

Where do the northern Atlantic salmon feed during their sea residence – in the Norwegian, Greenland or Barents Sea?

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Life cycle of Atlantic salmon



parr

smolt

June/July

17 cm/30 g



postsmolt



1-6 yr

Tana/Kola = 4-5 yr

fry

RIVER

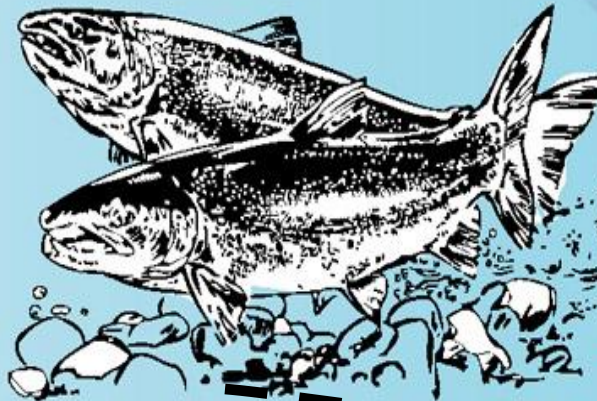
OCEAN



alevin (sac fry)



eggs



spawners

Kelts



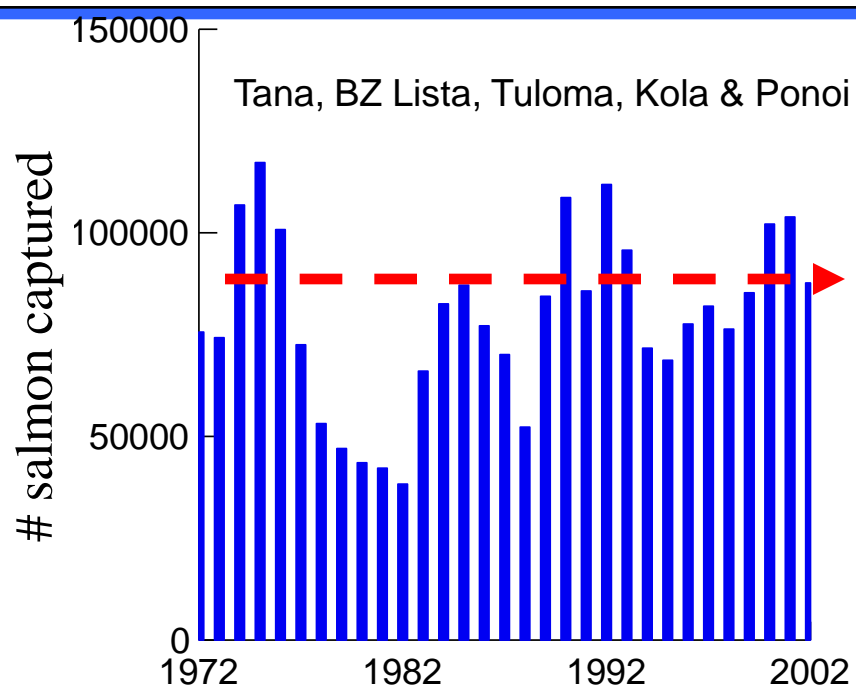
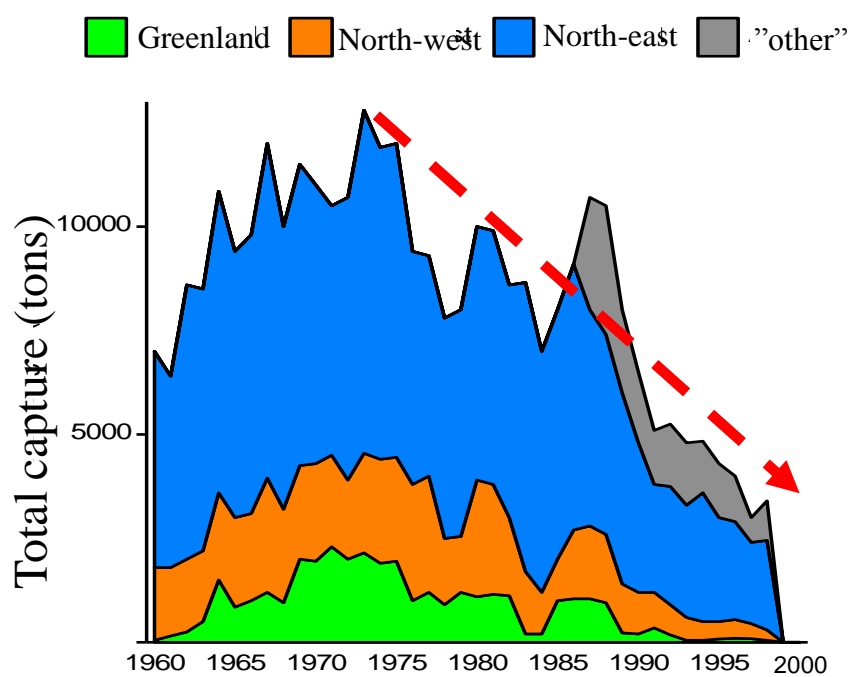
adults

1-5 yr

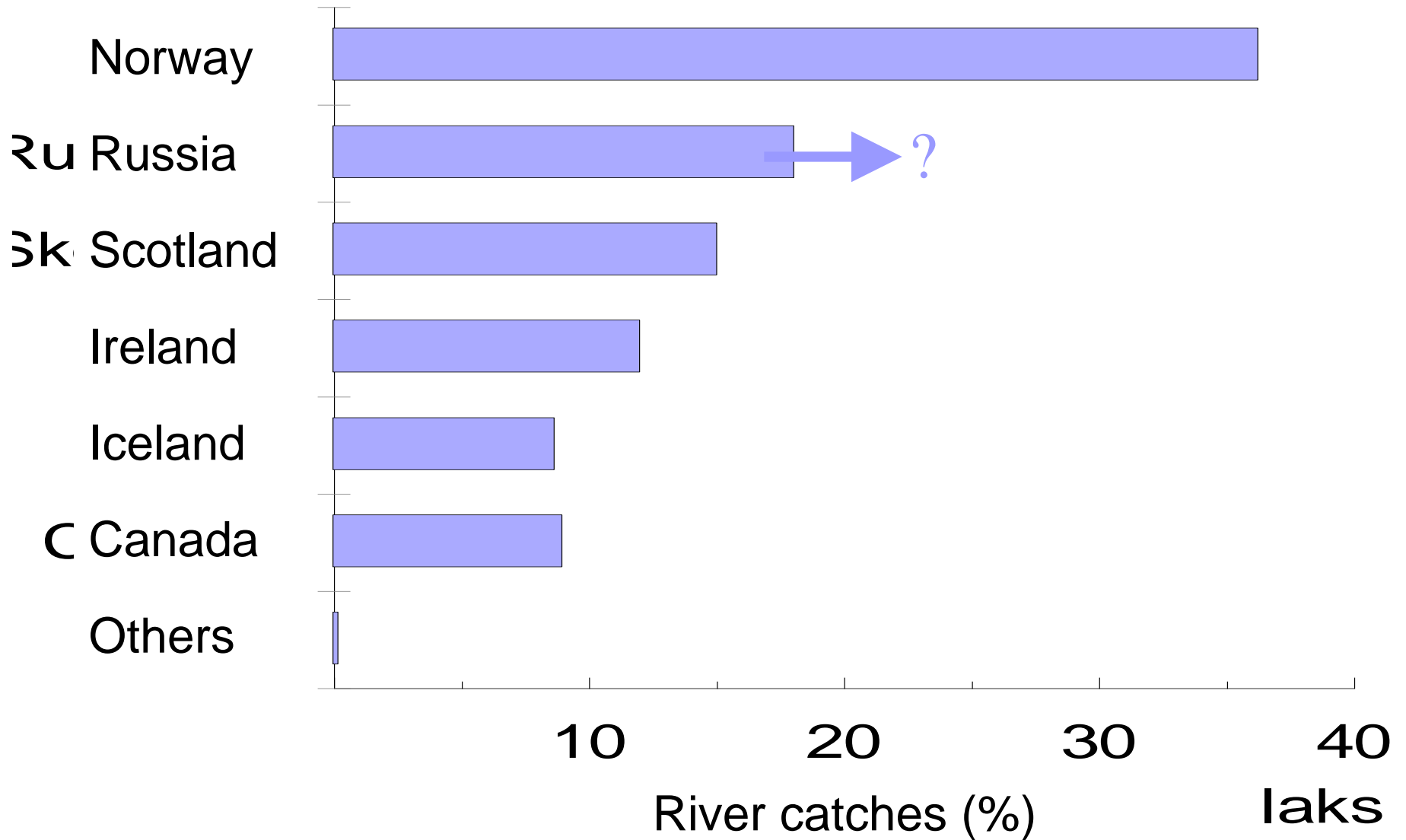
1 SW ~ 2 kg

3 SW ~ 10 kg

5 SW ~ 25 kg

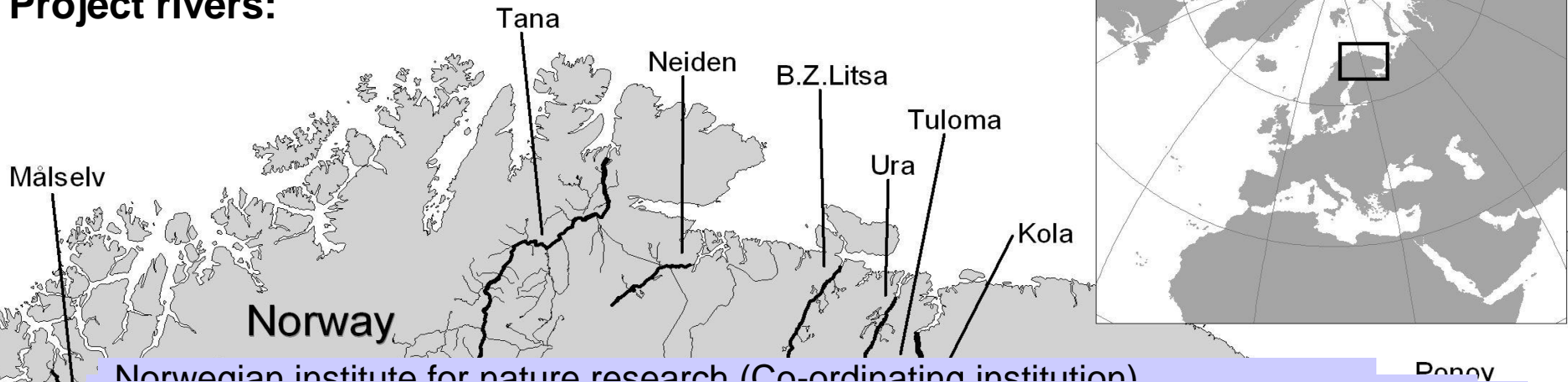


River catches of Atlantic salmon



“Salmon in the North”: Phase I (2002-2006) and Phase II (2007-2010)

Project rivers:



Norwegian institute for nature research (Co-ordinating institution)

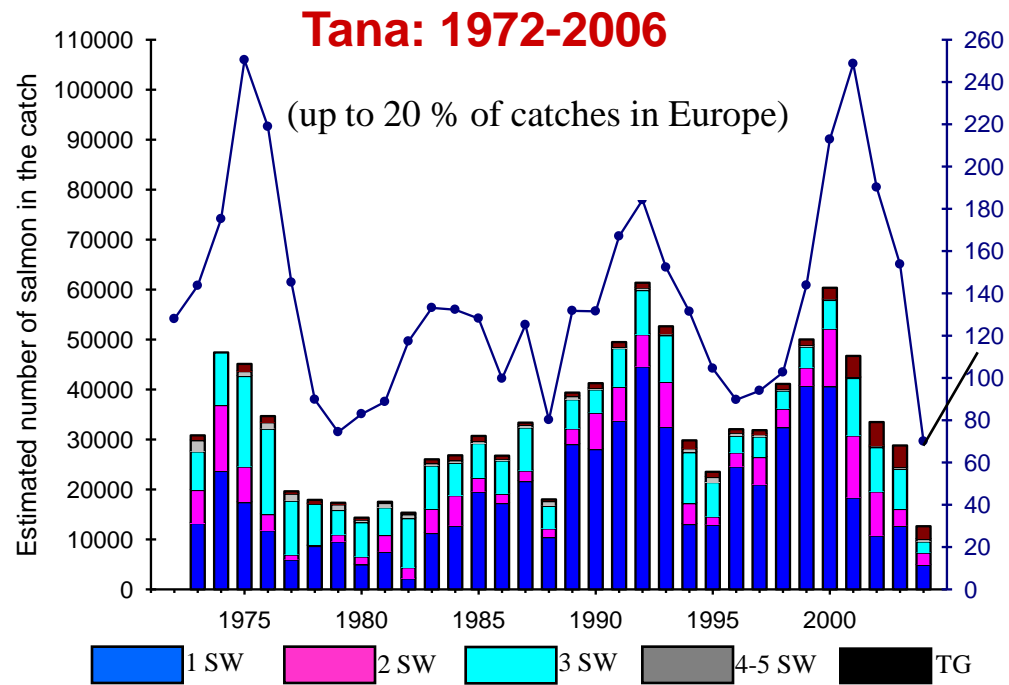
- present some “relevant” results from the two projects, i.e.:
- give a brief overview of the Barents sea salmon populations
- emphasize their uniqueness compared to other populations
- suggest/discuss/speculate possible feeding areas
- describe some activated projects (2007-10) to describe marine feeding areas

University of Life Sciences (Norway)

Department of Environmental Affairs, County of Finnmark (Norway)

50 0 50 100 Kilometers





Commercial fisheries – 60 %



Angling – 40 %



Kola peninsula

- more than 65 rivers with Atlantic salmon
- fish traps in some rivers back to 1959
- rod and line fishery (catch and release) dominates



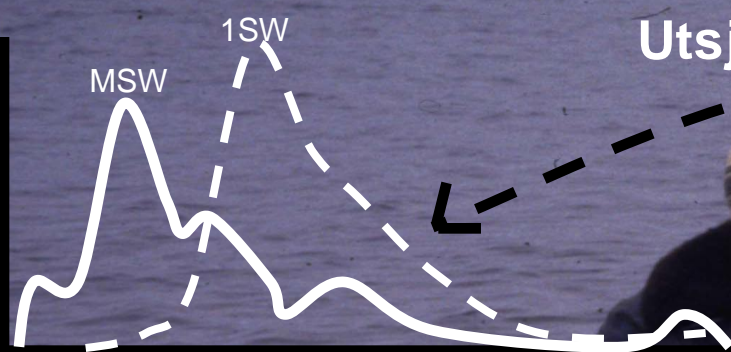
The kola peninsula rivers

– reliable information about ascending salmon since 1959



- fish trap in river Varzuga
 - closing the river every second -> third day
 - similar traps used in a few some Kola-rivers since 1959
- ↓
- giving precise estimates of ascending salmon the last 45 years
 - scale samples, SW, sizes, sea temperatures etc.

of salmon



June

July

August

Utsjoki/Tana



of salmon



Varzuga

June

October

Spawning next autumn !!

Life cycle of Atlantic salmon



parr



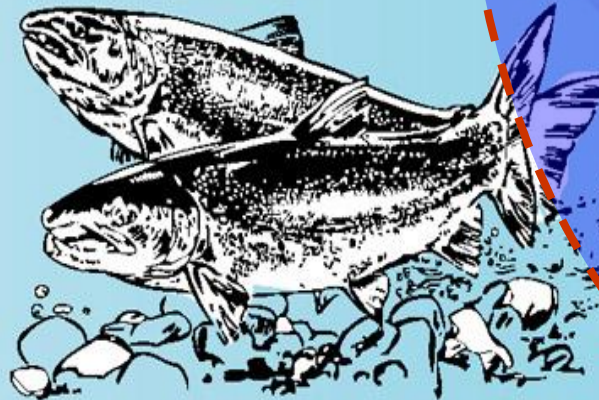
fry



alevin (sac fry)



eggs



spawners



smolt

June/July

17 cm/30 g



postsmolt



adults

1-5 yr

1-6 yr

Tana/Kola = 4-5 yr

RIVER

OCEAN

Utsjoki as an index river for Tana

RKTL (research station)

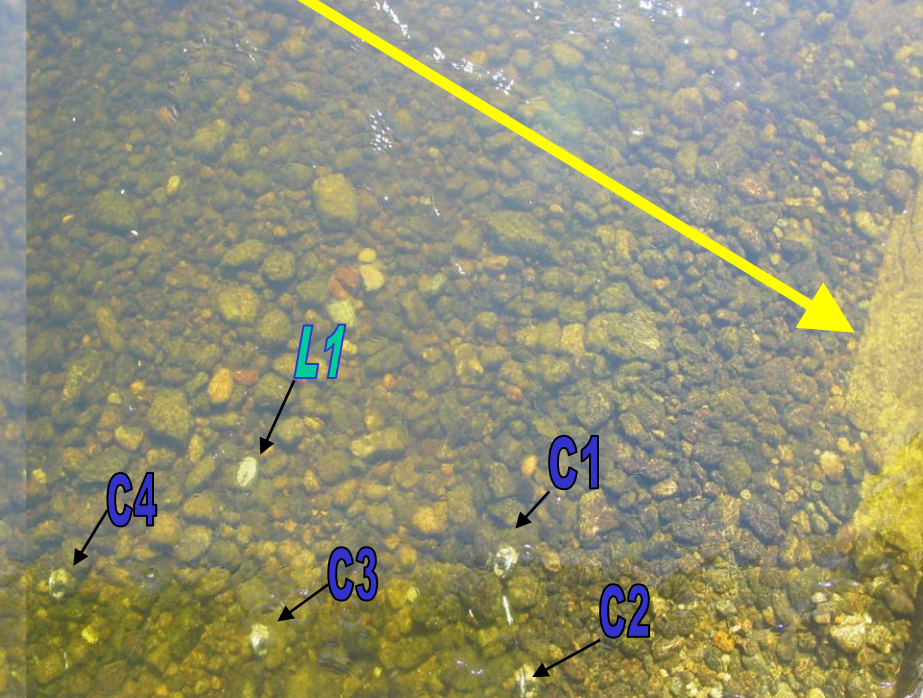
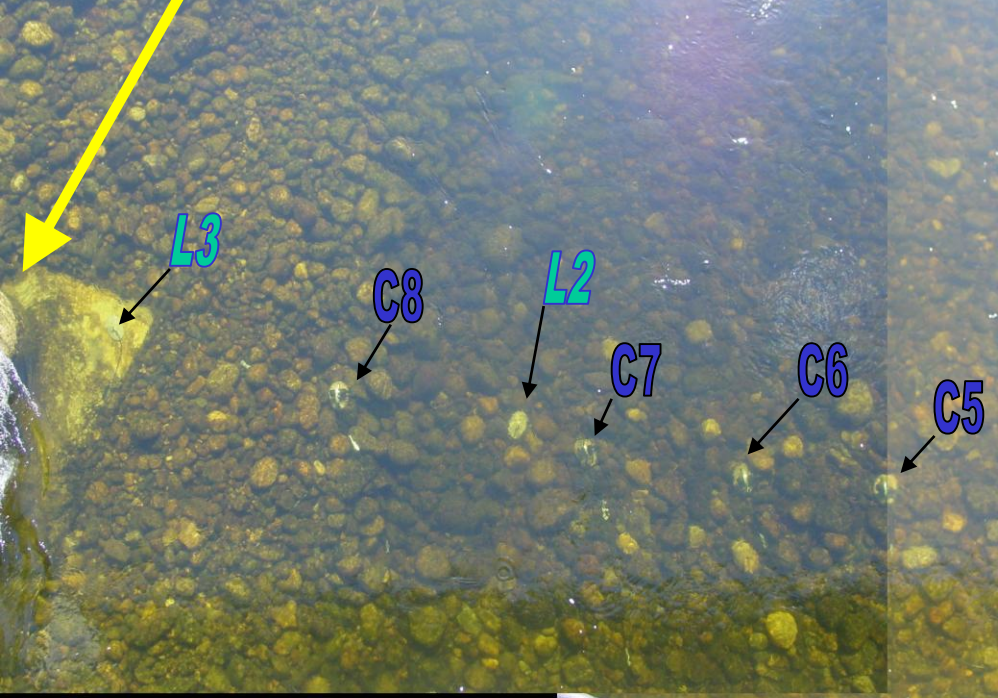
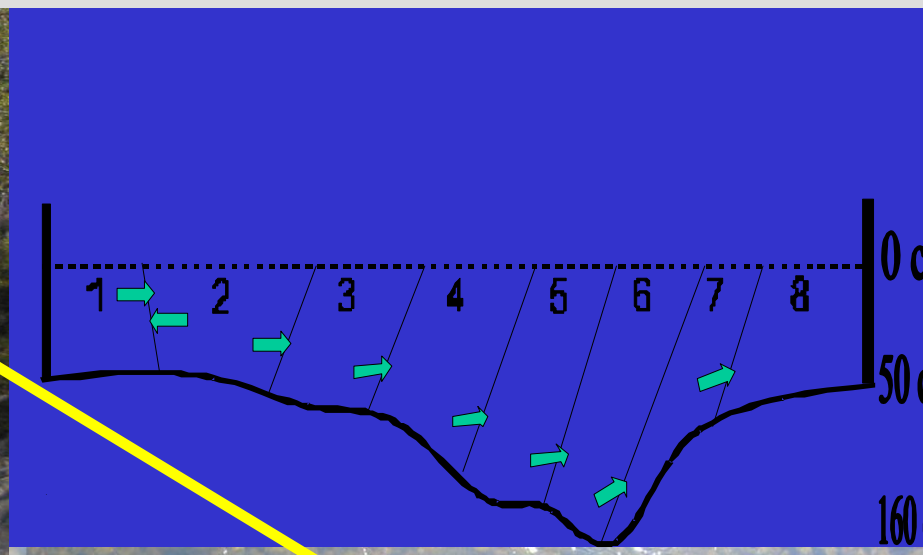
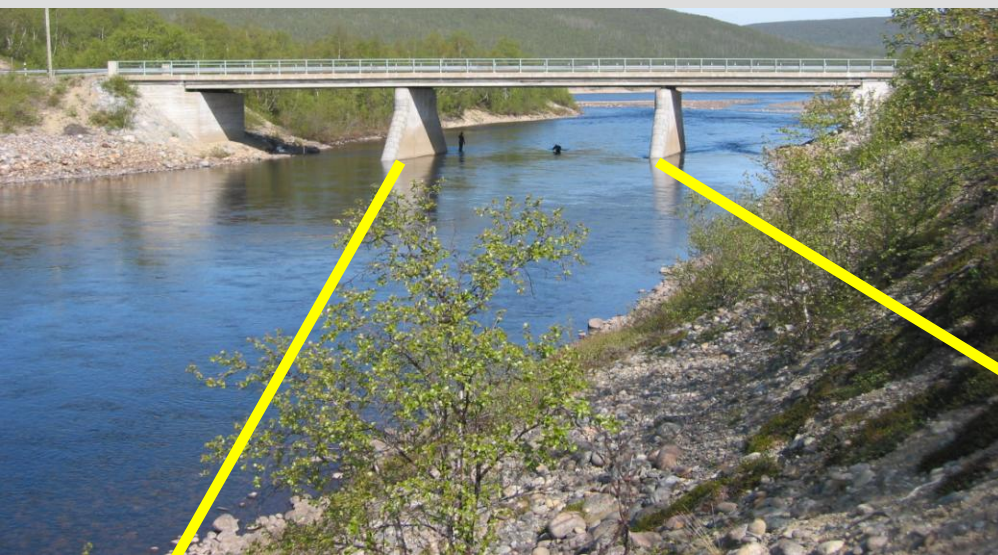
Tana river

Utsjoki river

Video monitoring of descending smolts and ascending adult salmon

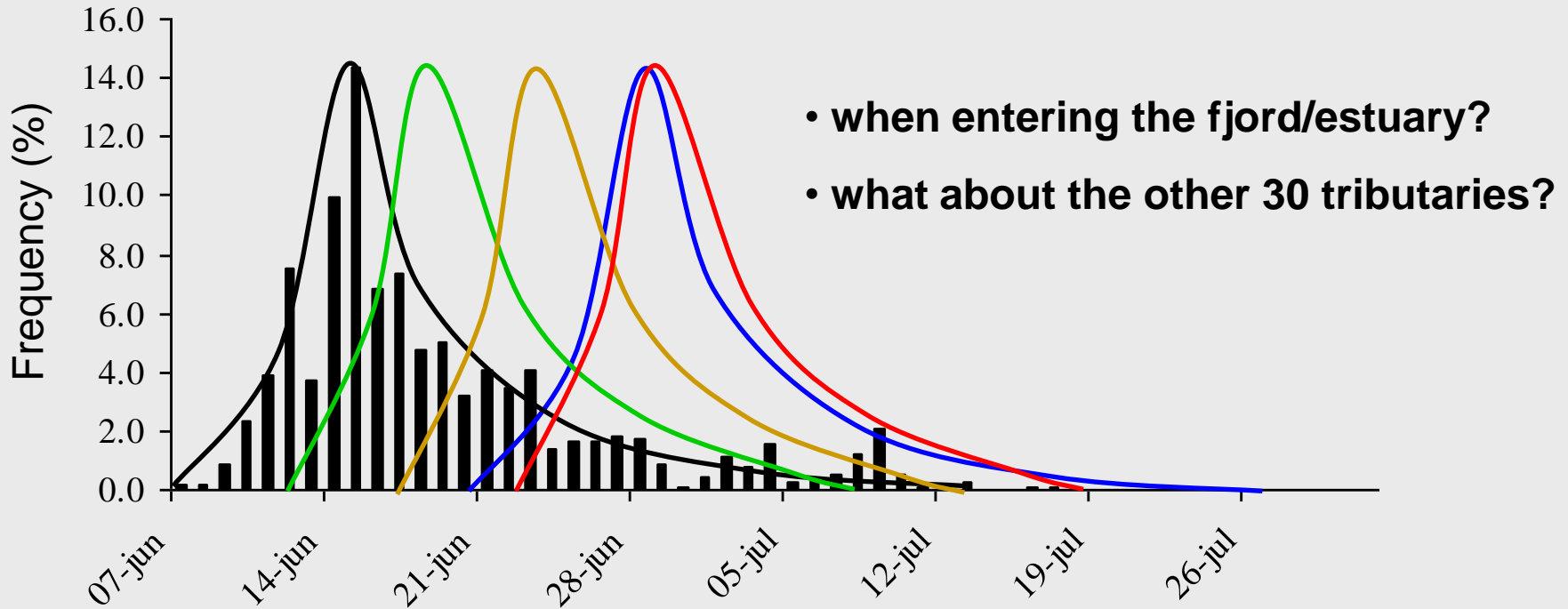


Temporal and spatial migration patterns of Atlantic salmon salmon in the sub-Arctic River Utsjoki – a large tributary to the Tana river



Number of smolts descending Utsjoki per year

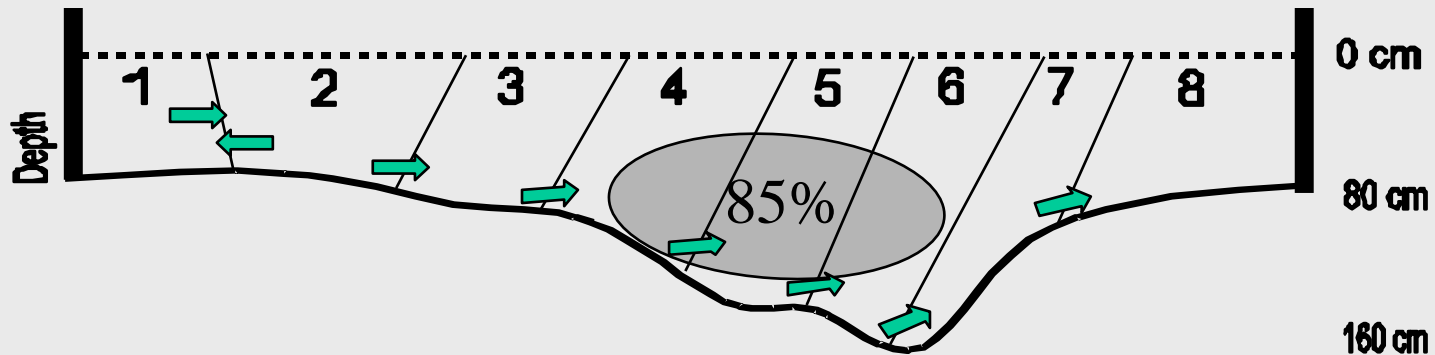
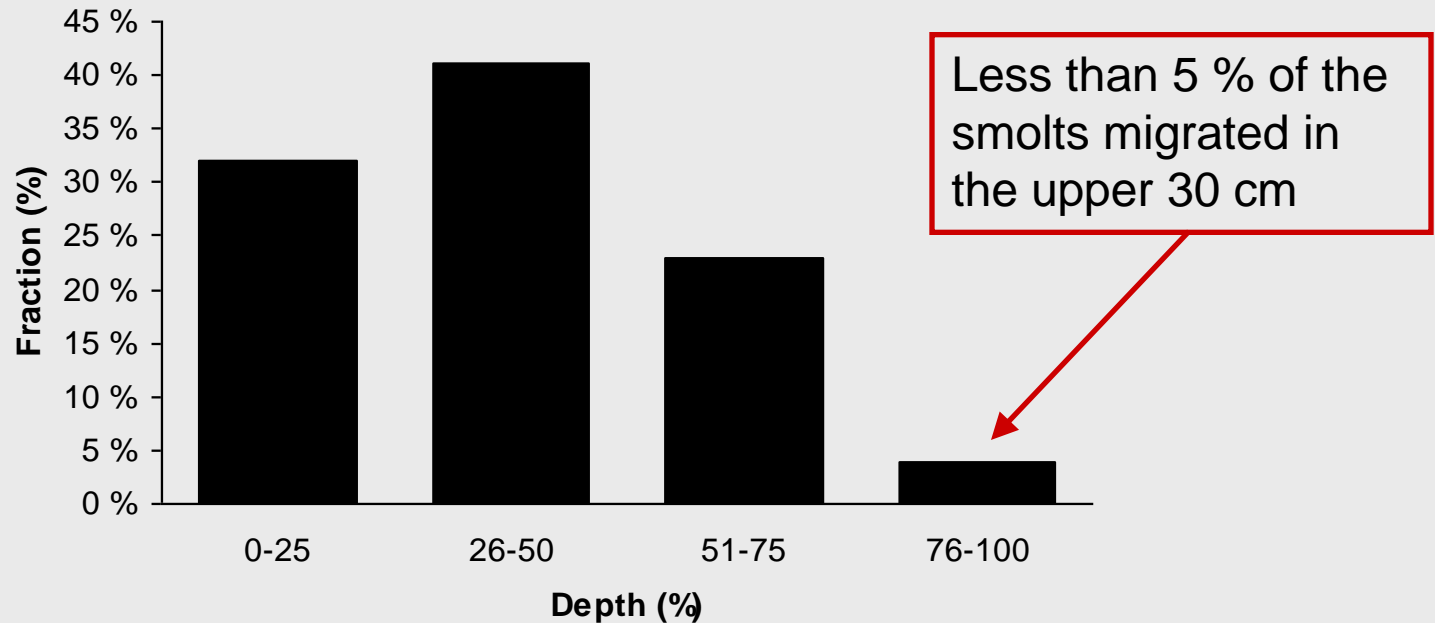
2002	2003	2004	2005	2006
12 852	13 800	27 113	40 000	26 000



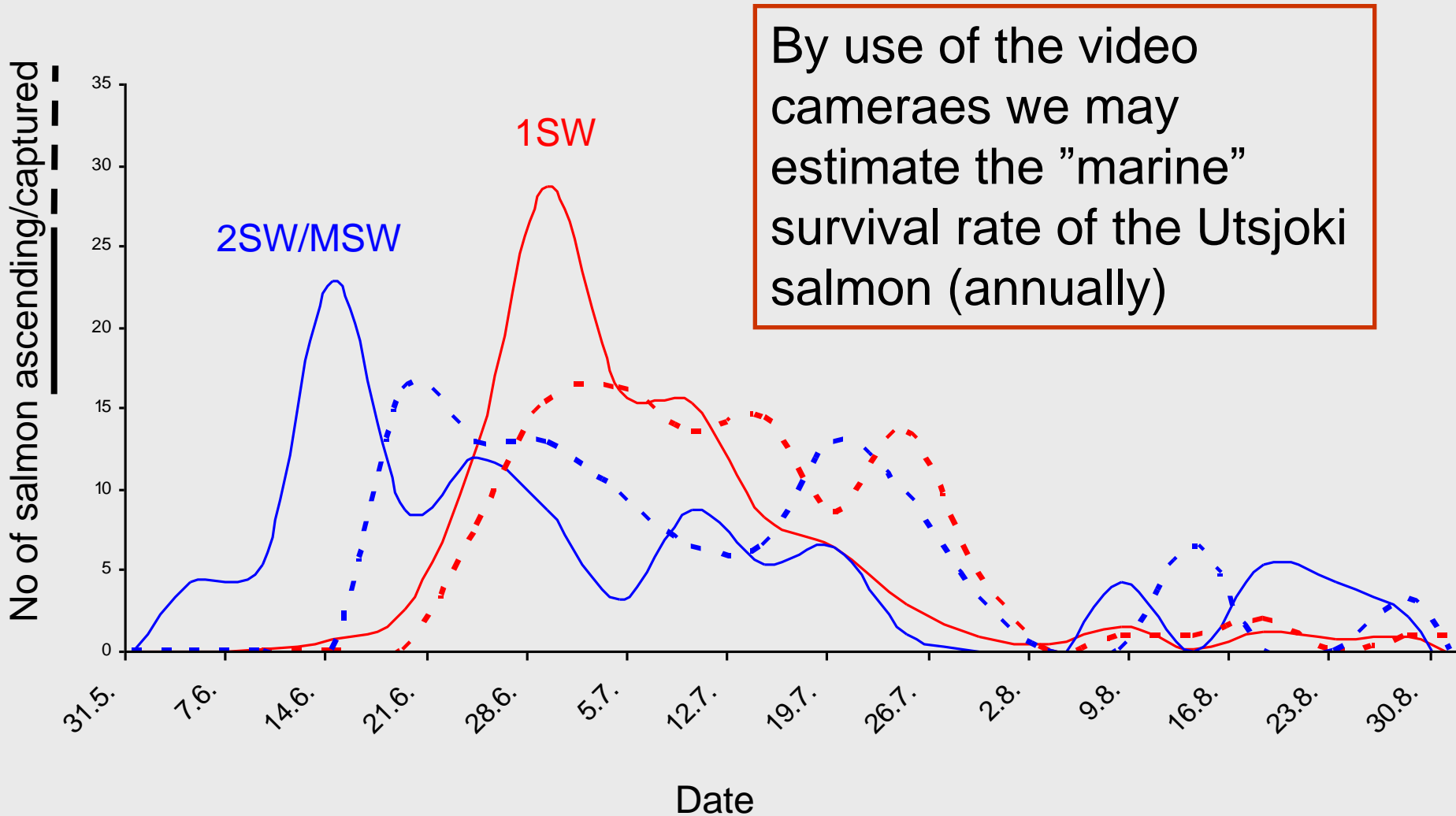
Unique smolt behaviour for northern populations?

When? Both day (60 %) and night (40 %)

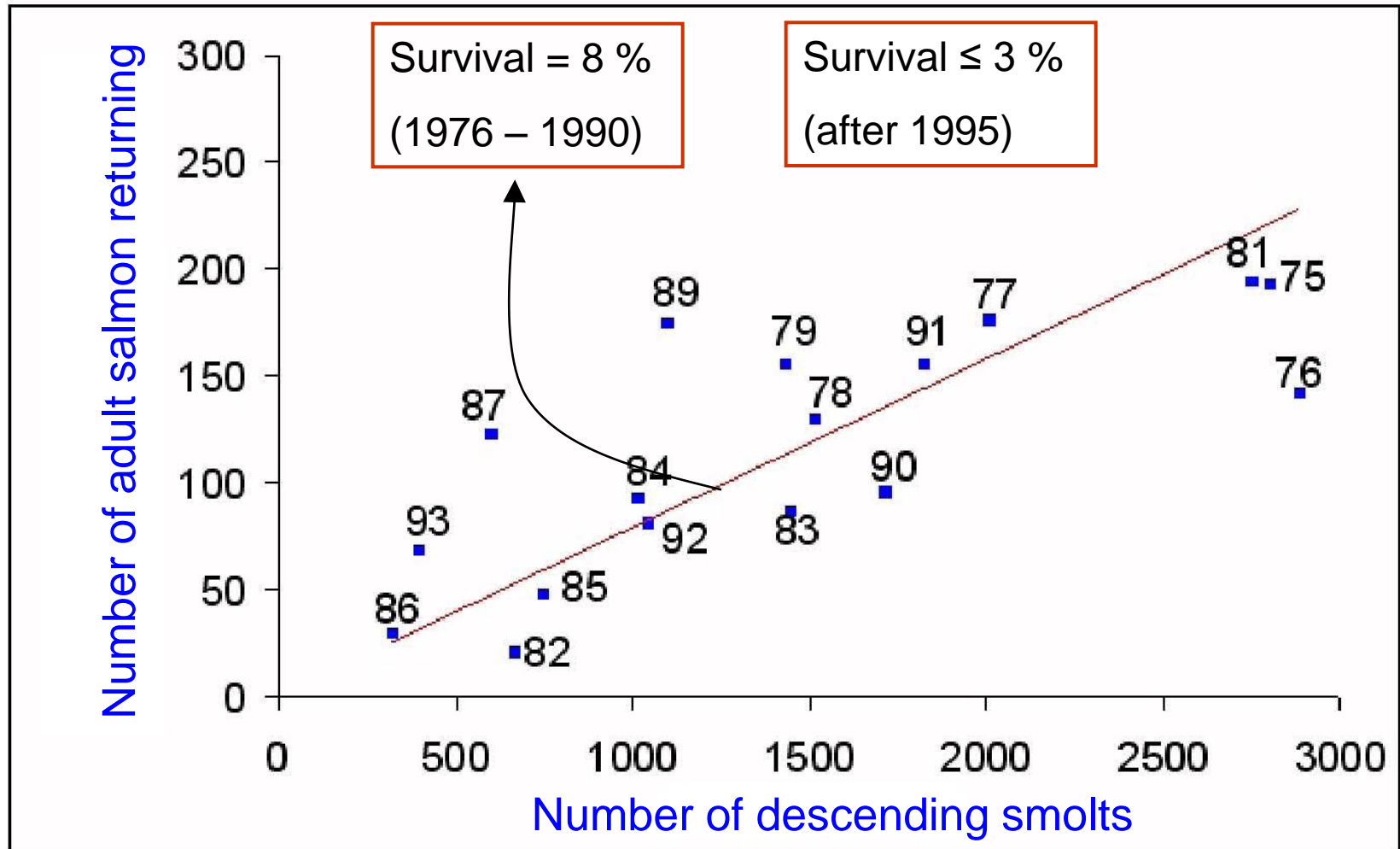
Where?



Ascendence and capture of adult salmon in Utsjoki



Mortality for Atlantic salmon during the sea residence is probably density independent

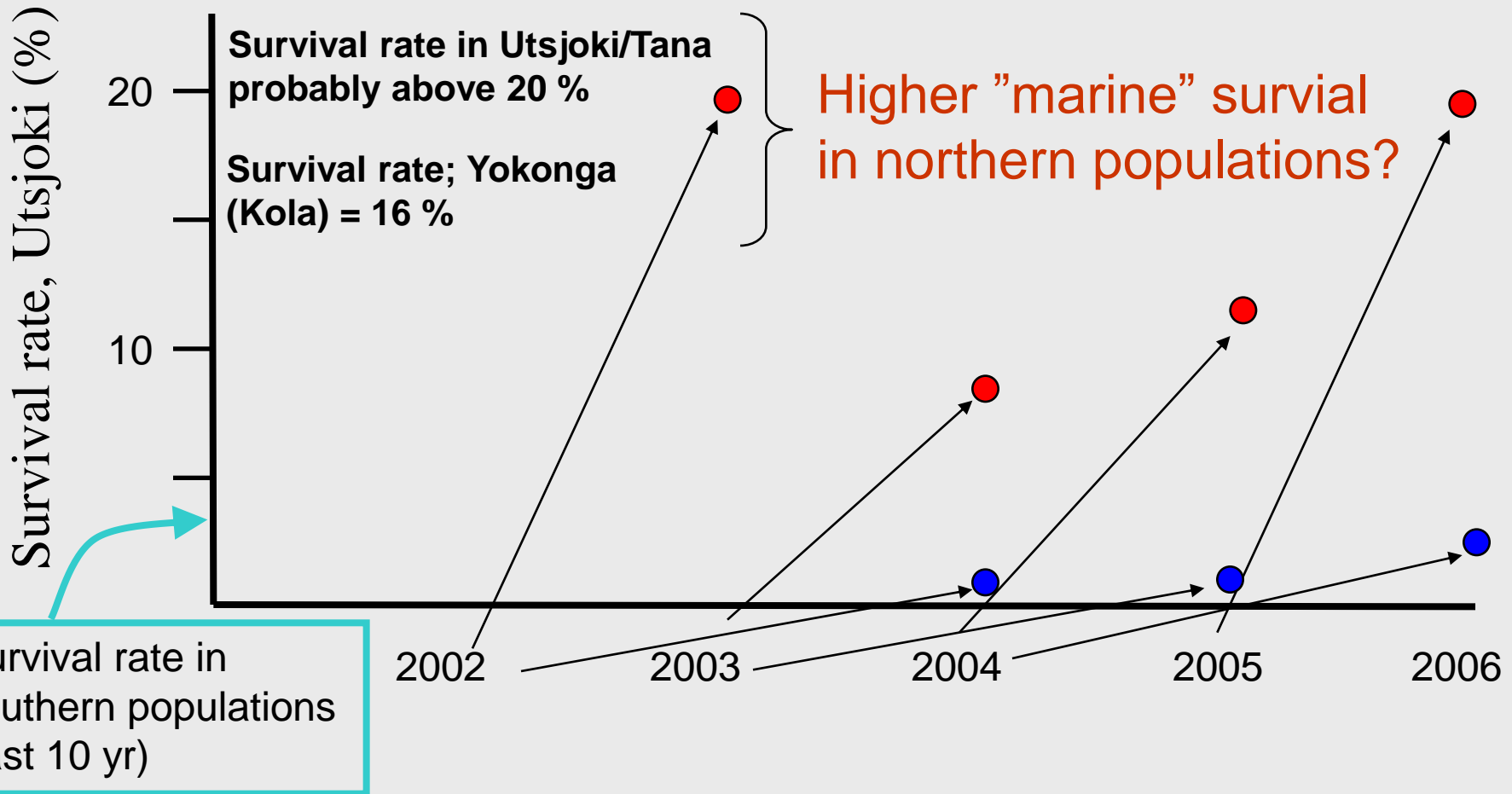


Revised after Jonsson et al. 1998 (based on data from River Imsa)

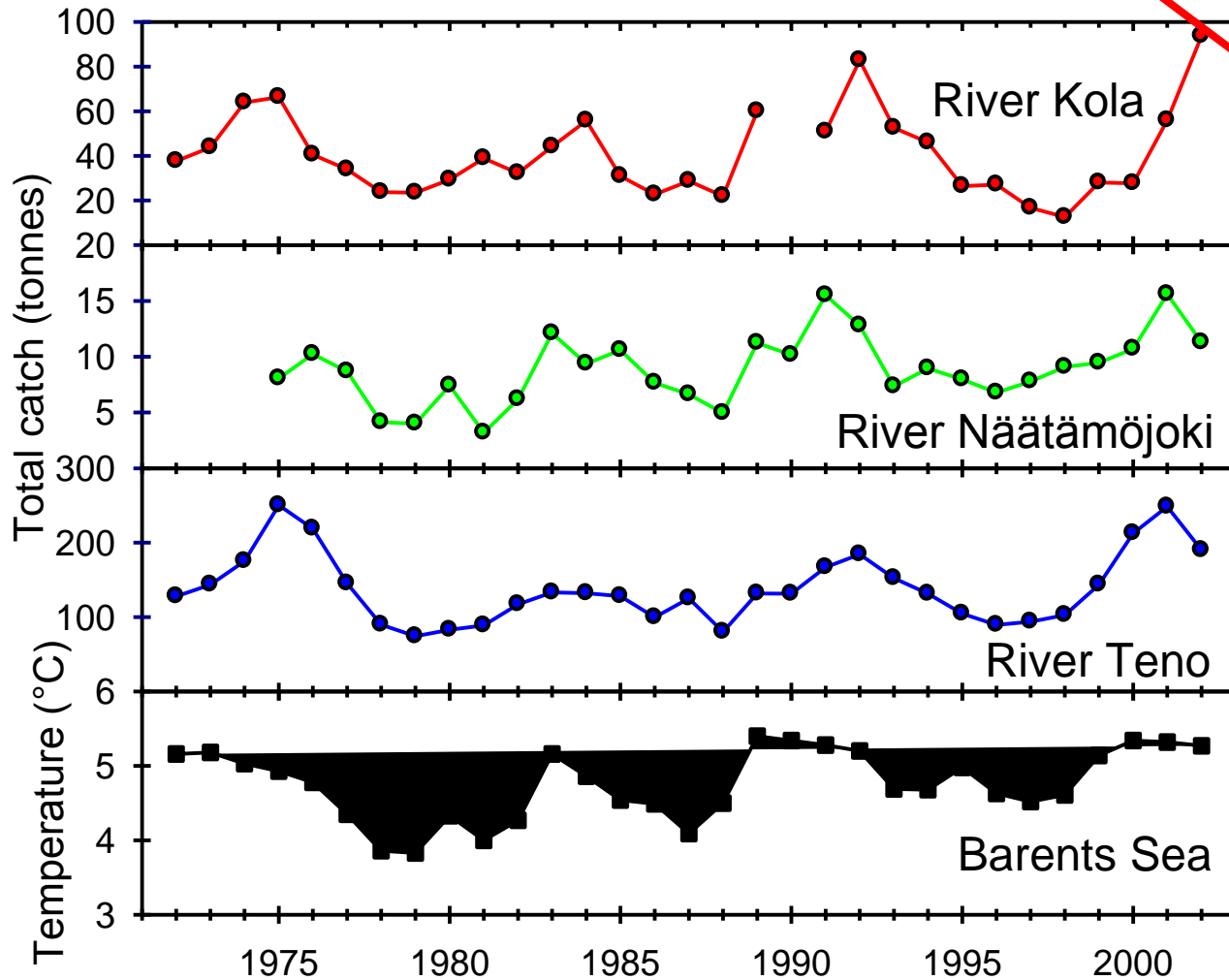
No of smolts descending (Utsjoki)

2002	2003	2004	2005	2006
12 852	13 800	27 113	40 000	25 000

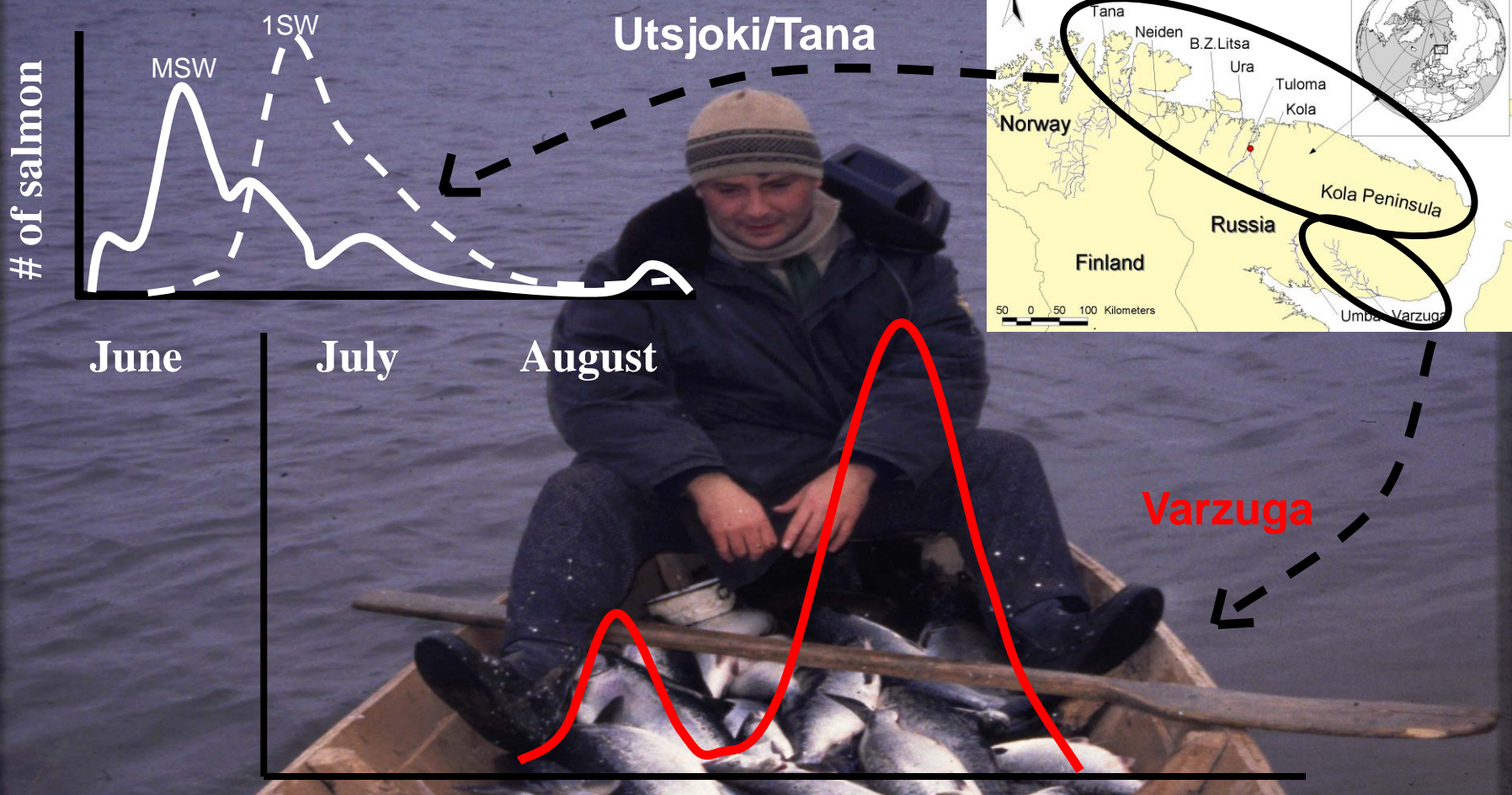
No of adults returning: ● 1SW ● Multi SW



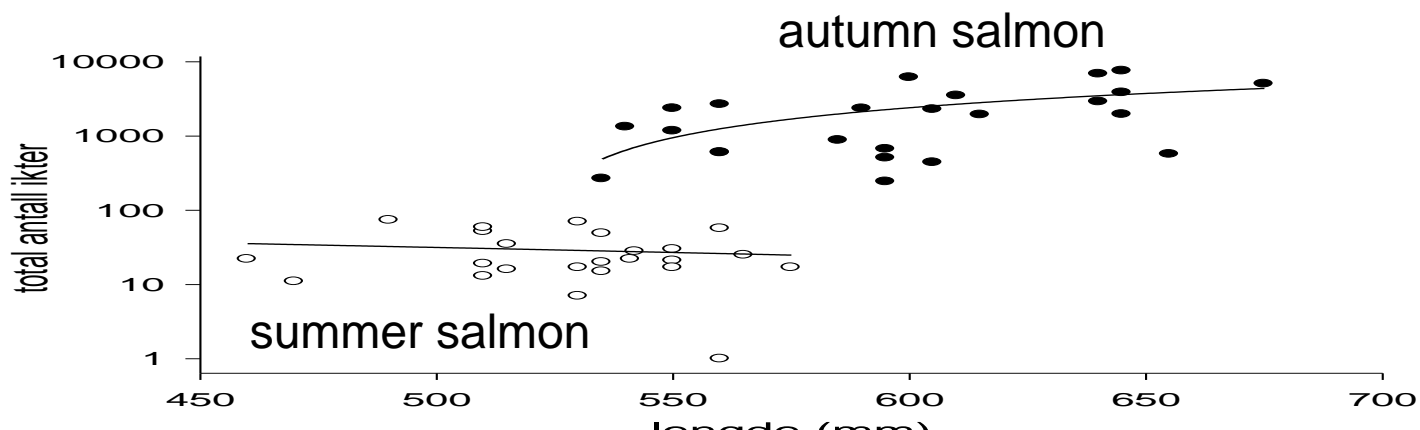
- correlated to the Kola section temperature
- not correlated to NAO-index



Positively correlated to NAO-index

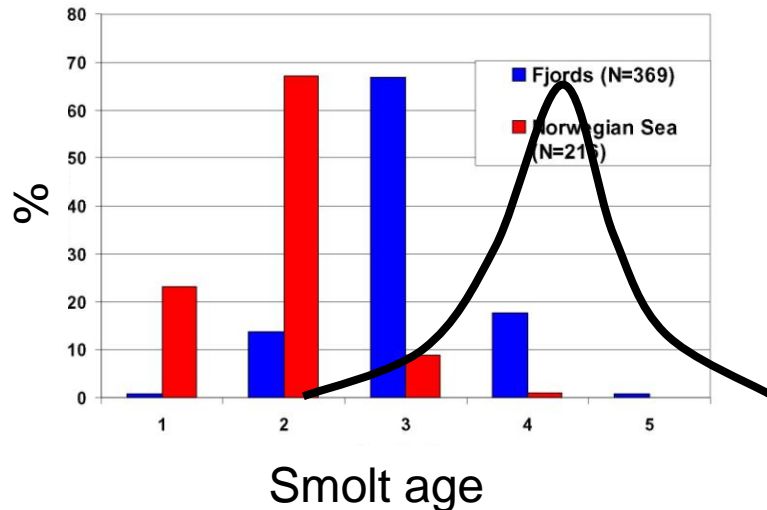


Different parasite burden suggest different marine feeding areas between summer and autumn salmon



Tana/Kola salmon – feeding where?

Age distribution of salmon smolts captured in inner fjords and in "open" sea

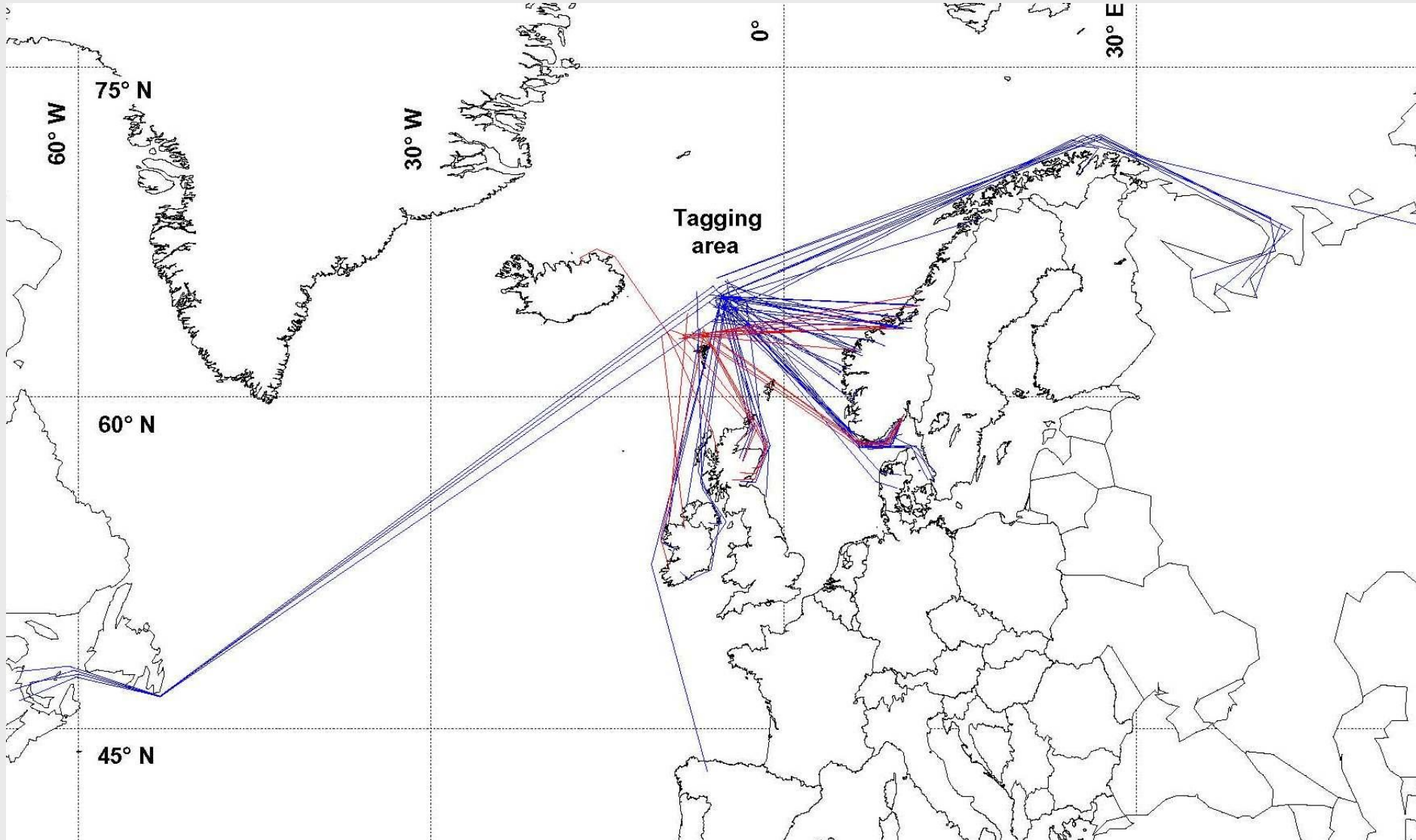


Smolt age for most Tana and Kola salmon ~ 4-5 years

The low smolt age of postsmolt and adult salmon captured in the Norwegian Sea (2 yr) and inner "southern" fjords (3 yr), strongly indicates that the Tana and Kola salmon are feeding elsewhere

– in the Barents Sea?

Recaptures of wild salmon tagged and released by the Faroes in the **autumn** and in **winter** in the period 1992-95 (From Hansen & Jacobsen 2000)

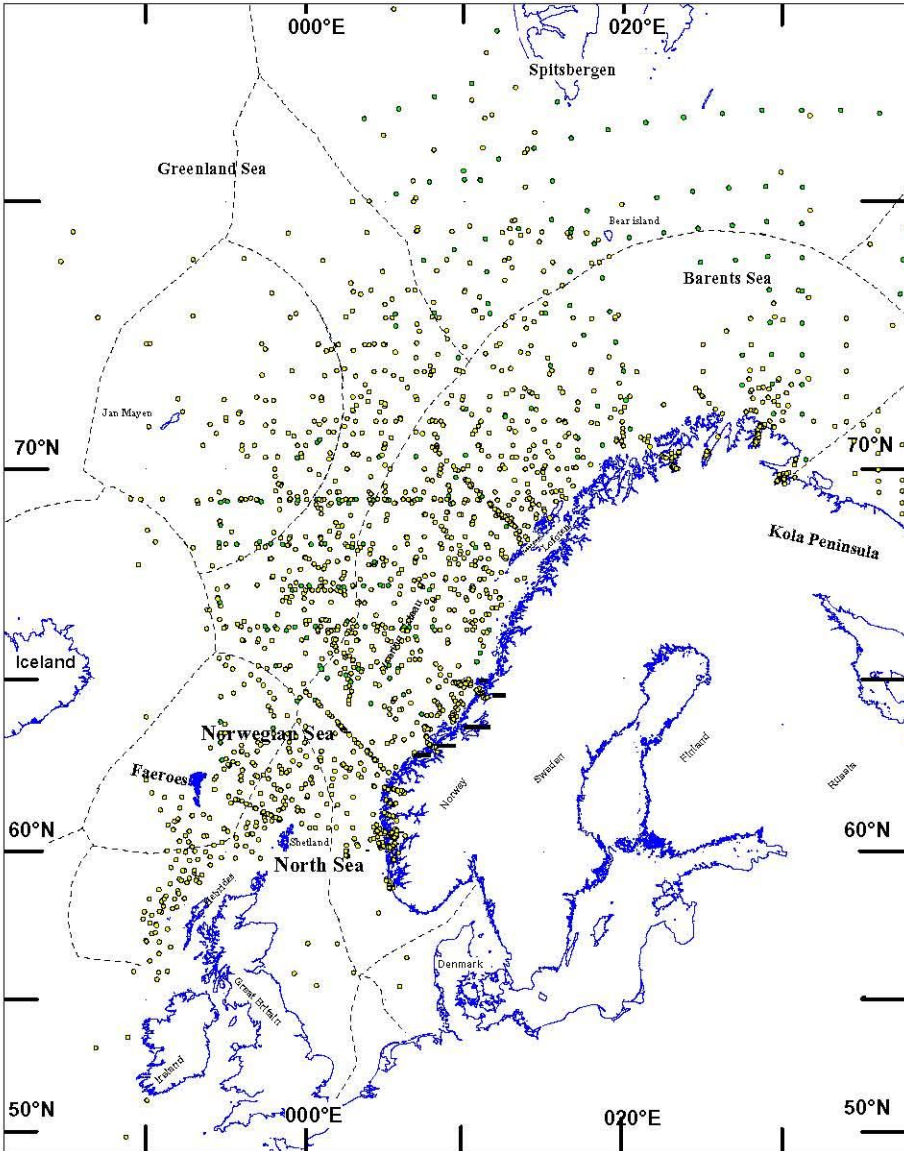




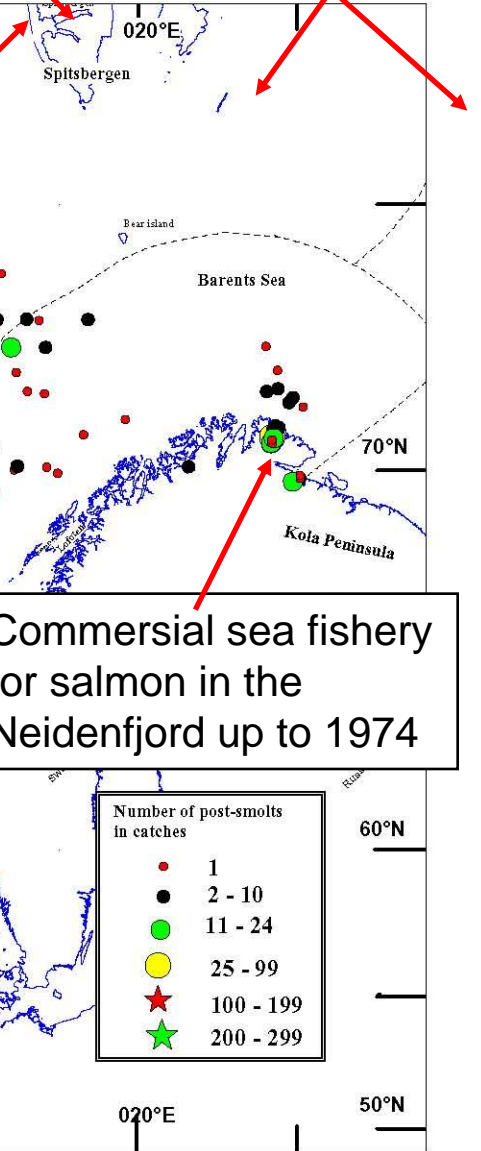
Postsmolt trawling 1990-2001 (IMR)

Adult Atlantic salmon captured annually in inner Isfjorden (LYR)

Salmon smolt captured west of Novaya Zembyla (Sept/Oct)



Pink salmon is very frequent along the Spitsbergen coast (even in lakes)

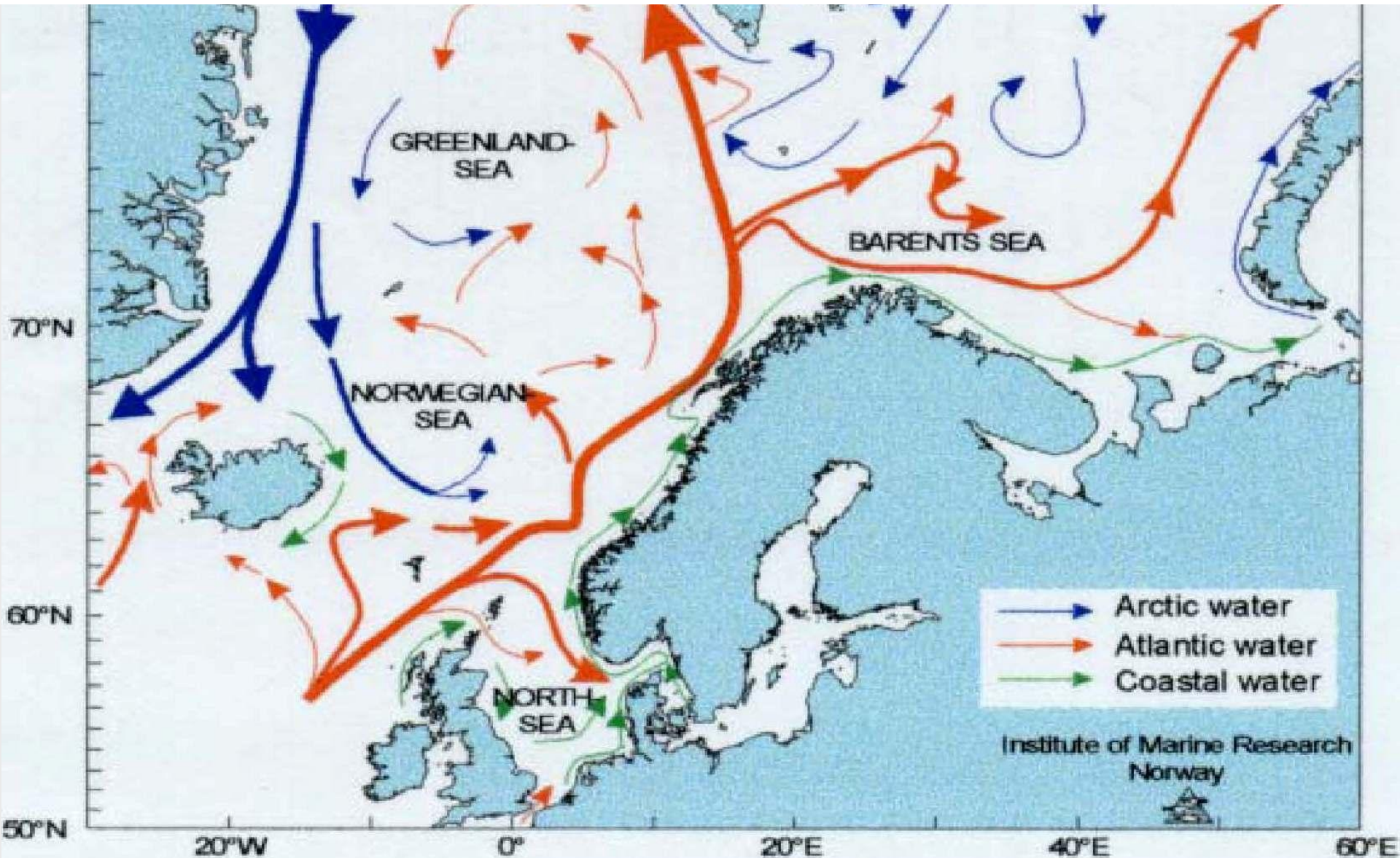


Commercial sea fishery for salmon in the Neidenfjord up to 1974

Number of post-smolts in catches	
●	1
●	2 - 10
●	11 - 24
●	25 - 99
★	100 - 199
★	200 - 299

Salmon in the north (2007-2010)

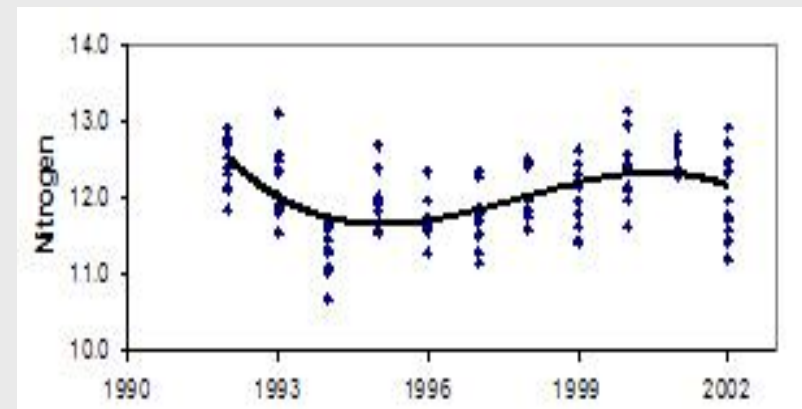
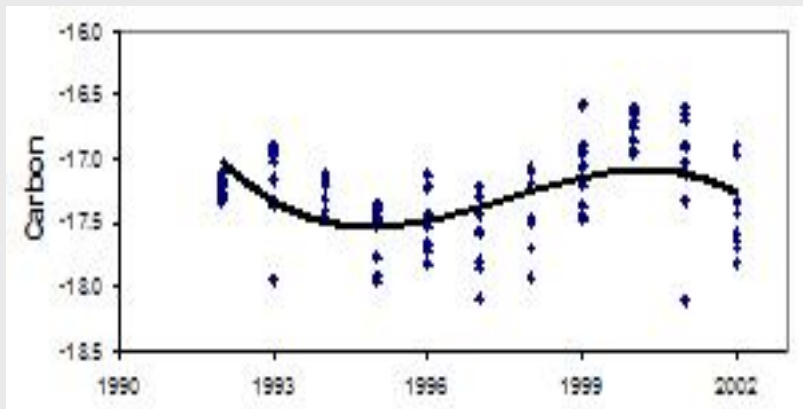
Surveys, stable isotopes, satellites and salmon:
exploring elements of the marine ecology of Barents Sea *Salmo salar*



1

Assess long-term changes in the marine trophic ecology of salmon by analysis of stable isotope signatures of carbon and nitrogen ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) in salmon scales sampled 1972-2007

- isotope signatures will be linked with salmon abundance, growth and also in relation to variation in marine climate conditions in the Barents Sea region
- analyses may provide an additional means to understand, in whole or in part, observed variability in abundance of various stocks of Atlantic salmon
- we hypothesize that nitrogen signatures would be higher during the second or third sea years owing to salmon feeding more piscivorously

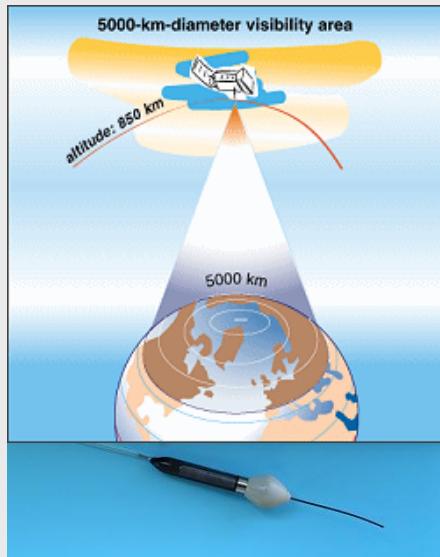


Preliminary analyses of $\delta^{13}\text{C}$ carbon and $\delta^{15}\text{N}$ nitrogen isotope signatures of River Tana salmon, using scales sampled in the period 1992-2002

We have also found a positive correlation between the size of adult salmon entering the Karasjokka river (a large tributary of river Tana) and the estimated density of capelin in the Barents Sea

2 Determine marine distribution patterns and ocean forage areas across seasons by the combined use of archival 'pop-up' **satellite tags** and DST archival tags (tagging kelts)

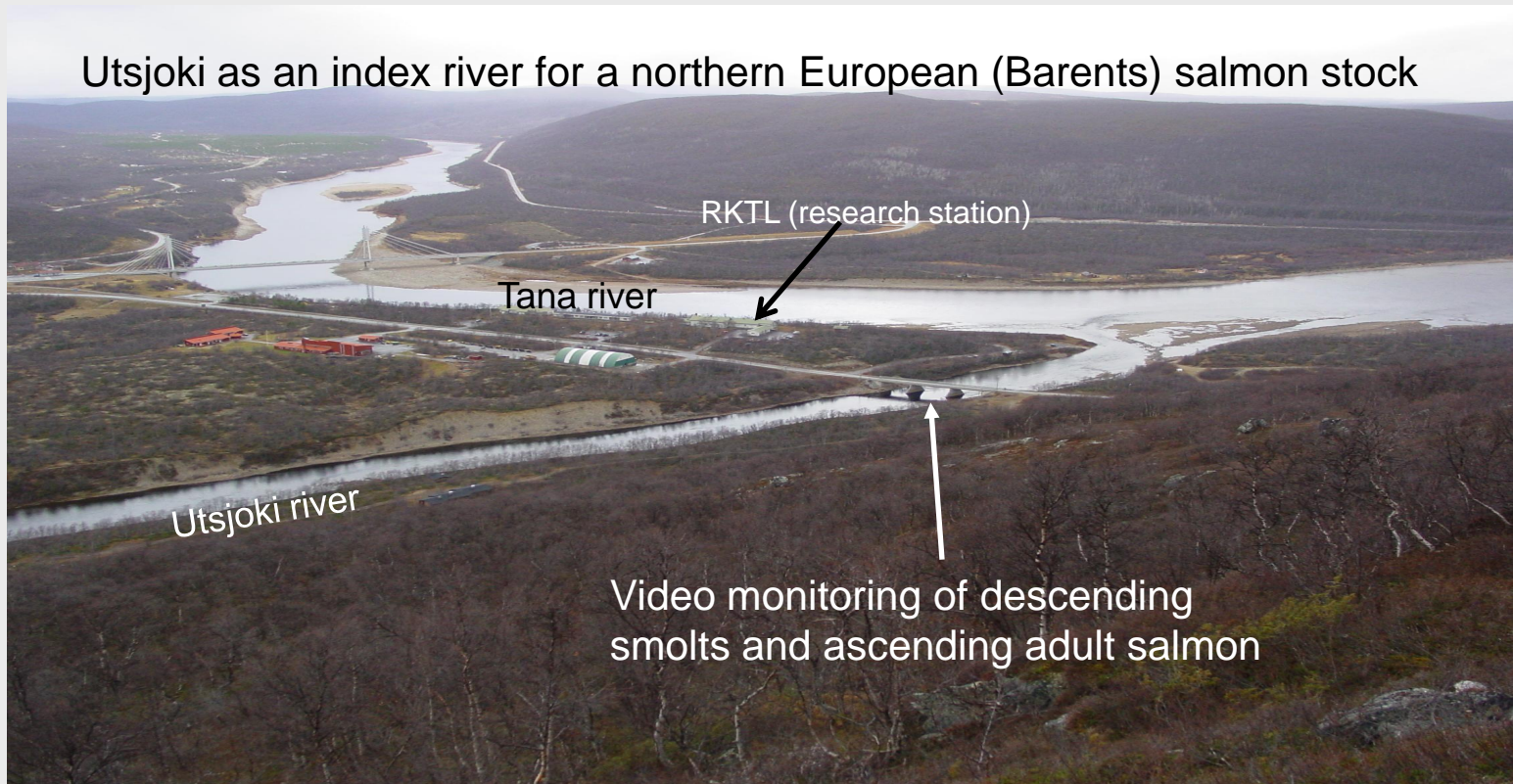
- first time pop-up (satellite) tags have been used on salmon
- 25 Atlantic salmon kelts were tagged when descending Tana river (Jun 2007)
- tags are programmed to pop-up after 3 (Sep), 5, 7 and 9 months
- recording depth, temperature and "light" (dusk and dawn)
- also tagged with DST-tags in four rivers (measuring water temperatures)



Atlantic salmon (kelts) from the Tana river tagged with satellite (pop-up) tags in mid June 2007.

3 Develop a time series of "marine" survival of a northern European (Barents) Atlantic salmon stock (Utsjoki)

- continue the video monitoring in the Utsjoki river
- develop a time series of "marine" survival of a "Barents" salmon stock
- correlate survival rate with prey abundance, climate conditions etc.



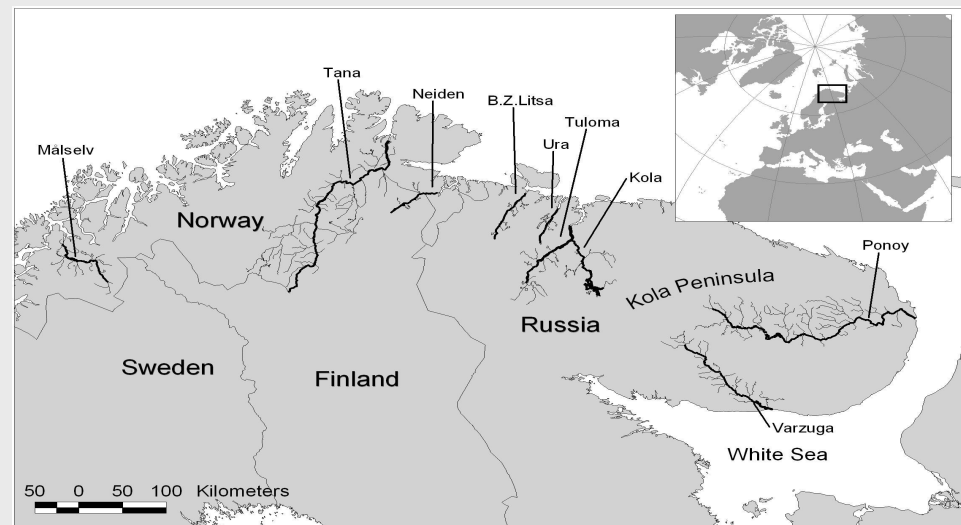
4 Apply molecular **genetic methods** to identify individual stock components in a mixed-stock fishery

- obtain more representative estimates of numbers of salmon that survive to return to home waters adjusting or correcting survival estimates to account for in-river, and possibly coastal, fisheries
- i.e. to correct survival estimates obtained from video monitoring operations


5 Examine **co-variation** in abundance and survival of salmon stocks in different Barents Sea rivers

- influence of climate and climate variability on annual variation in survival and abundance of Barents Sea salmon stocks (including Målselv river)
- co-variation in abundance and changes in sea-age at maturity

6 Develop **management plans** for northern Atlantic salmon rivers by integrating biological and local knowledge of the resource




Thanks for your attention!



Jaakko
Erkinaro

Brian
Dempson

Eero
Niemelä



Alexander
Zubchenko



Sergei Prusov



Mike
Power



Reidar
Borgström