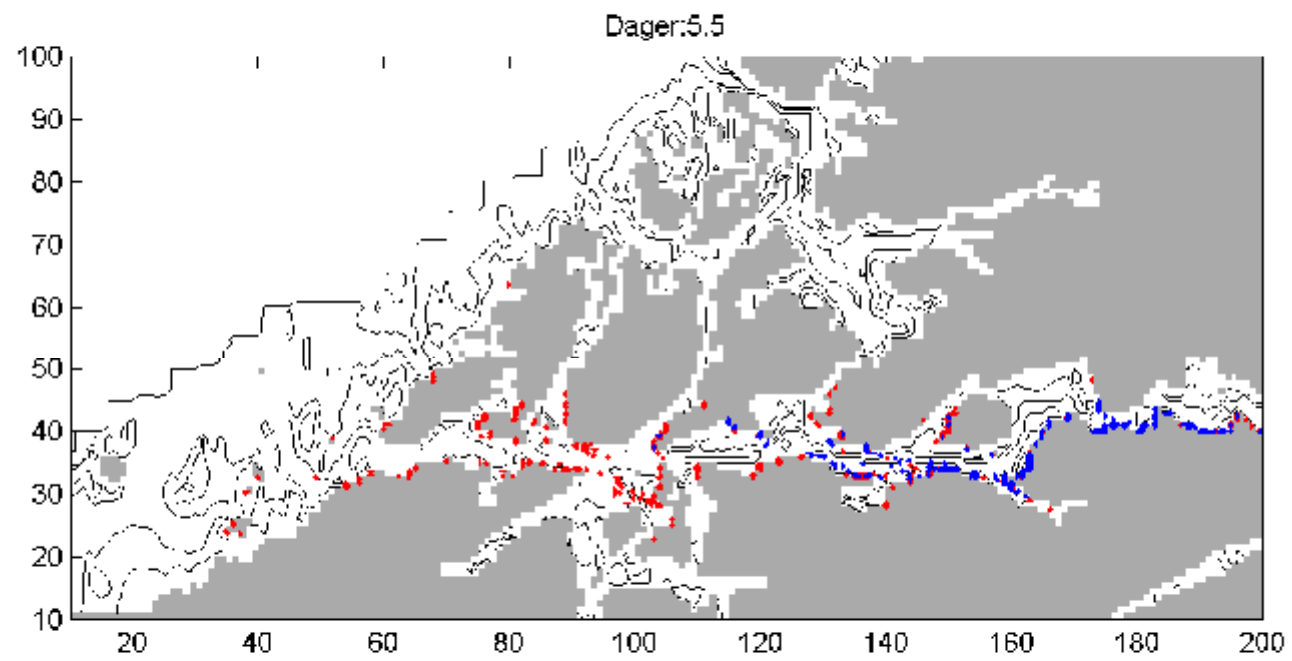


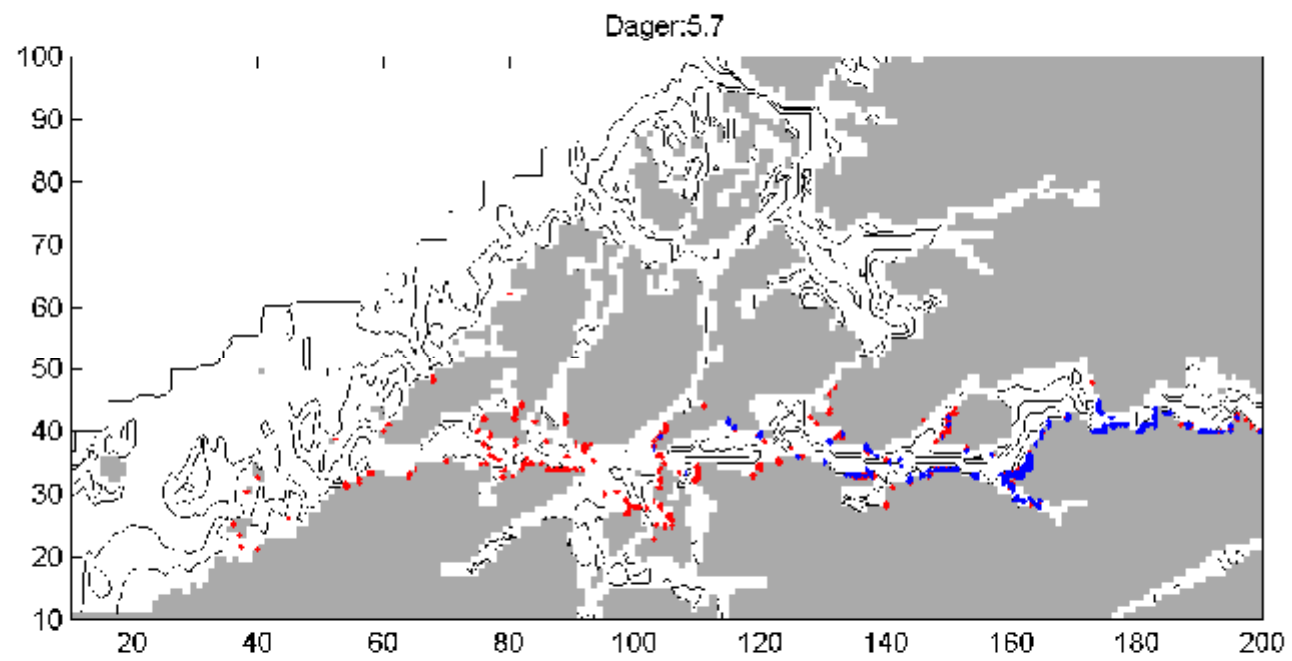


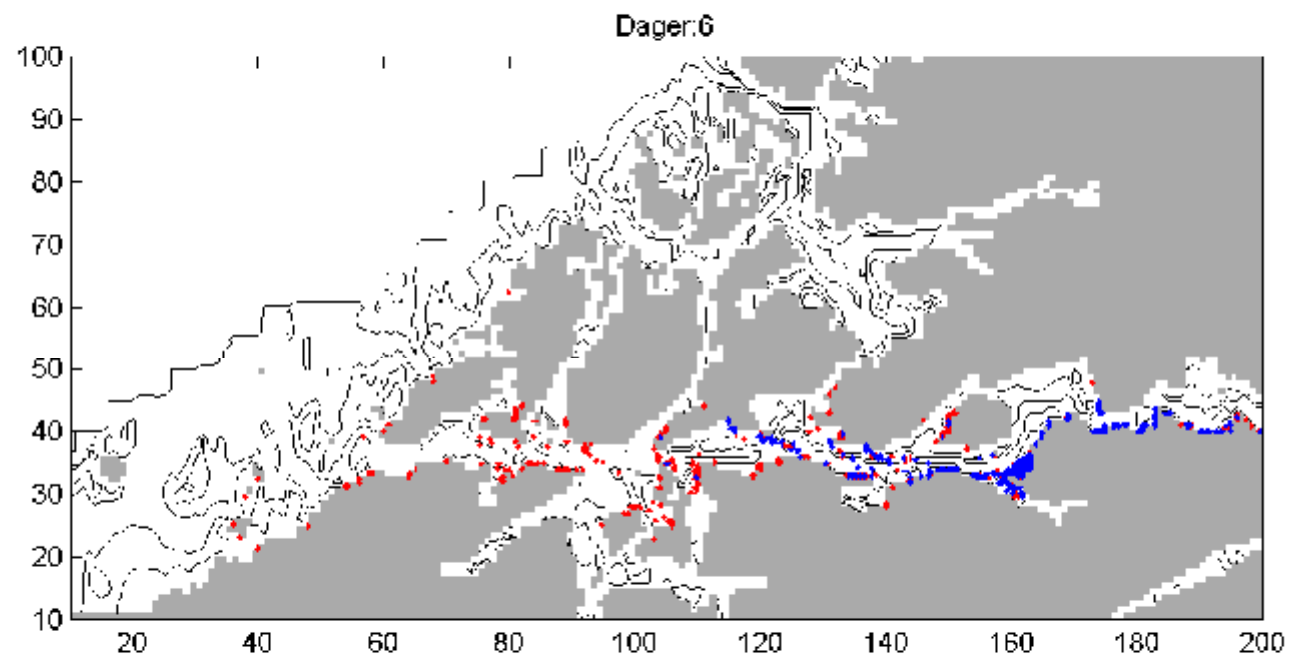


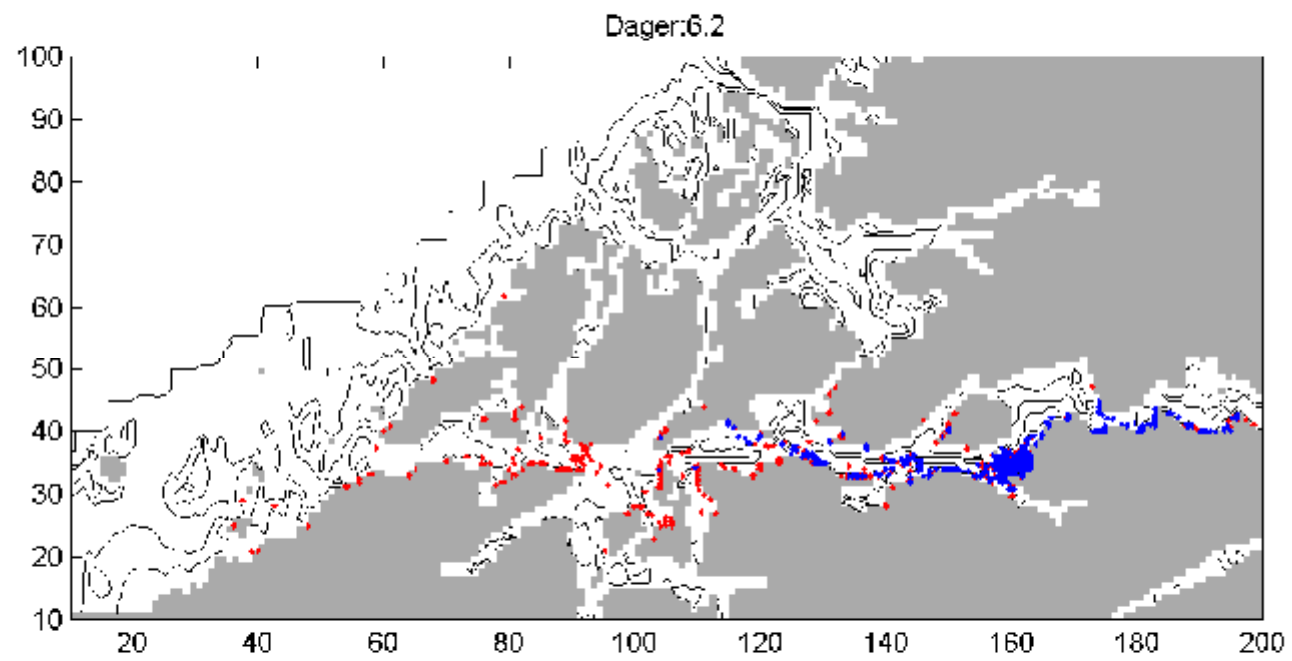


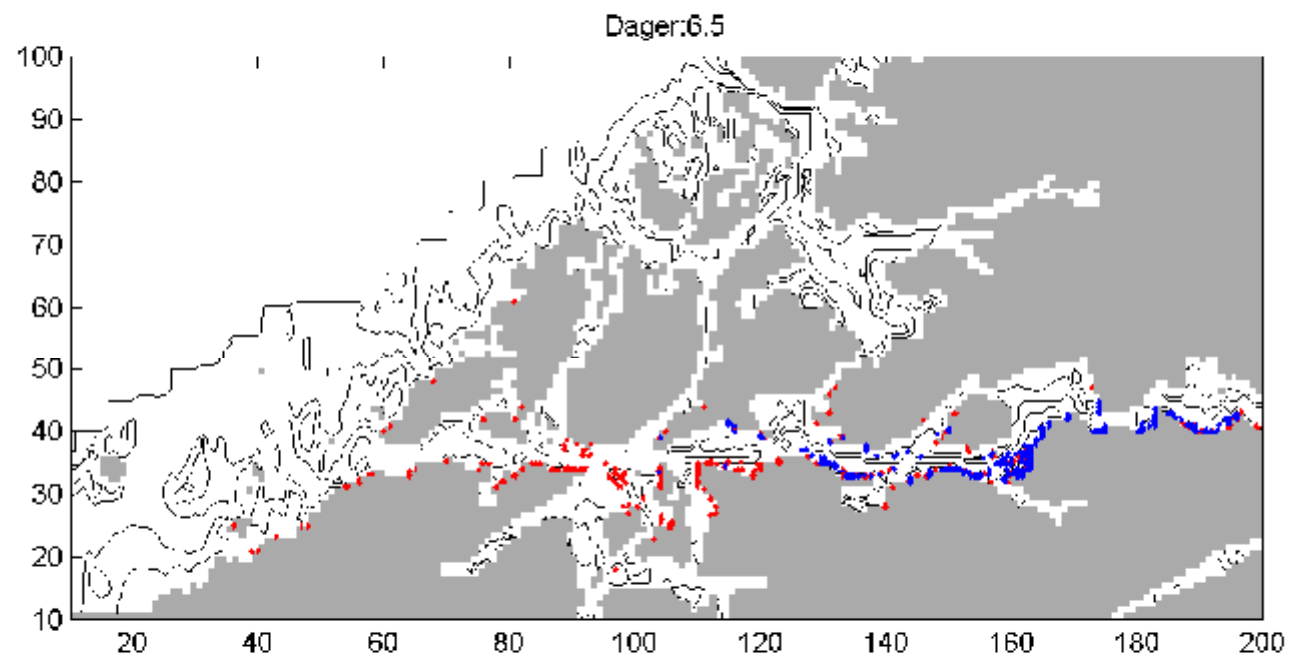


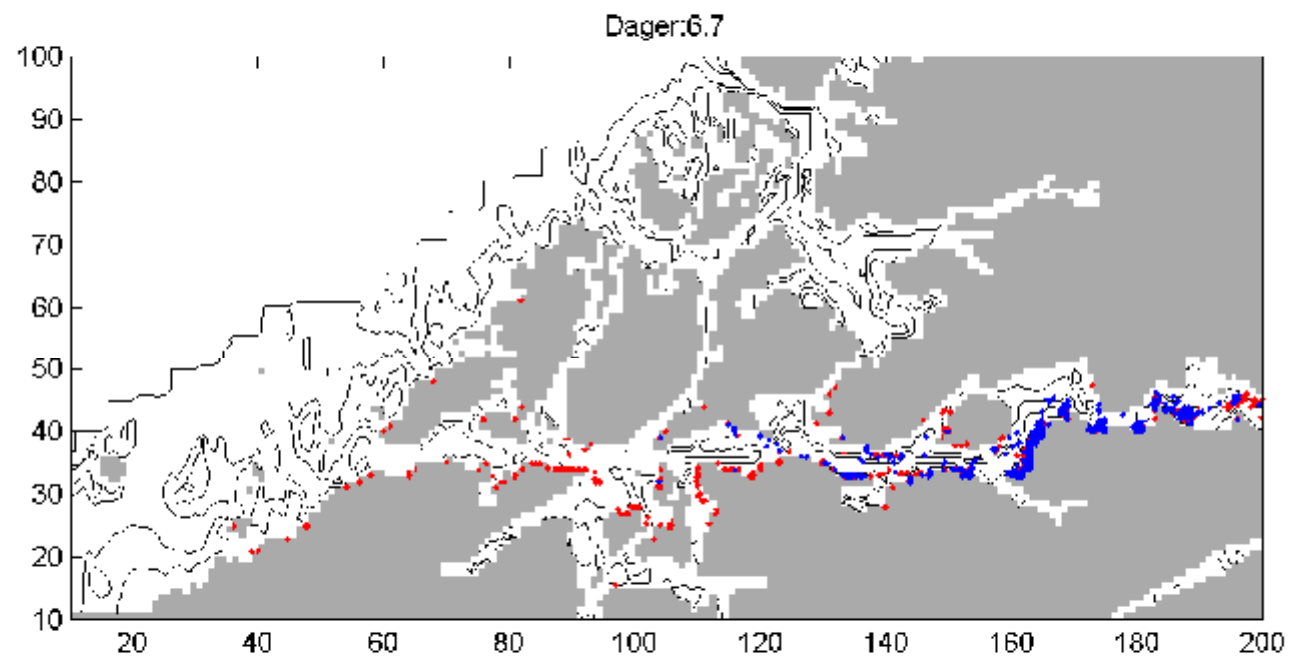


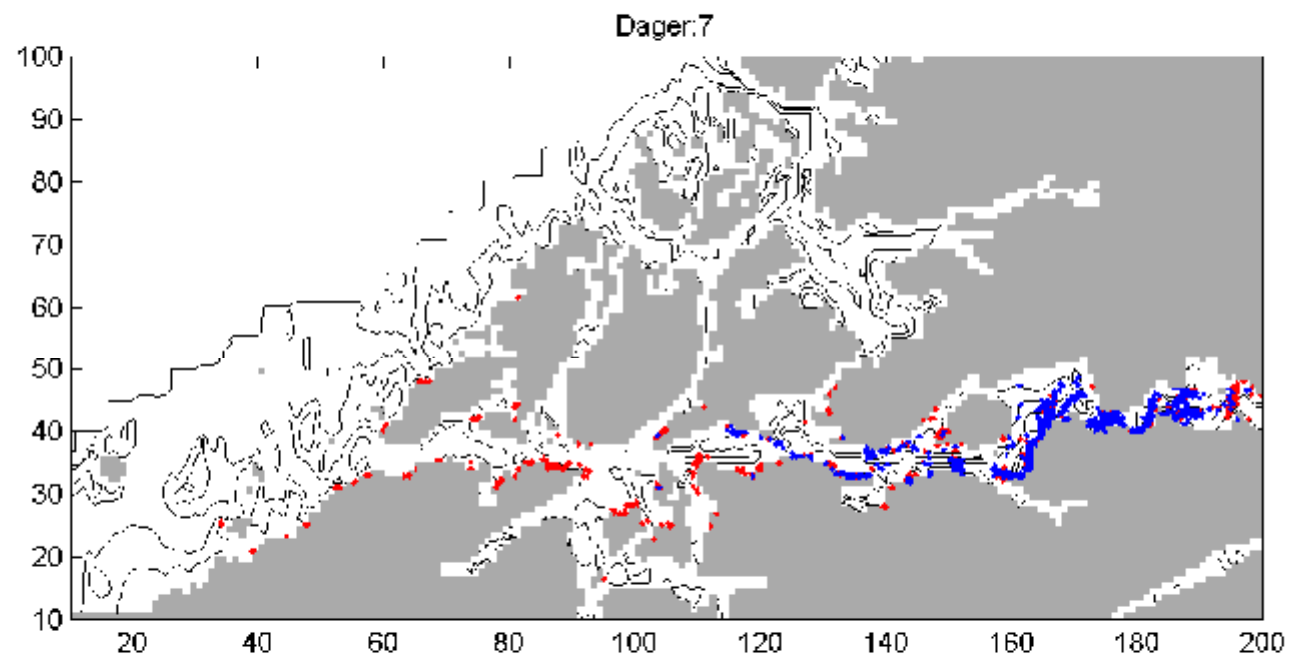


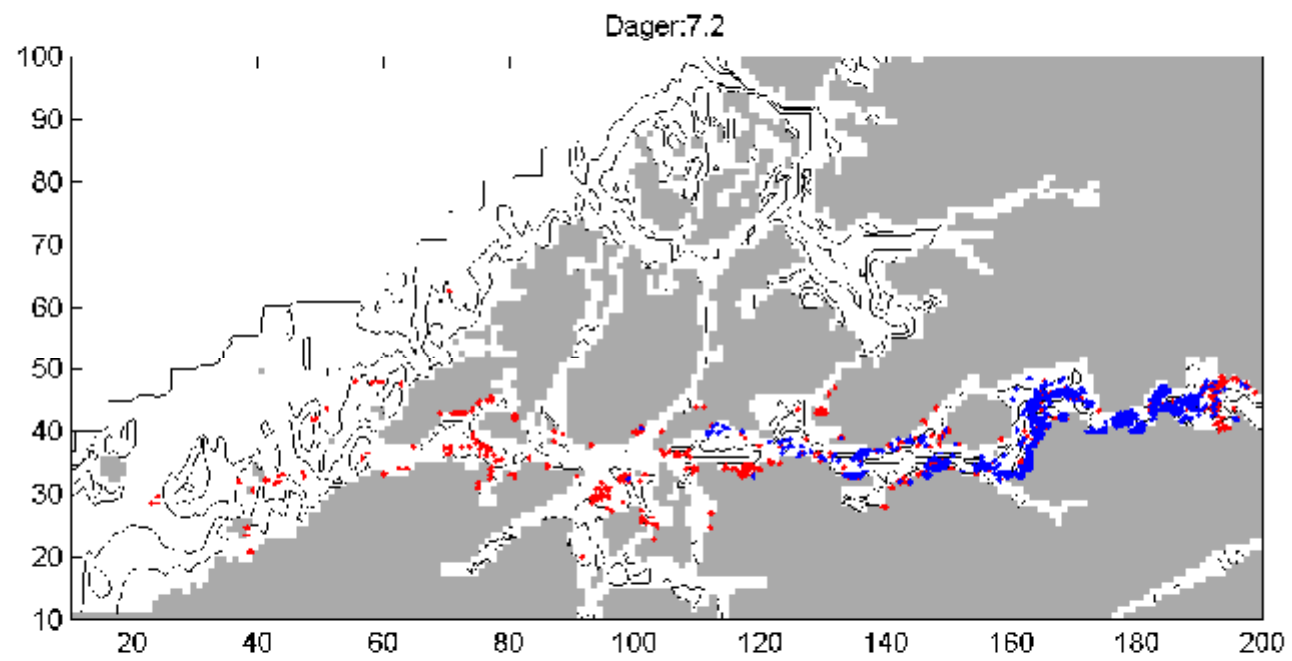


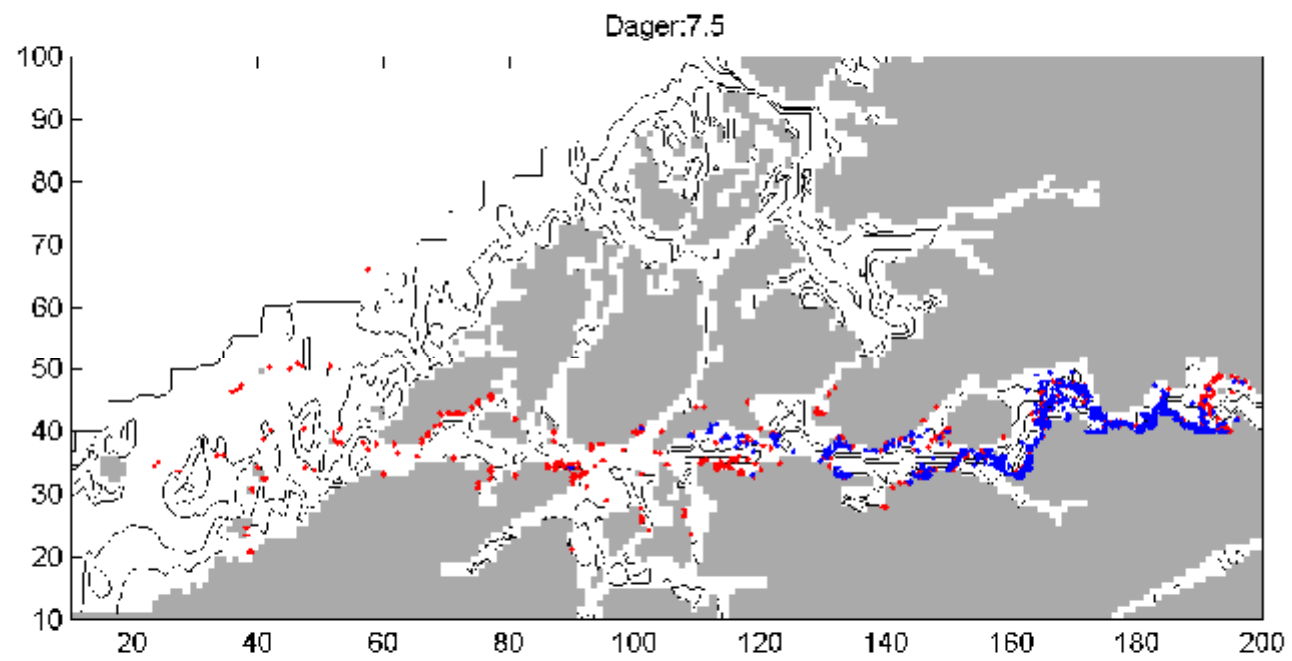


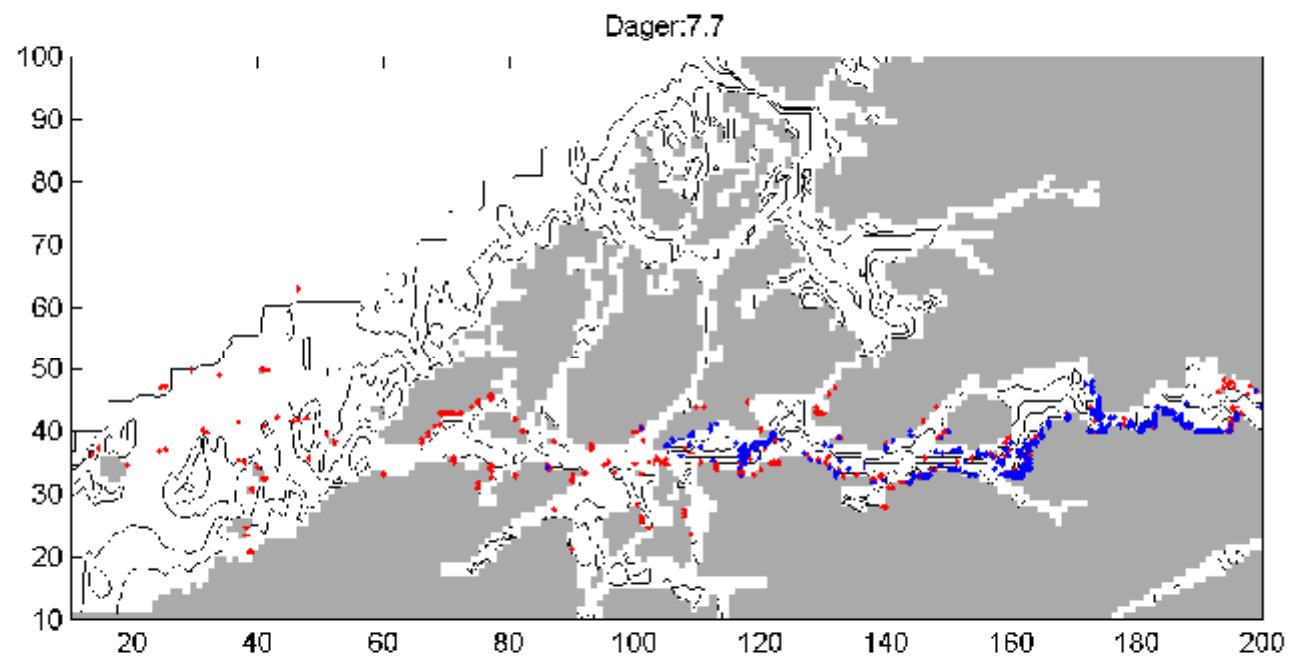


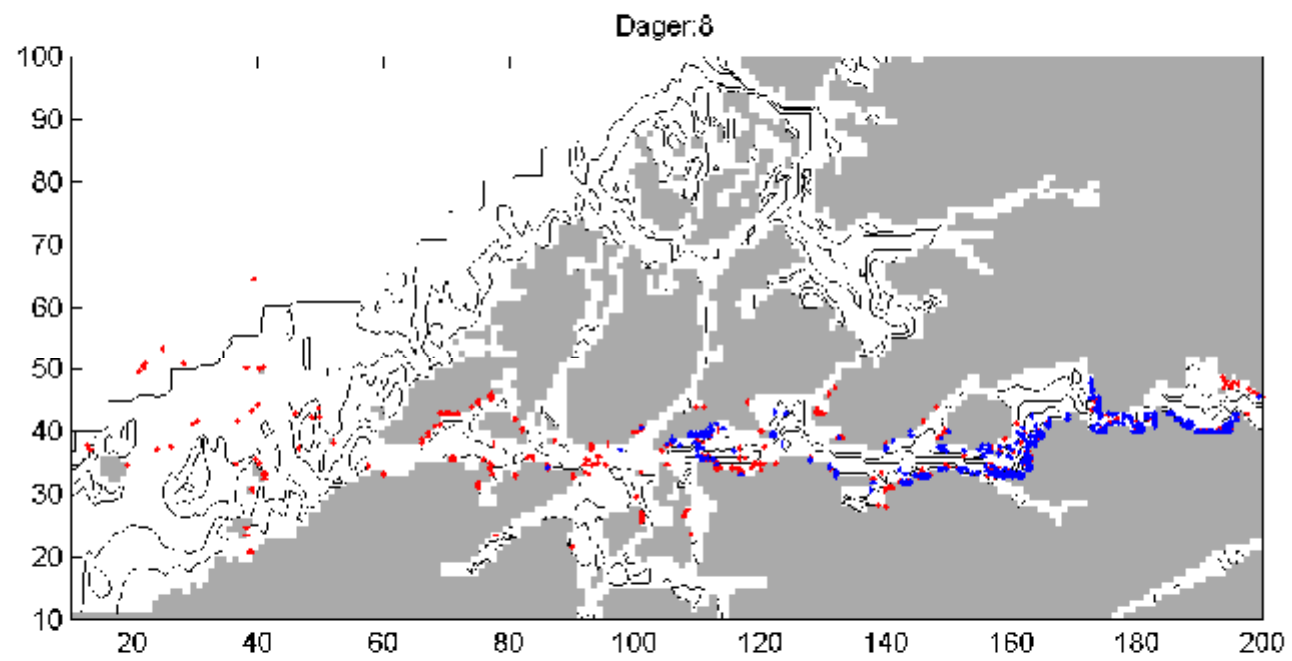


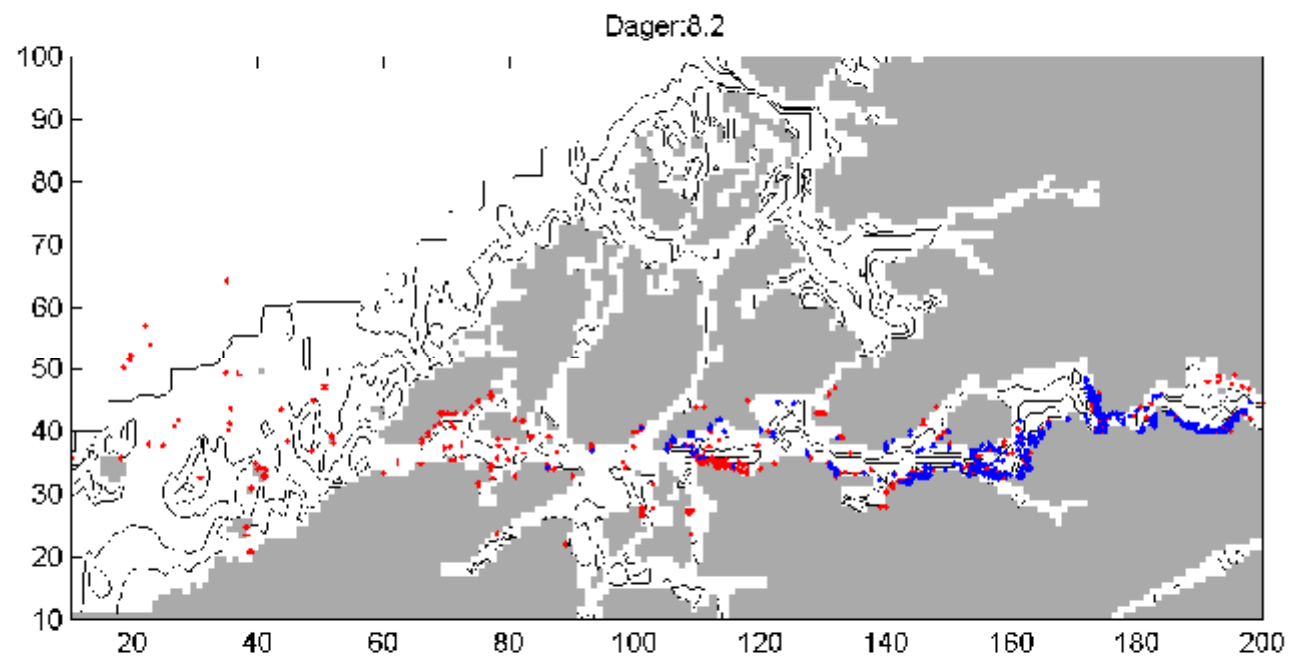


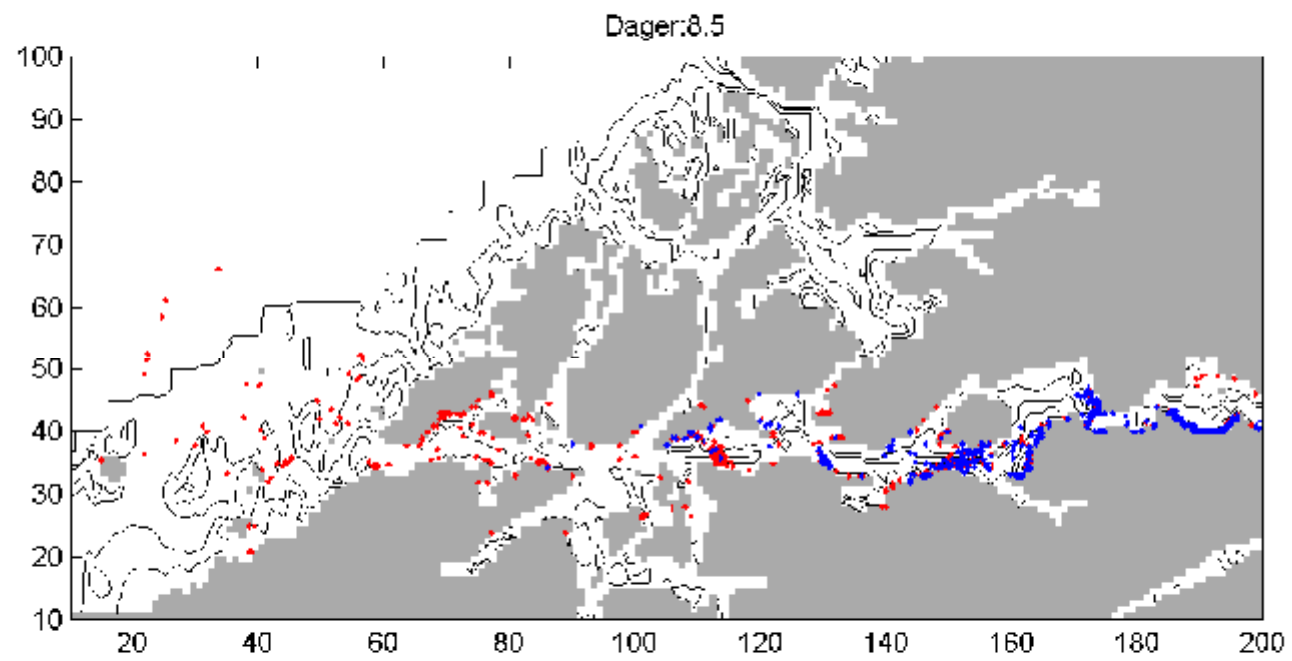


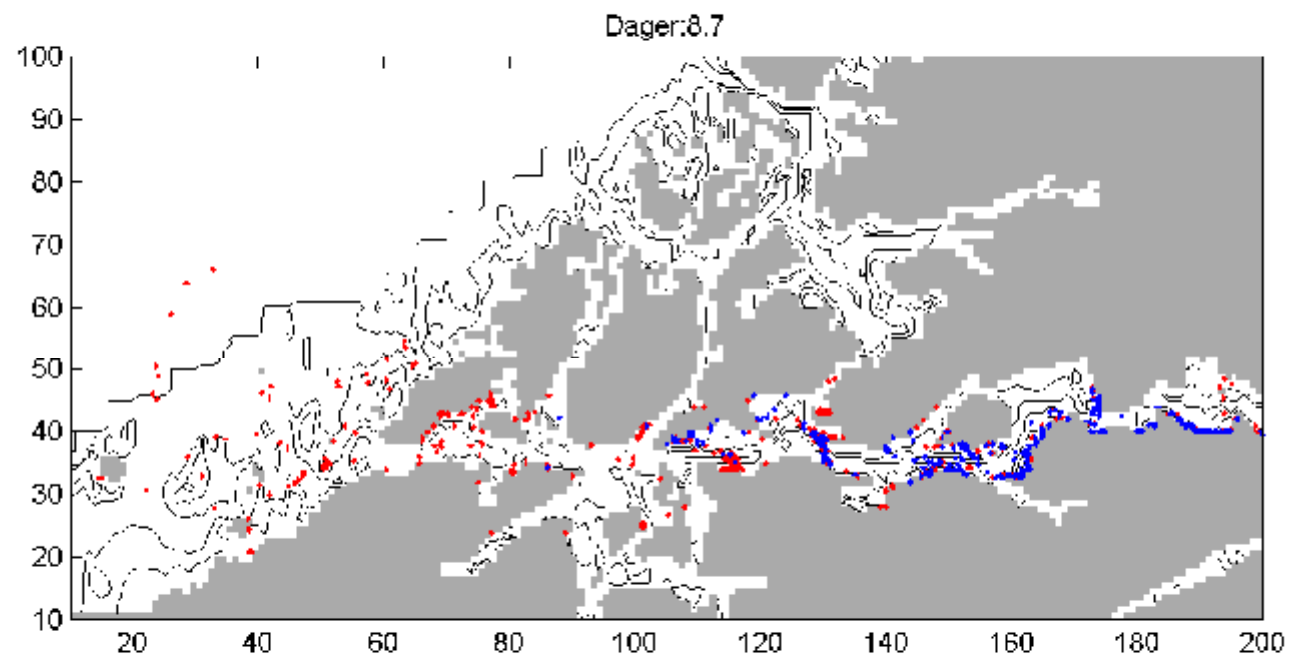


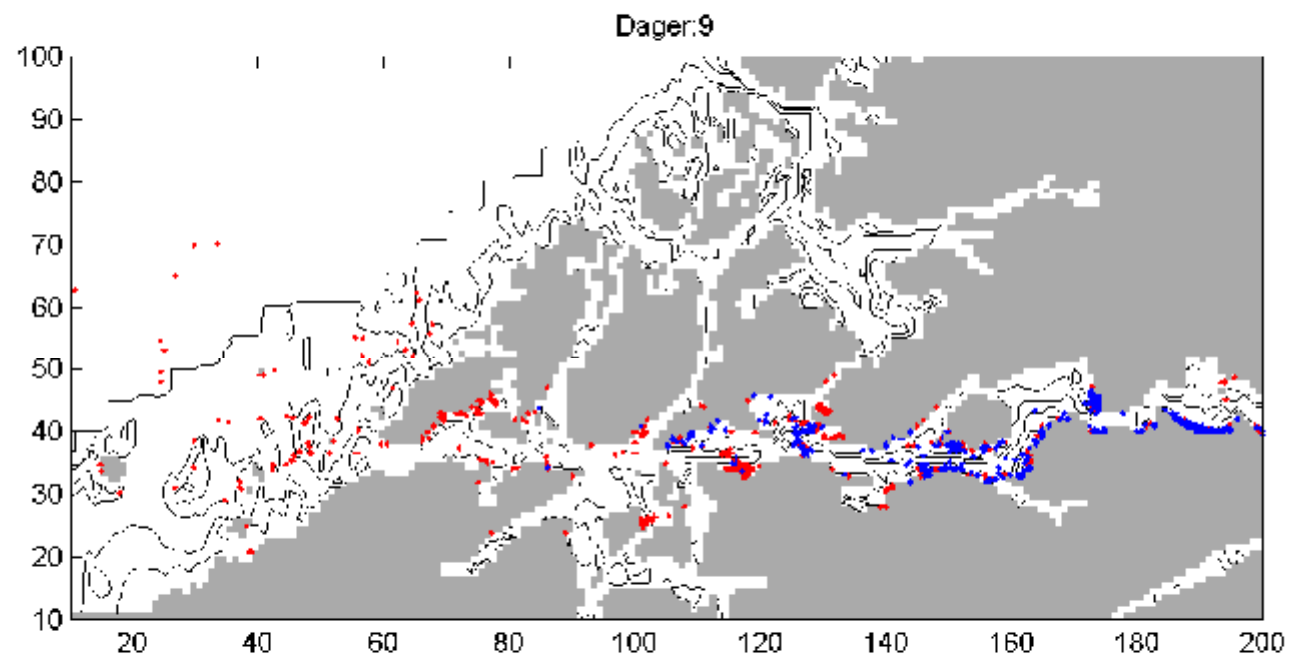


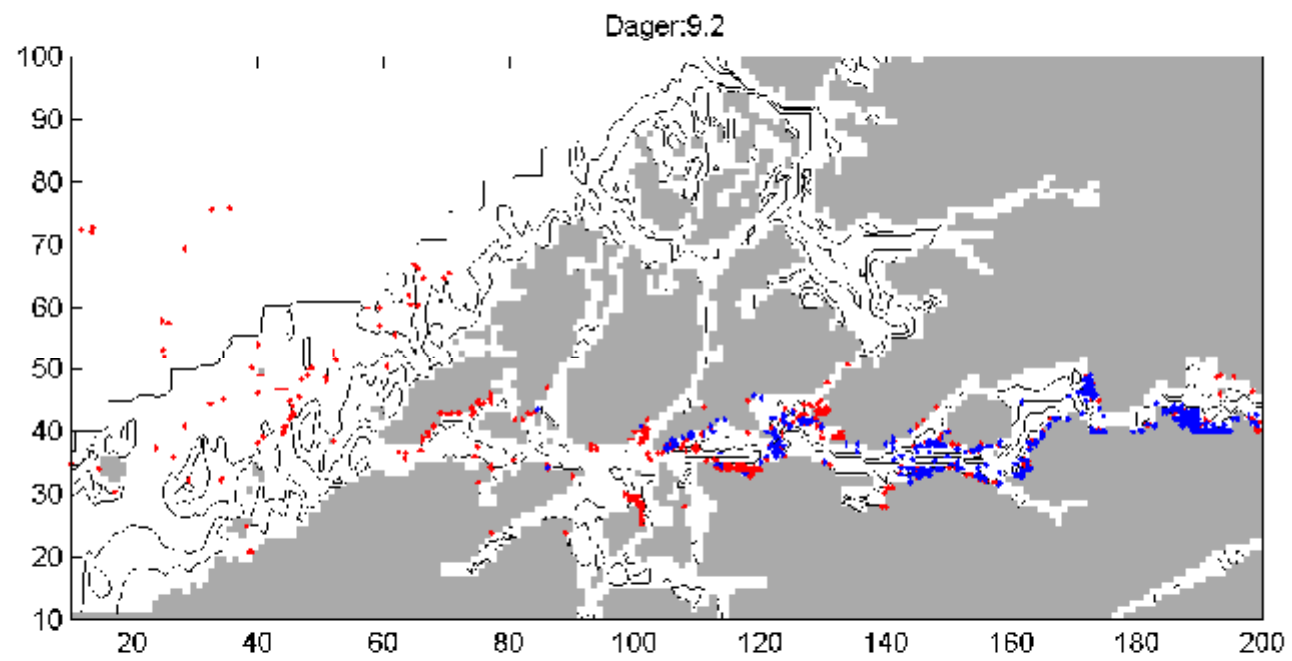


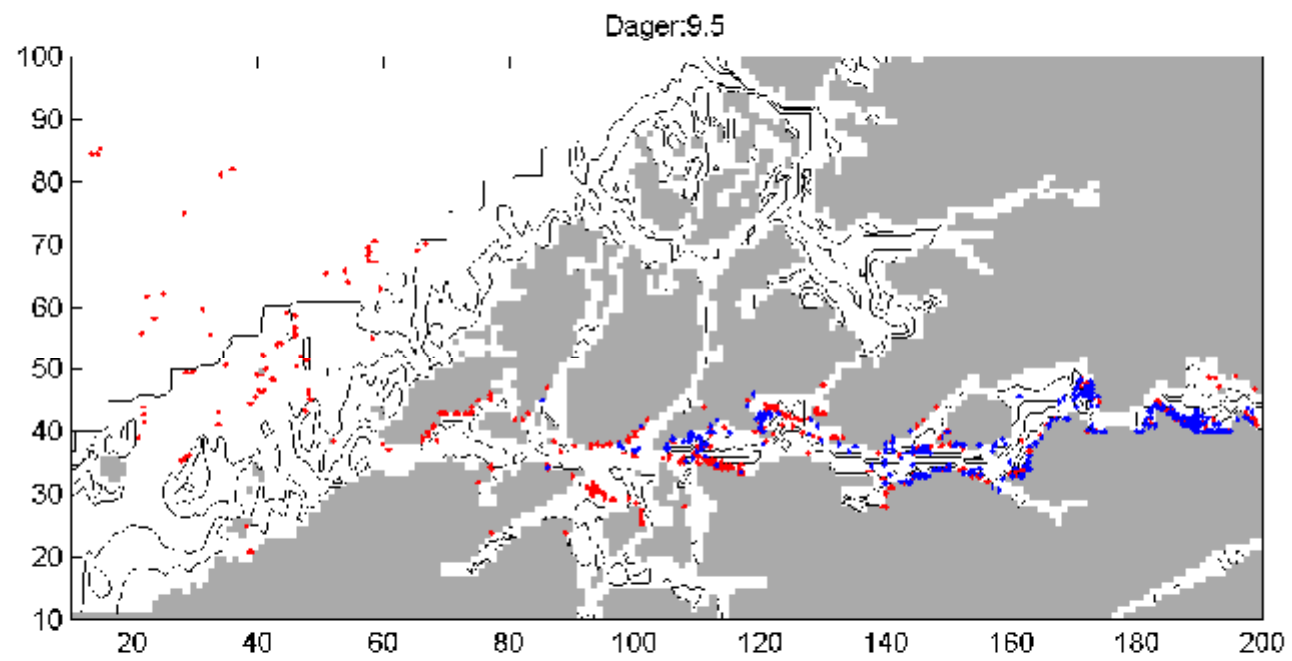


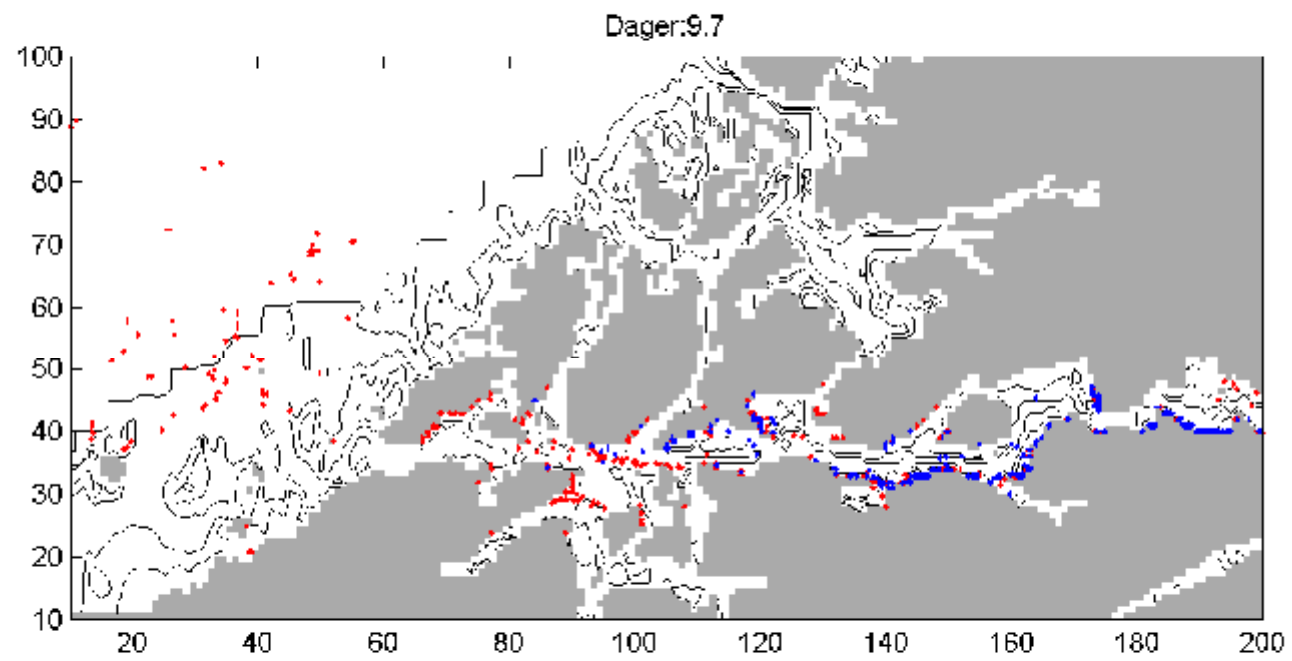


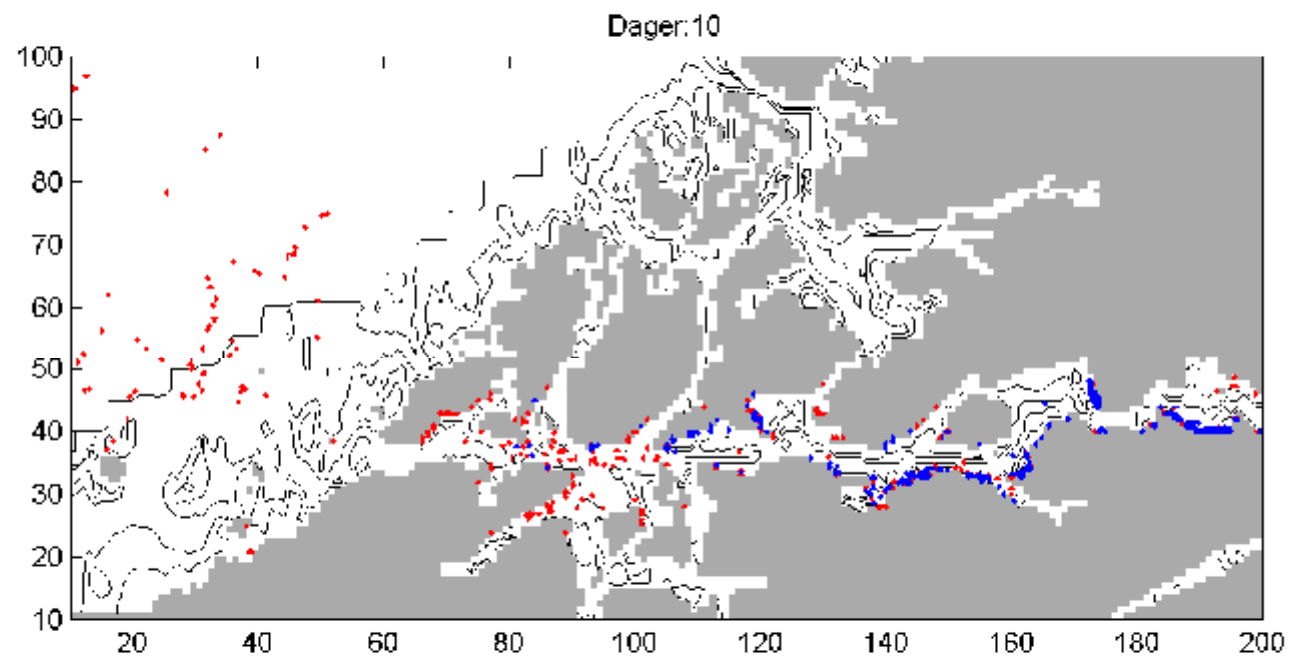


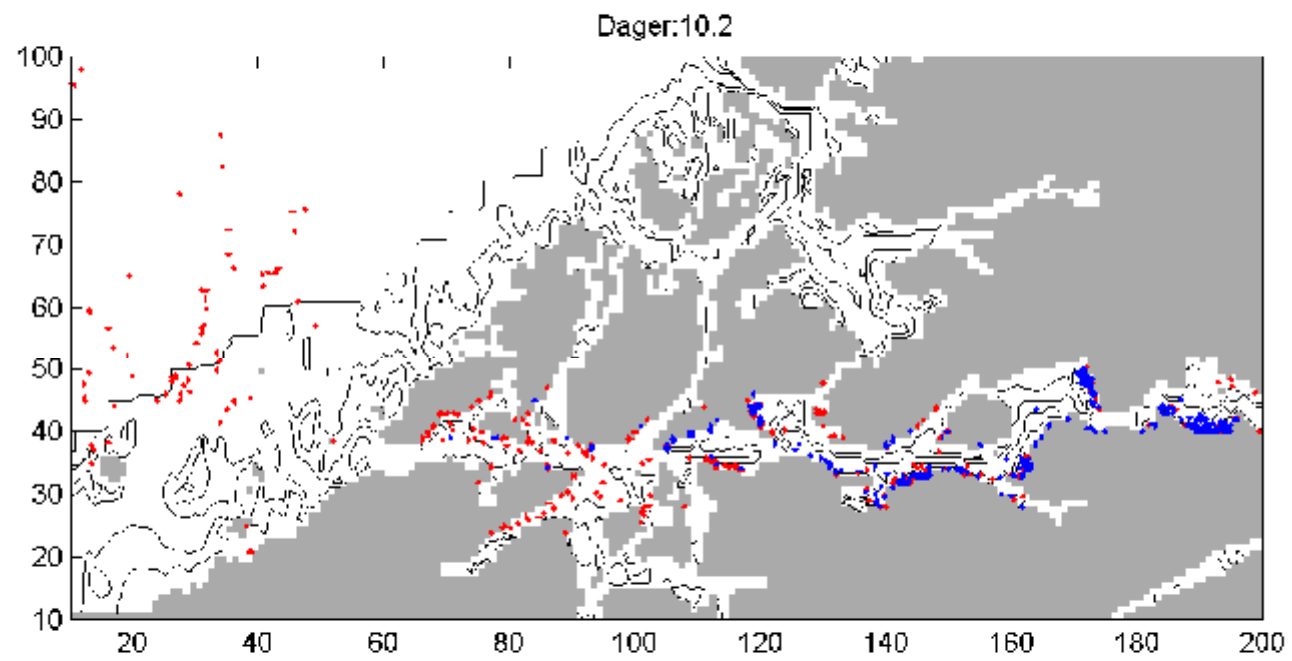


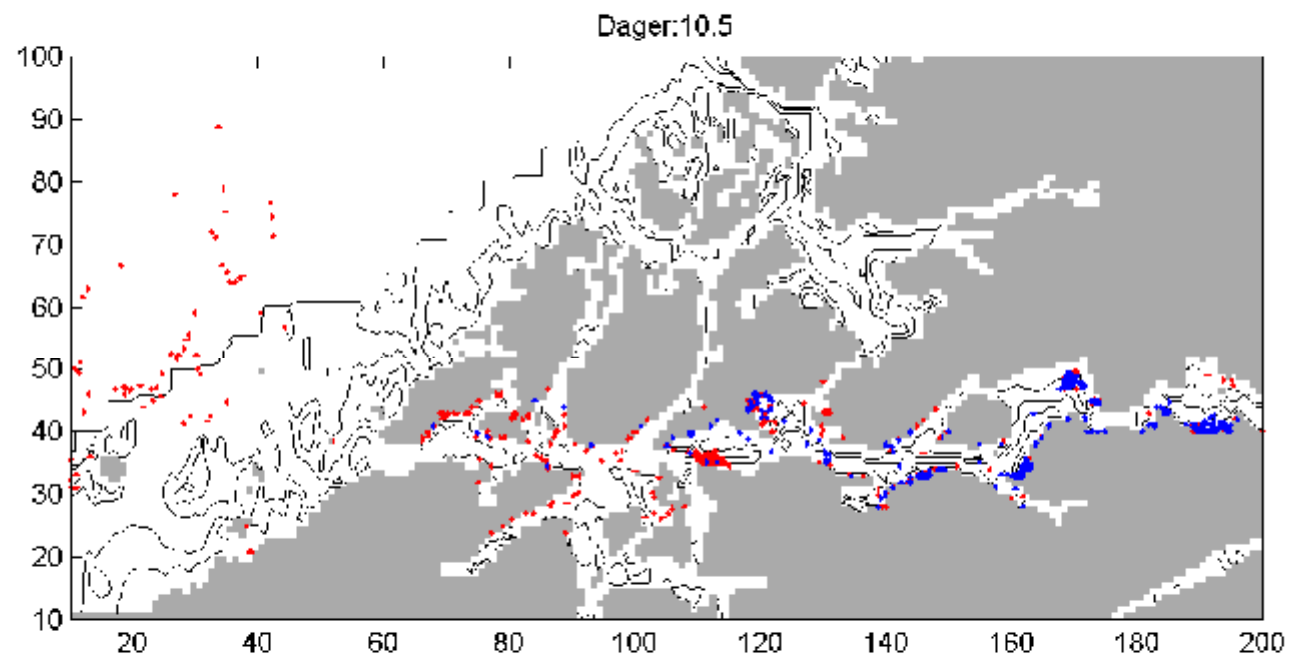


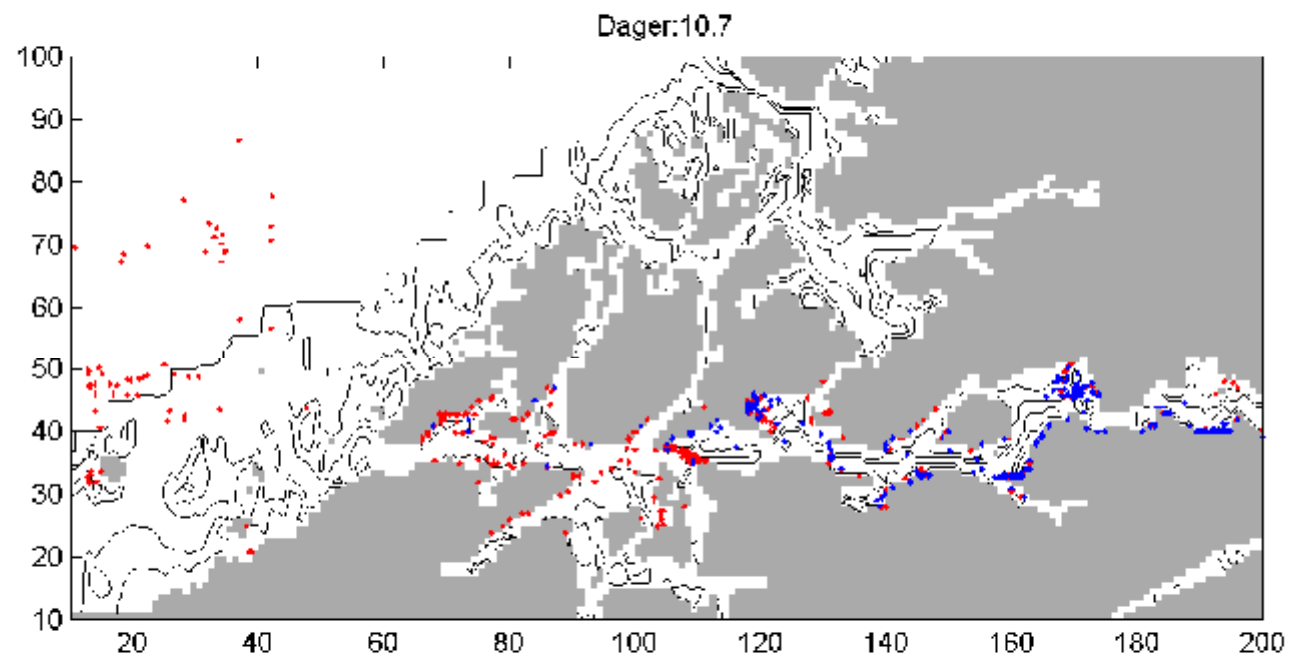


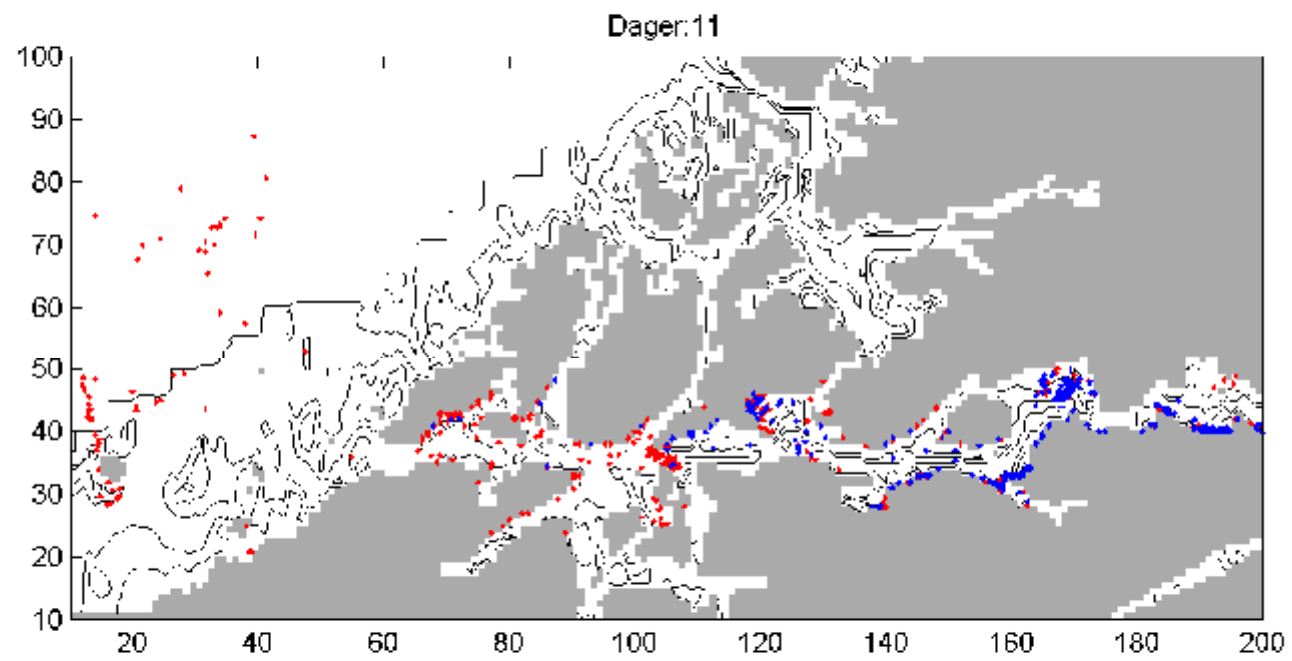


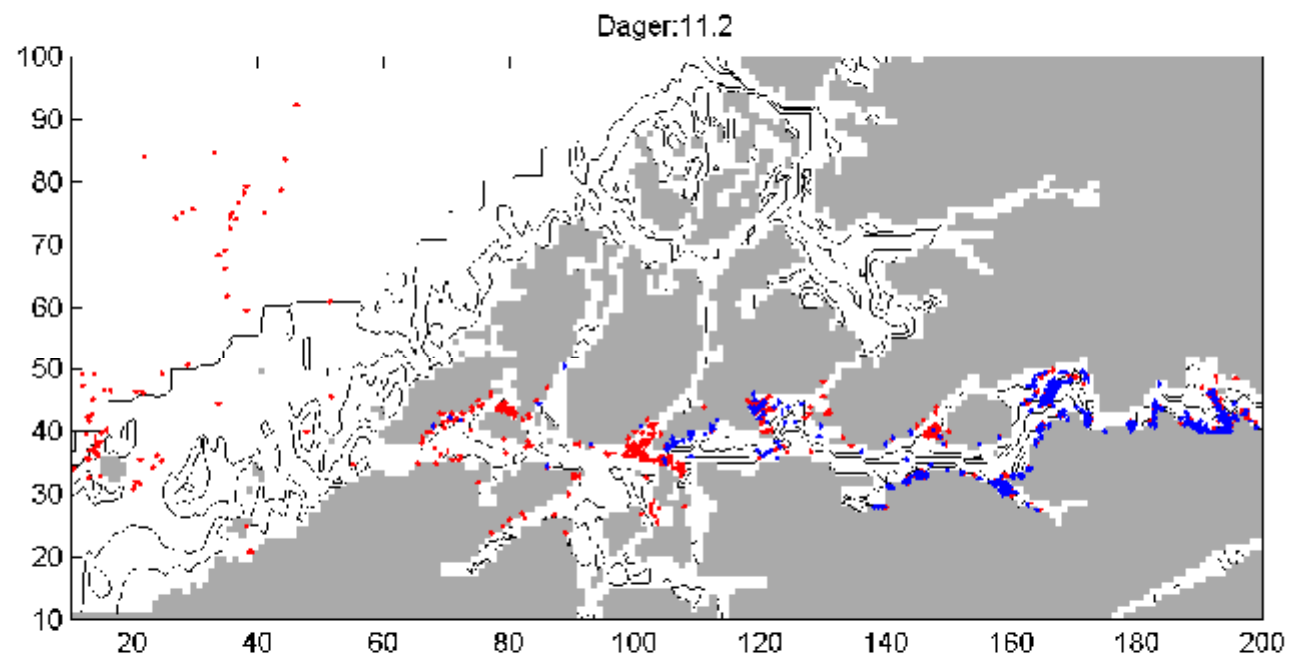


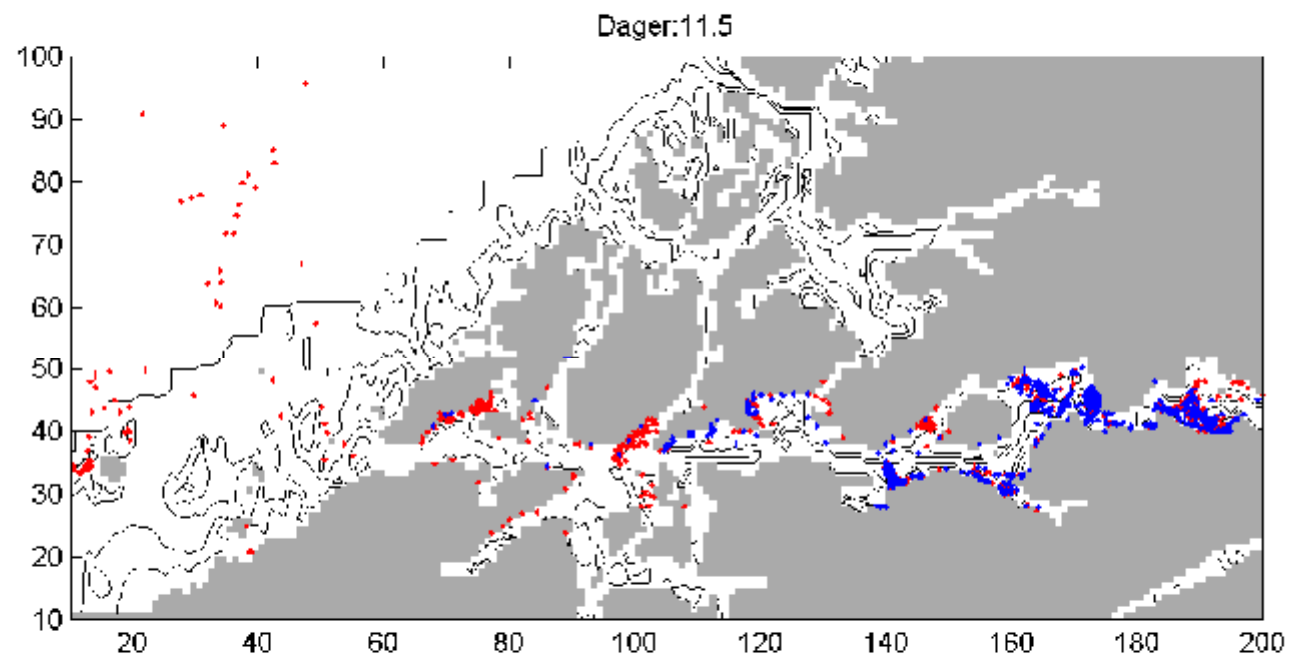


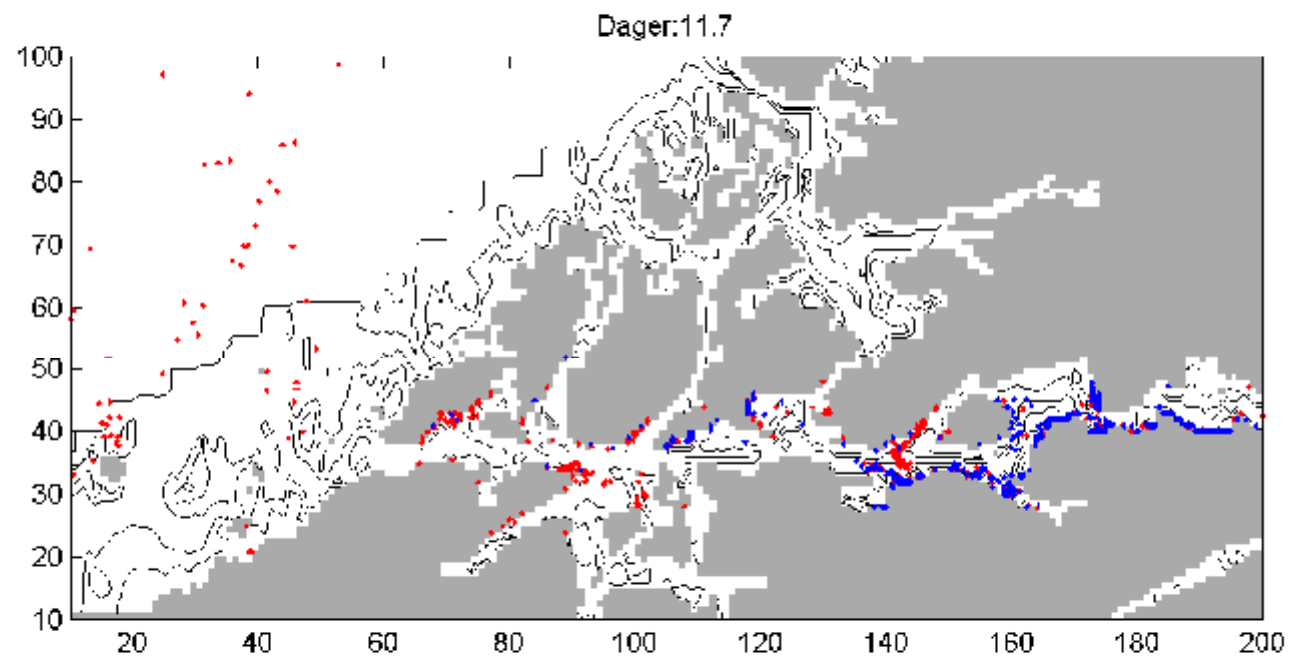


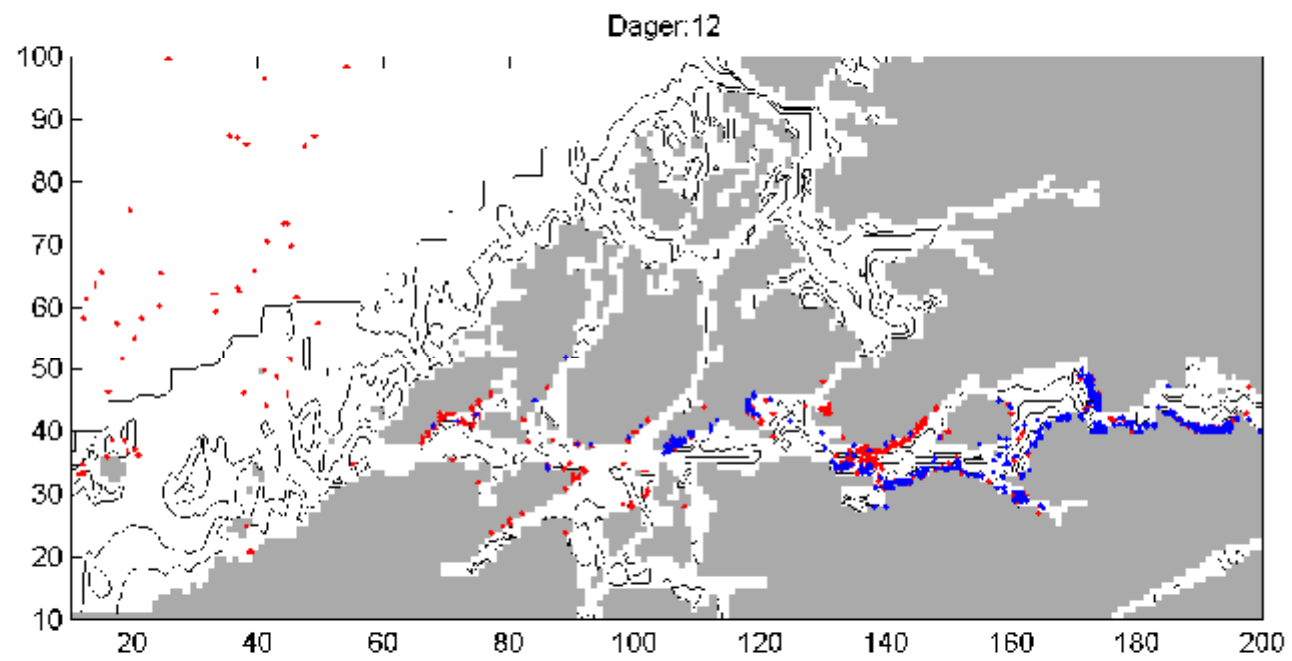


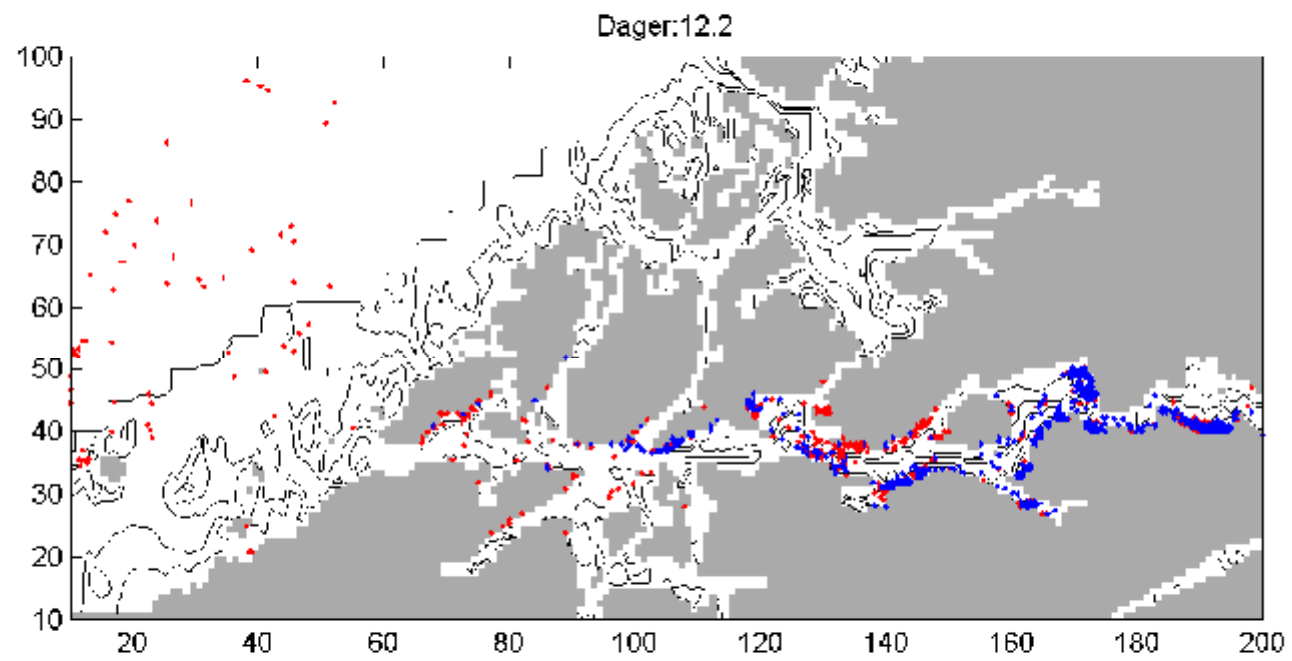


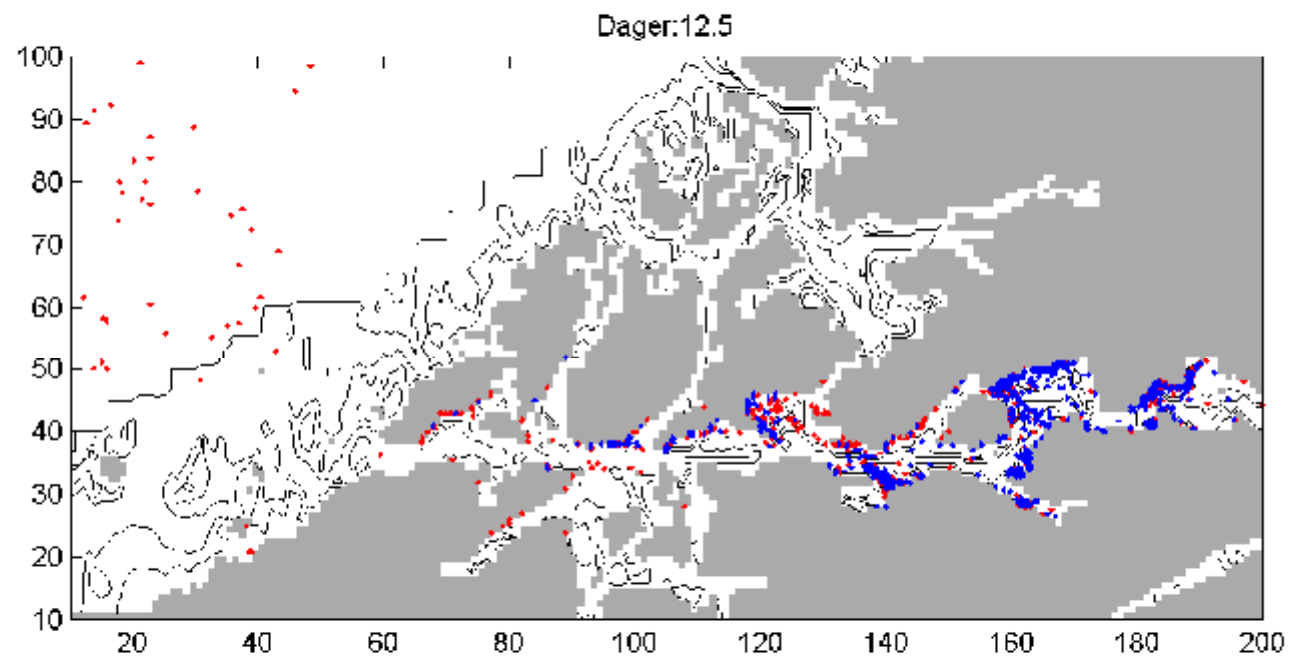


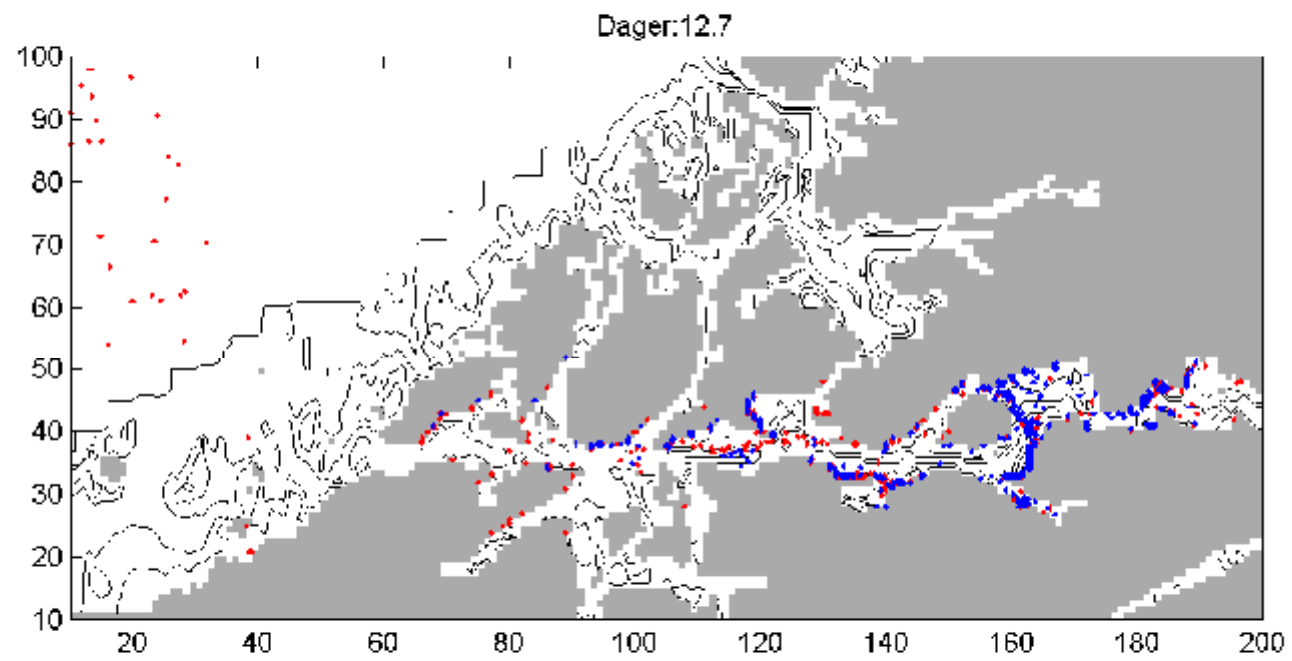


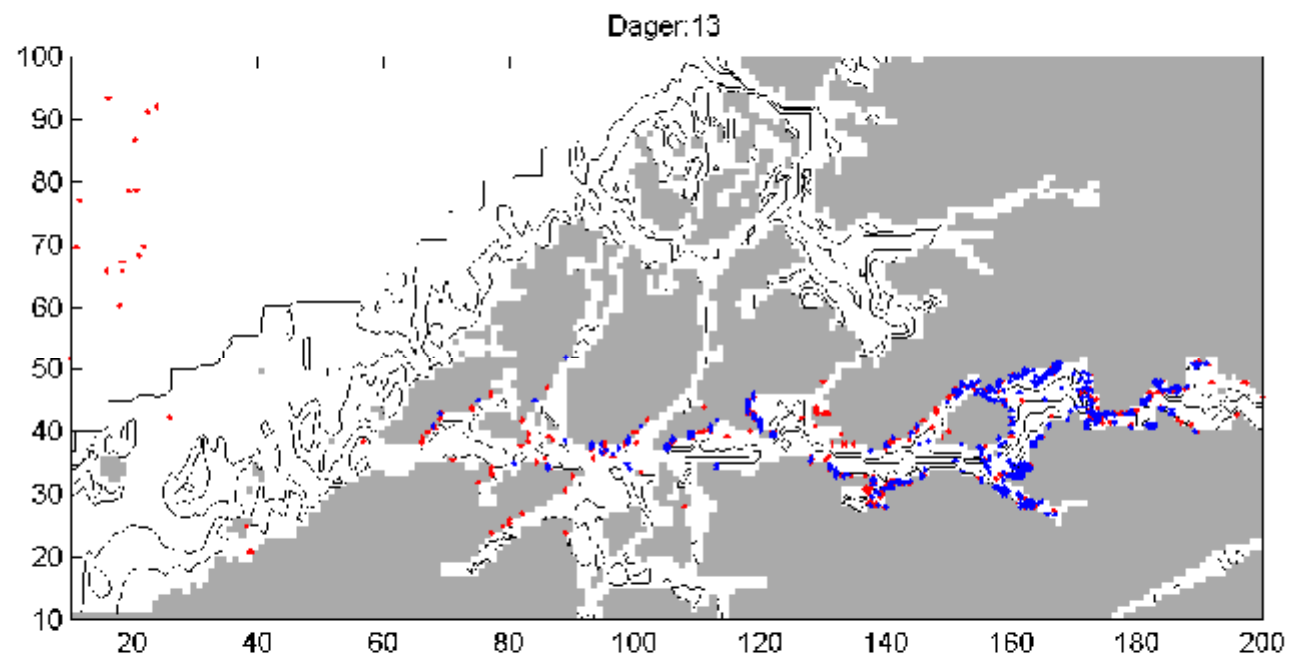


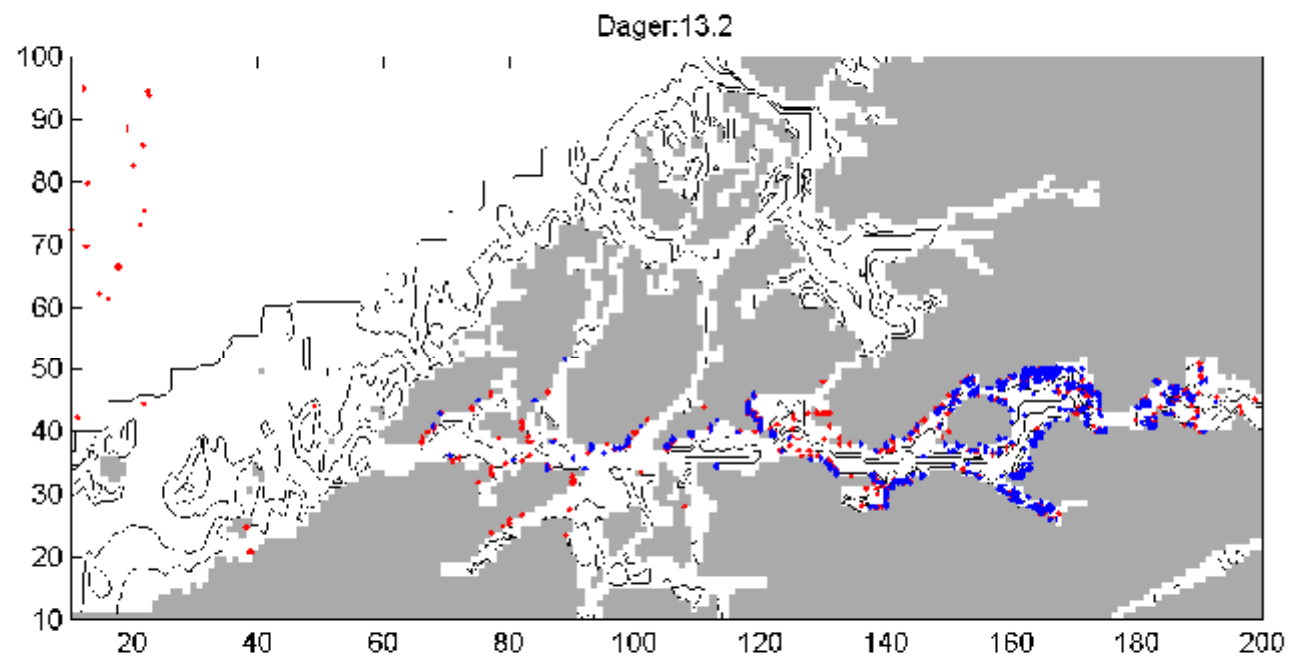


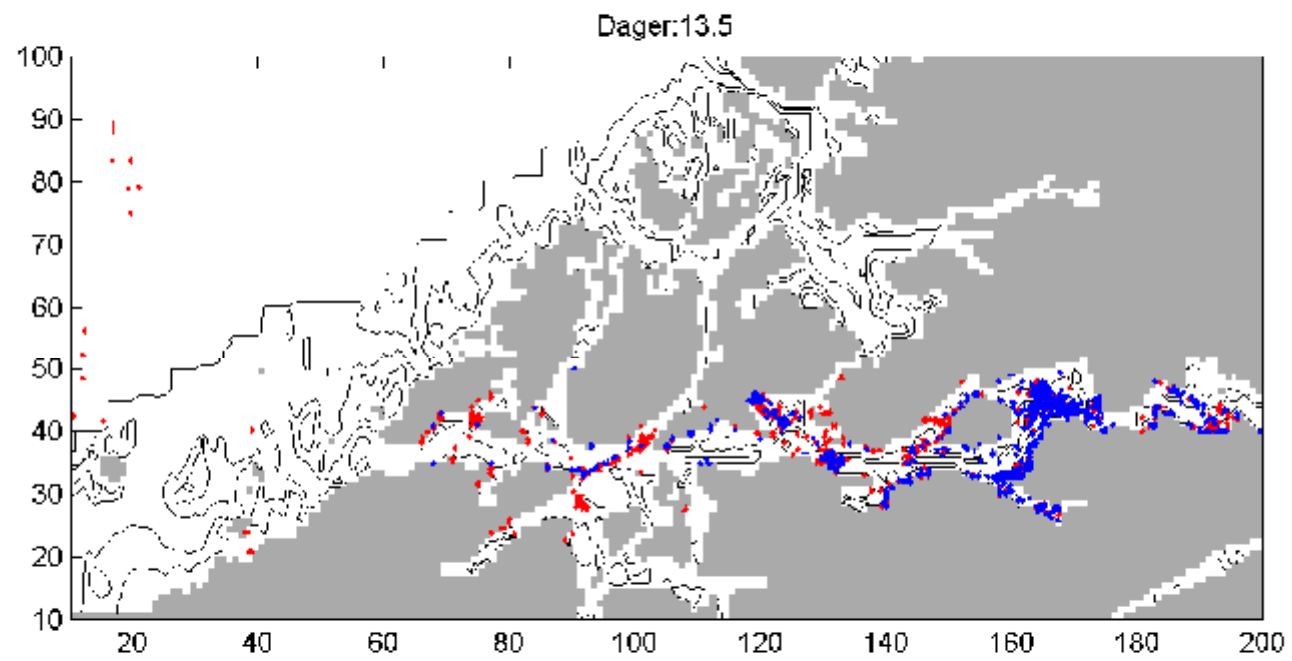


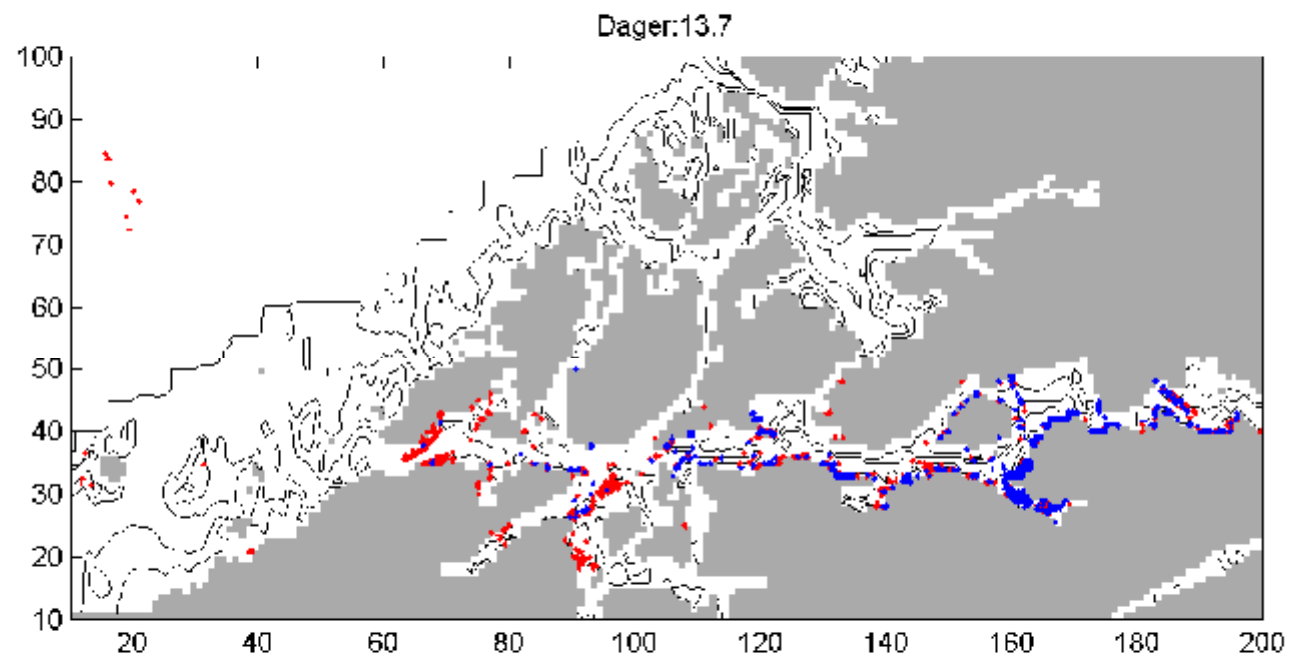






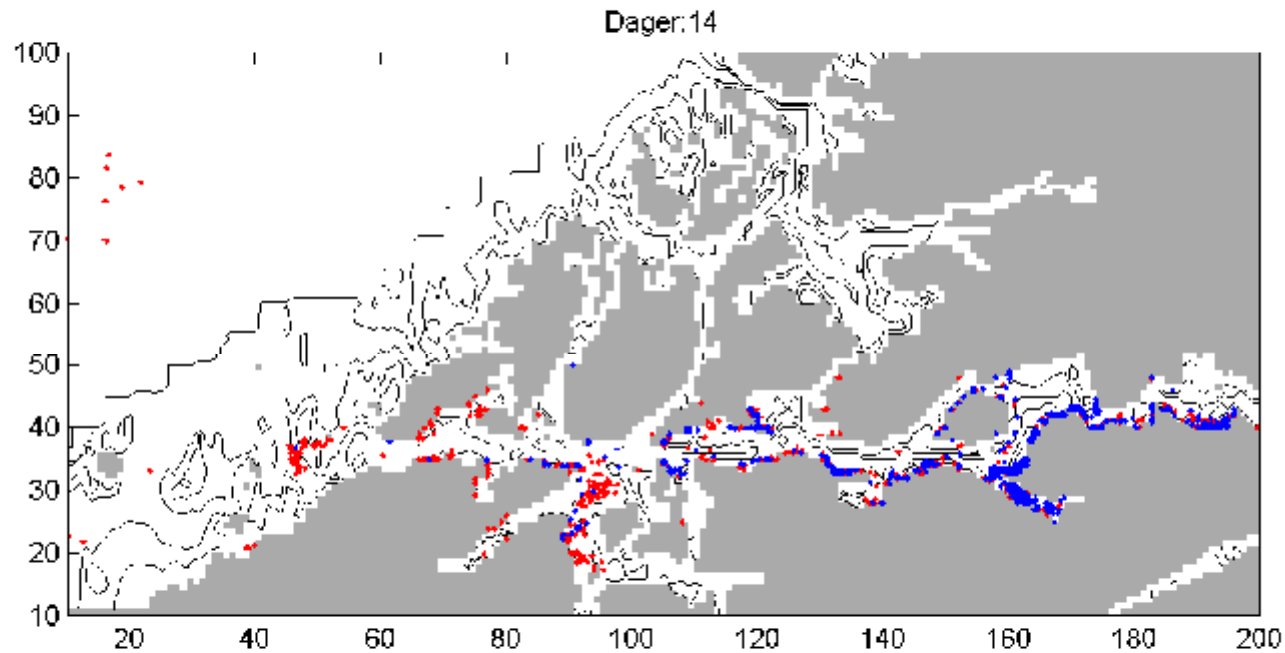






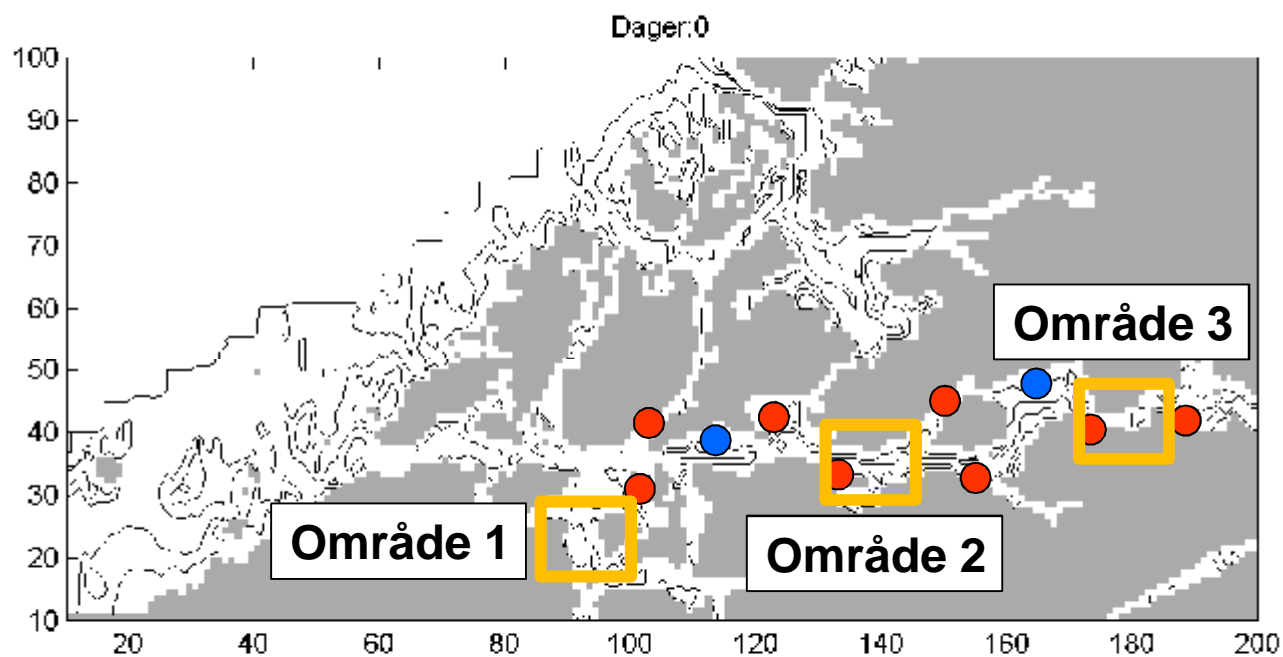
Modellert spredning i Hardangerfjorden

Etter 14 dager er tilsynelatende lakselus fra enkeltanlegg og klynger spredt utover hele fjorden.



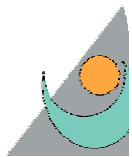
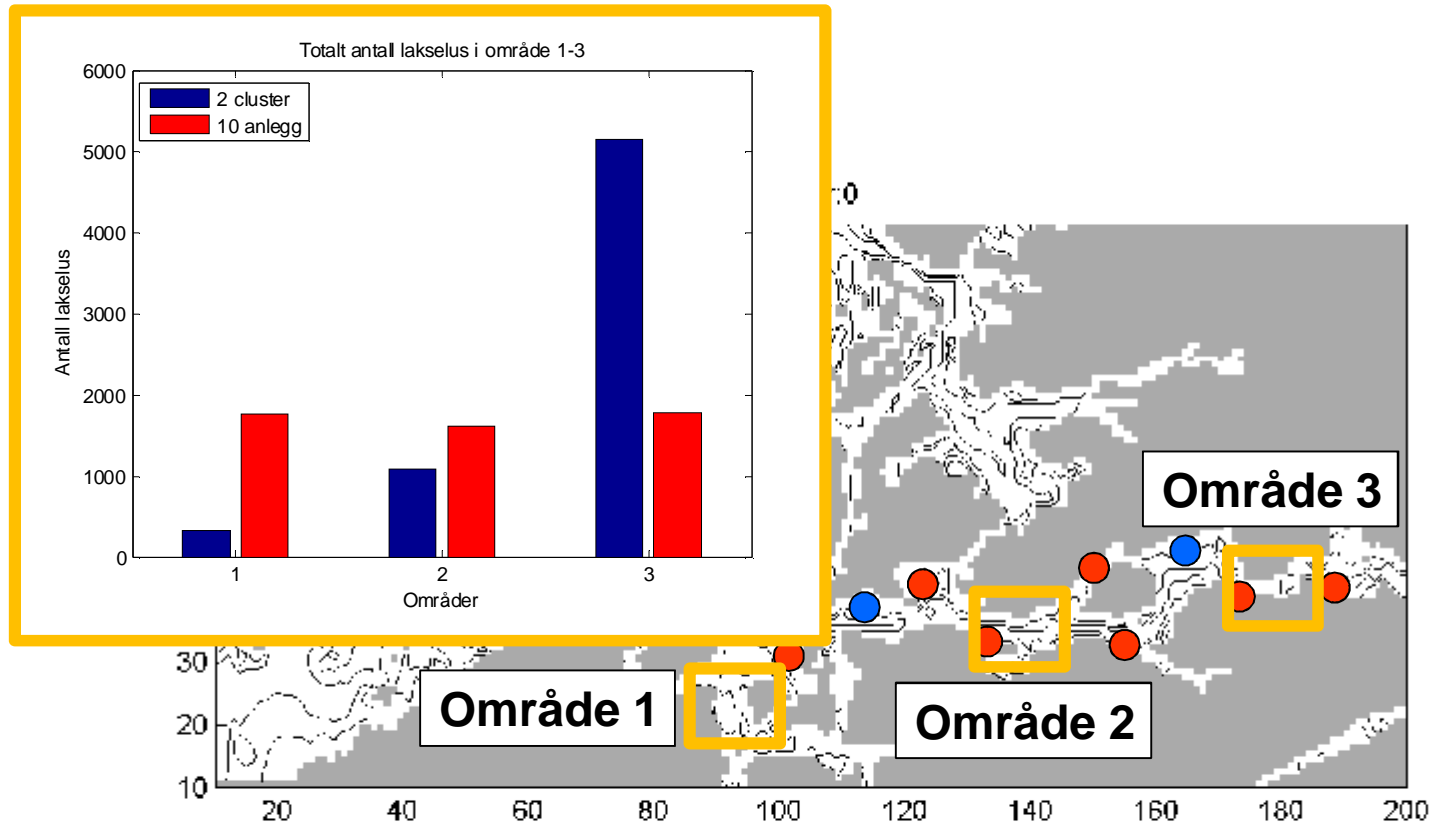
Modellert spredning i Hardangerfjorden

Summerer antall lus som har vært innom tre områder i løpet av simuleringen for å få kvantitativ informasjon om forskjelle



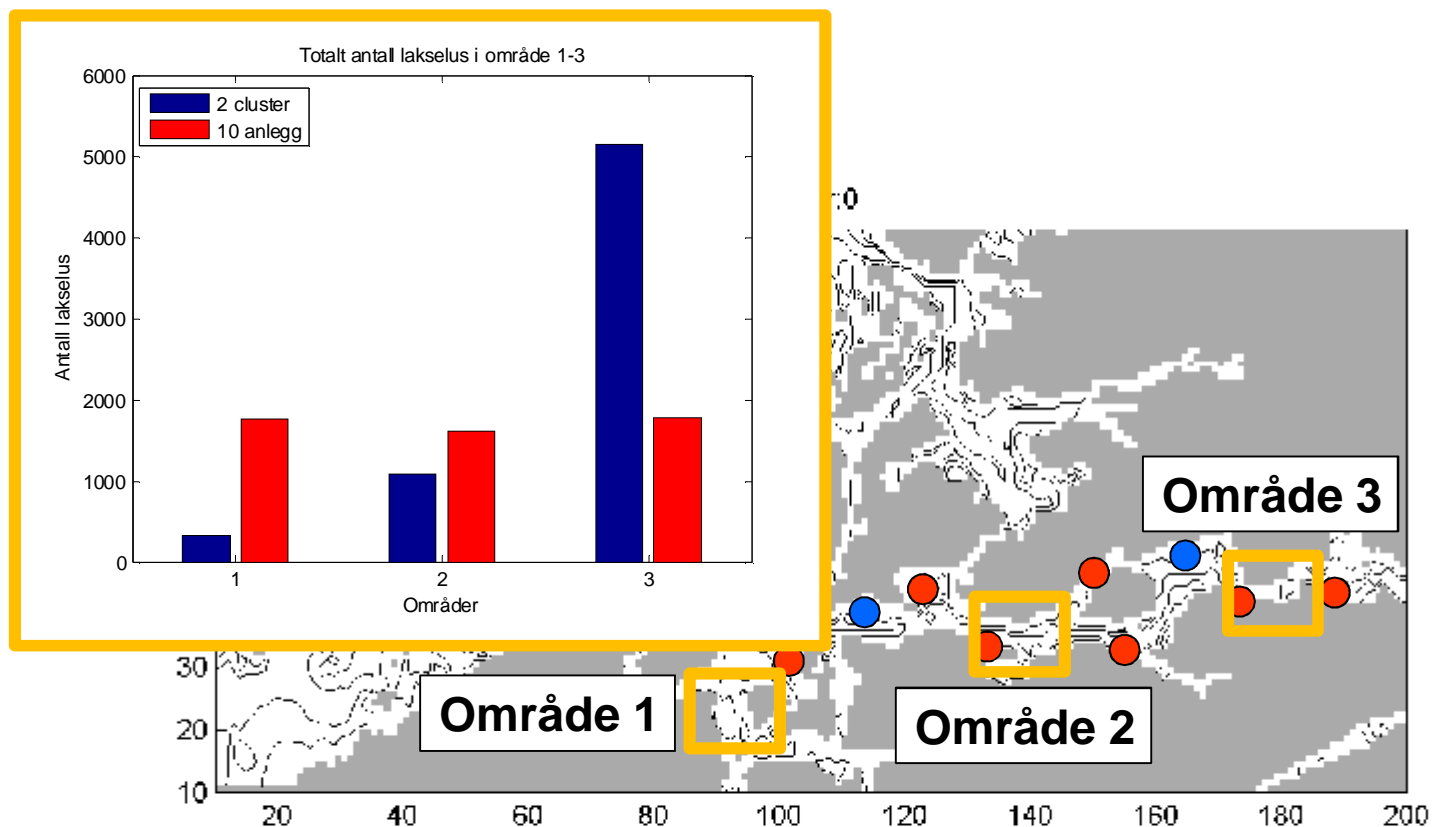
Modellert spredning i Hardangerfjorden

Totalt antall lus innom områdene 1-3 i løpet av 1-20. mai 2007



Modellert spredning i Hardangerfjorden

Totalt antall lus innom områdene 1-3 i løpet av 1-20. mai 2007



Men: Hva betyr dette?



Hvor stor dose/antall lus er tilstrekkelig for å utgjøre en trussel for de ville fiskebestandene??

Kunnskapsstatus og utfordringer

Resultatene vi har samlet gjennom de siste 10 årene er relativt entydige:

- Lakselus som trussel for vill fisk er i dag et resultat av for mye fastsittende lus på (for mange?) verter.
- Lokalisering av anlegg eller gunstige miljøforhold vil bare redusere denne trusselen i mindre grad.

Det er en utfordring å forbedre resultatene som ligger til grunn.



Kunnskapsstatus og utfordringer

- **Trenger flere tidsserier av miljødata fra fjorder.**
- **Må etablere en validert metodikk for å observere mengde og fordeling av planktonisk lakselus i fjordmiljøet.**
- **Må finne absolutte tall for hvor mye lakselus et område tåler uten å påvirke ville fiskebestander negativt.**
- **Hvor detaljert trenger vi å kjenne til lakselusens biologi med hensyn til hvordan den finner en ny vert?**
- **Vi må se økosystemet, miljøet og næring i sammenheng – et bredt samarbeid vil være en nøkkel.**



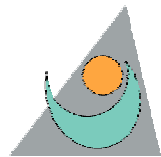
Til slutt

Havforskningsinstituttet gjennomfører en relativt betydelig overvåkning av mengde og fordeling av lakselus.

Deler av dette arbeidet vil inngå naturlig i andre problemstillinger, som fjordøkologi, patogenspredning, bæreevne eller klimaendringer.

Havforskningsinstituttet ønsker å samarbeide bredt om problemstillingene i norske fjordområder, da dette er så store oppgaver at ingen klarer å gjøre dette godt nok på egen hånd.

Vi samarbeider også bredt internasjonalt.



NINA (takk for støtte fra FHF og Forskningsrådet)