Samarch
FORUM INTERNATIONAL
MONT SAINT-MICHEL - 16 > 18 MAI 2018

Saumon & Truite de mer
MIEUX CONNAÎTRE. MIEUX COMPRENDRE. MIEUX GÉRER.

# État des populations de grands salmonidés migrateurs en Europe et dans le monde

## *Status of Atlantic salmon population in Europe and Worldwide*


**Etienne Rivot**

*UMR ESE Ecology and Ecosystem Health*

INRA SCIENCE & IMPACT — AGRO CAMPUS OUEST — AGENCE FRANÇAISE POUR LA BIODIVERSITÉ, MINISTÈRE DE L'ENVIRONNEMENT


**16 Mai 2018**

Interreg France (Channel Manche) England — SAMARCH — Normandie Grands Migrateurs — eau Seine Normandie, Agence de l'eau — Fédération Nationale Pêche — La Manche Conseil Départemental — Région Normandie

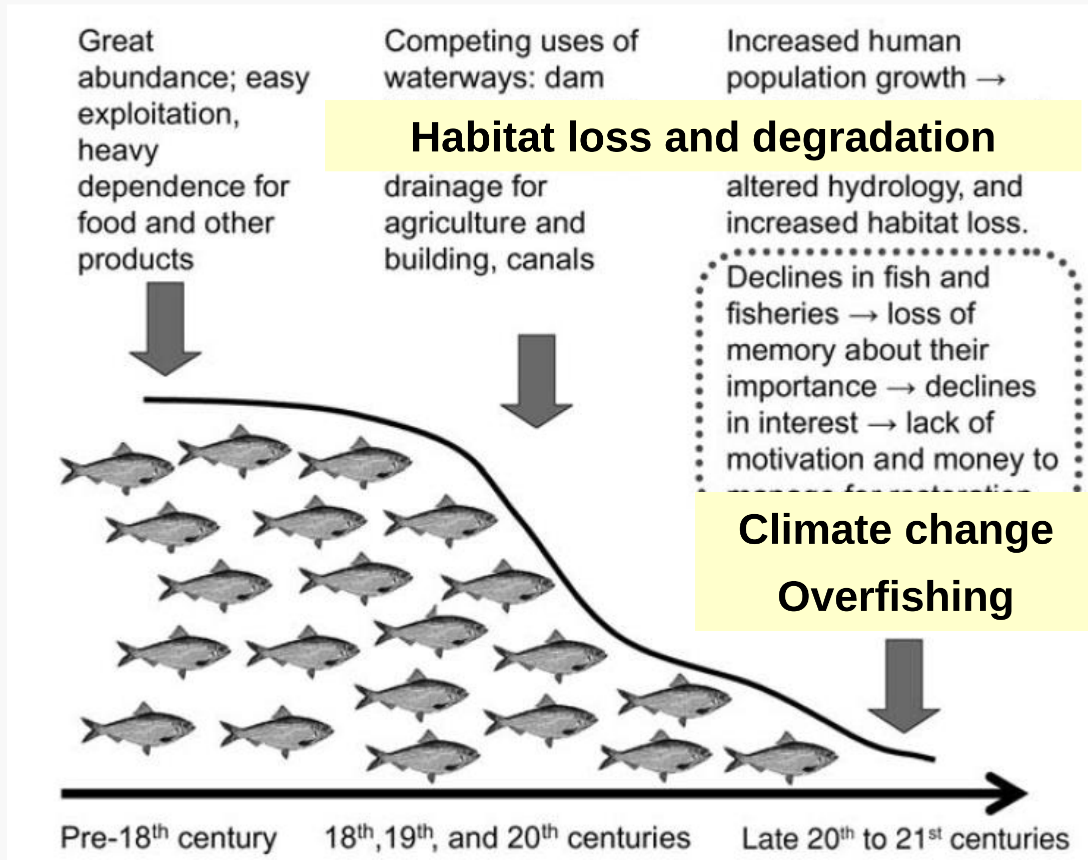
# A dramatic decline of North Atlantic diadromous fishes

Limburg and Waldman

BioScience

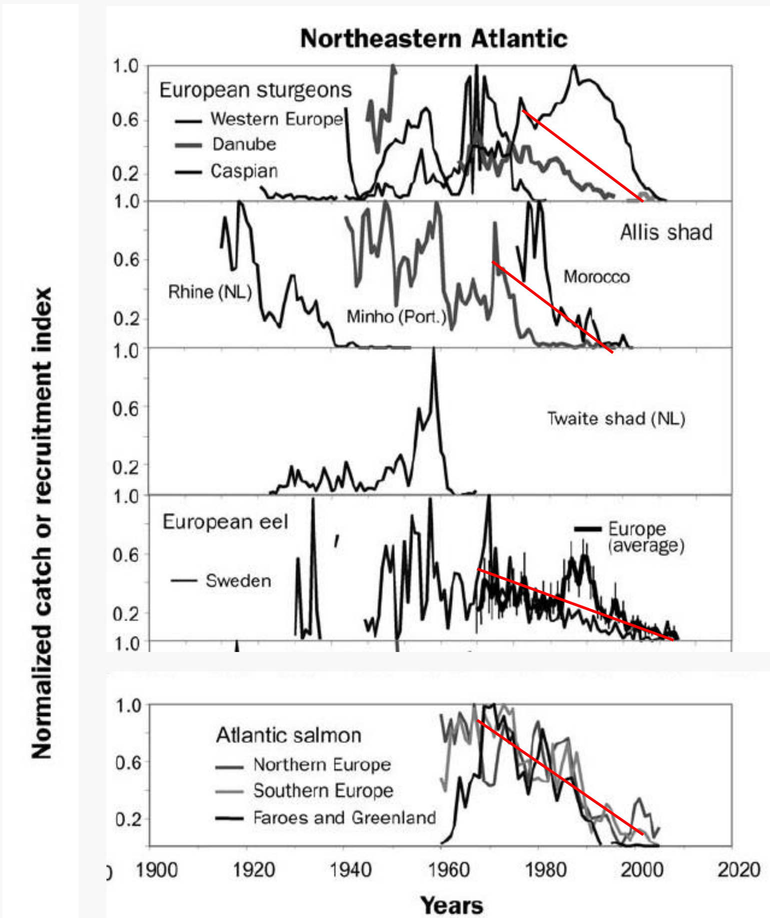
2009

Mechanisms are complex and multifactorial




*Source* : Limburg, K. E., & Waldman, J. R. (2009). Dramatic declines in North Atlantic diadromous fishes. *BioScience*, *59*(11), 955-965.

# A dramatic decline of North Atlantic diadromous fishes




***Esturgeon d'Europe***
***Acipenser sturio***

***Grande Alose***
***Alosa alosa***

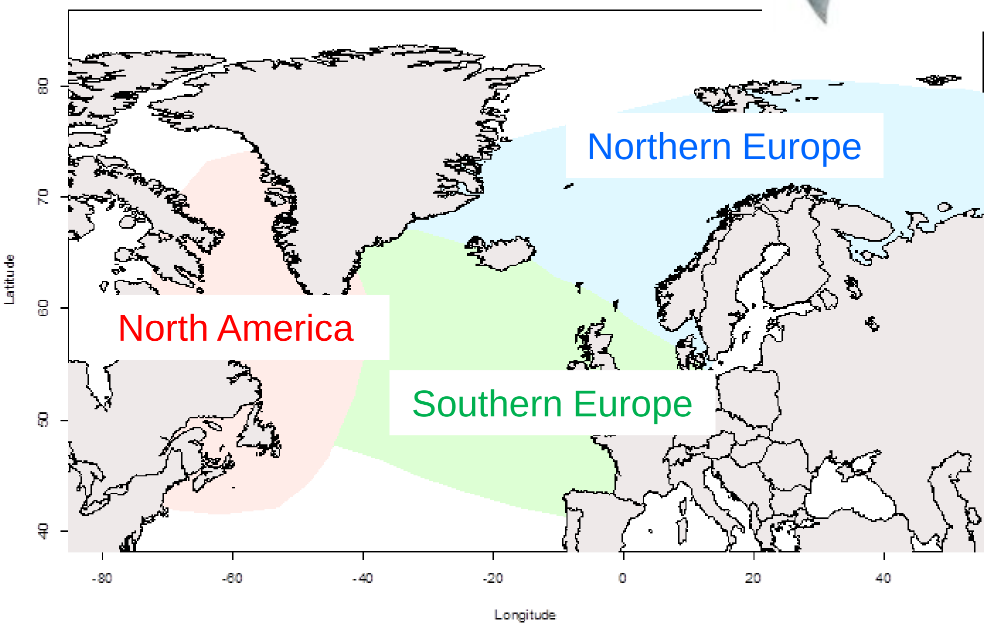
***Anguille européenne***
***Anguilla anguilla***

**Saumon atlantique**
***Salmo salar***

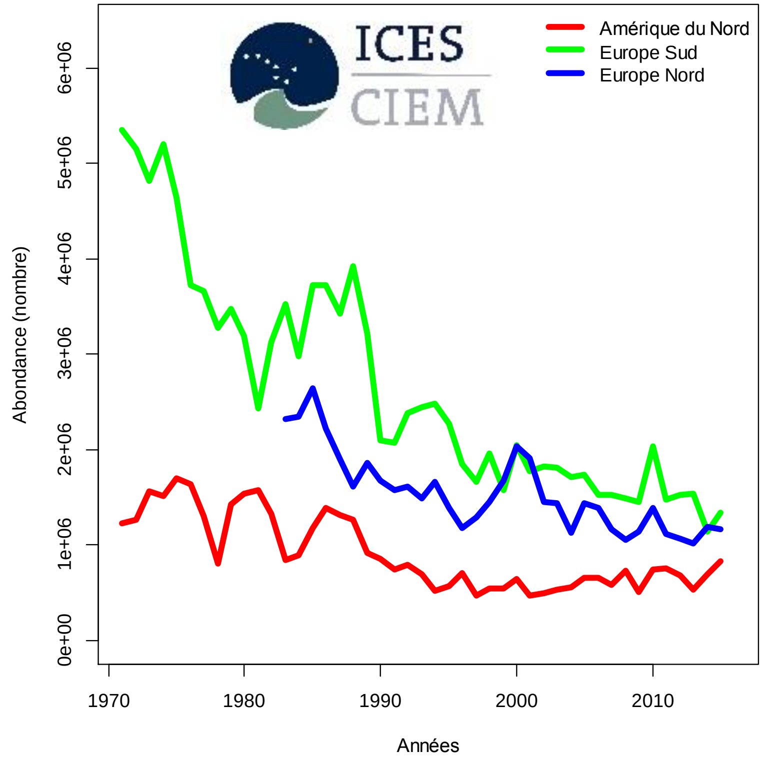
*Source* : Limburg, K. E., & Waldman, J. R. (2009). Dramatic declines in North Atlantic diadromous fishes. *BioScience*, *59*(11), 955-965.

# Atlantic salmon (*Salmo salar*)

3 continental stock groupings

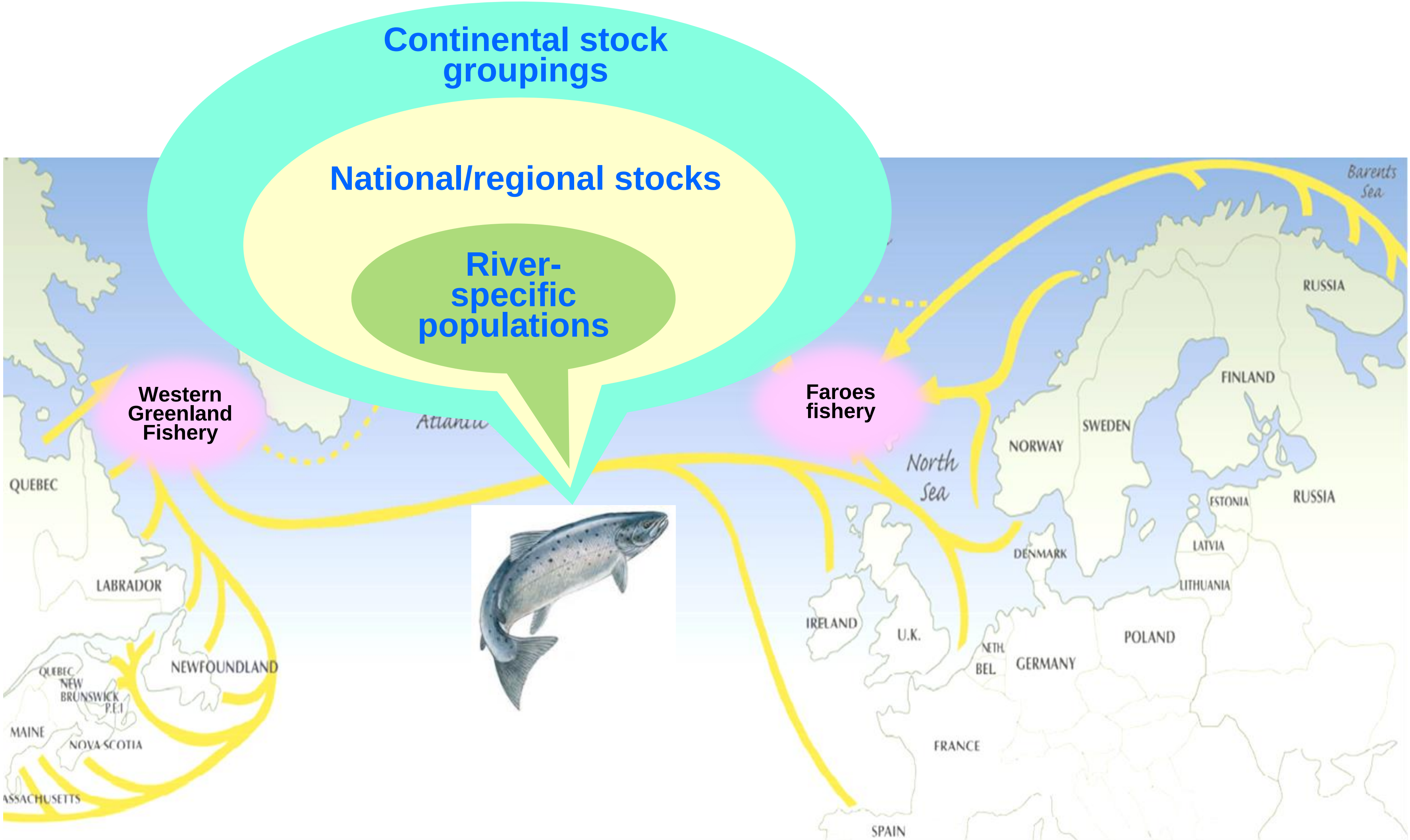



Abundance at sea before any marine fishery for the 3 continental stock groupings

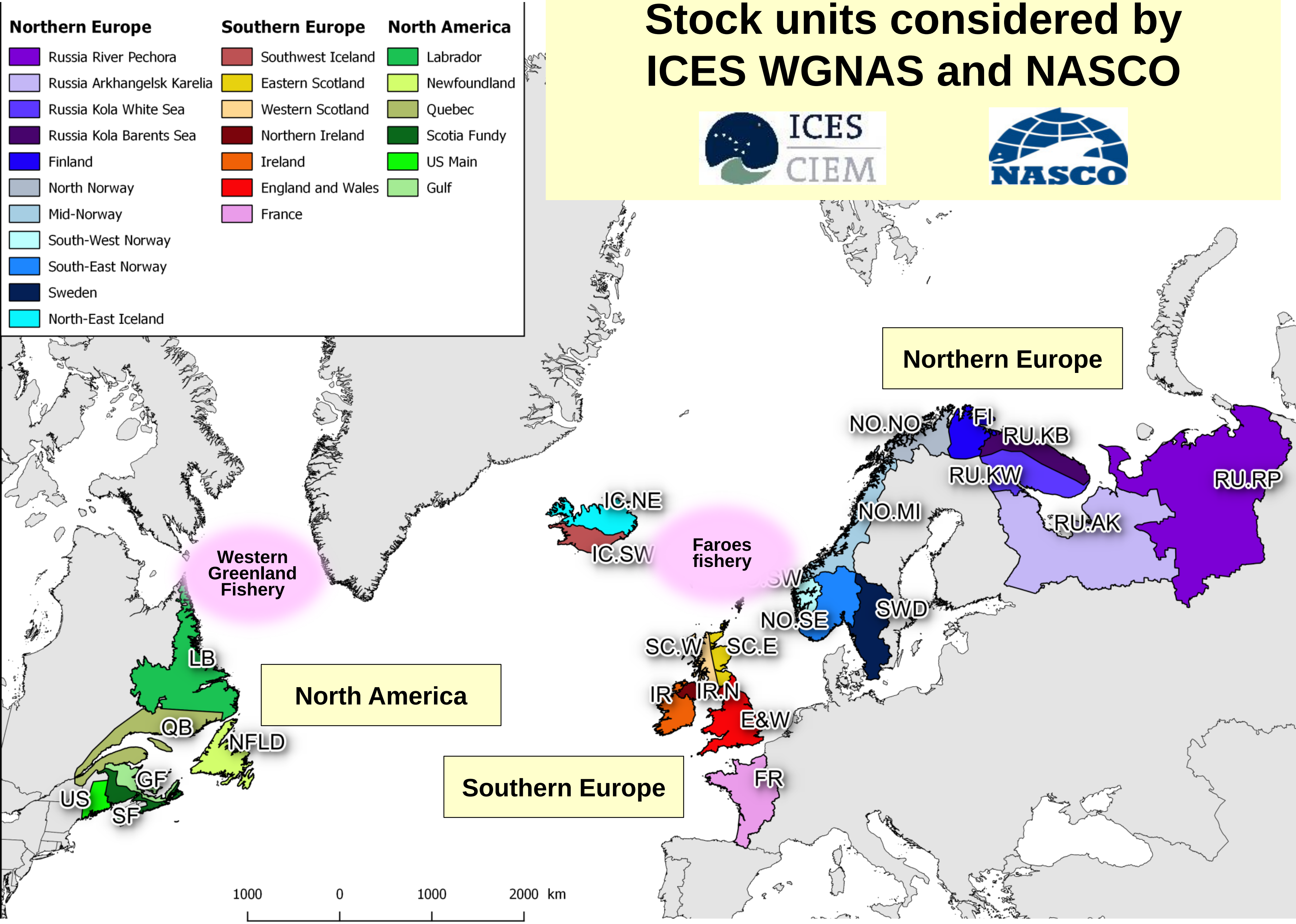



*Source* : ICES WGNAS Report 2015

# Populations are assessed and managed at various scales



# Stock units considered by ICES WGNAS and NASCO



# Outlines

- **Assessment at local scale (river-by-river)**
  - References points to assess abundance of returns on a river-by-river basis: *Conservation limits* (*CLs*)
- **Assessment at regional or national scale**
  - % of rivers with eggs deposition **>** *CL*
  - Total returns / national *CL*
- **Assessment at international scale**
  - Abundance at sea before any marine fishery (*Pre-Fishery Abundance, PFA*)
  - Scientific advices to manage mixed stock fisheries at sea
- **Conclusions and future prospects**

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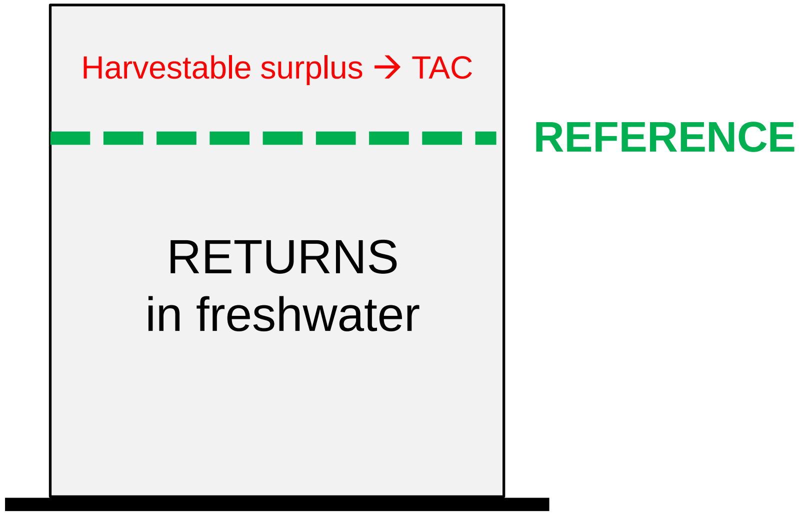
# Population assessment - river basis

- **River-by-river basis**
- **Assess the abundance of returns against a reference**



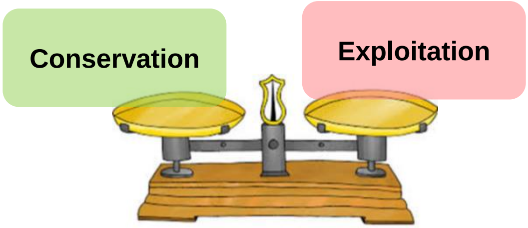
# Conservation limits (*CLs*)

*1998*

- **Reference = Conservation Limits**

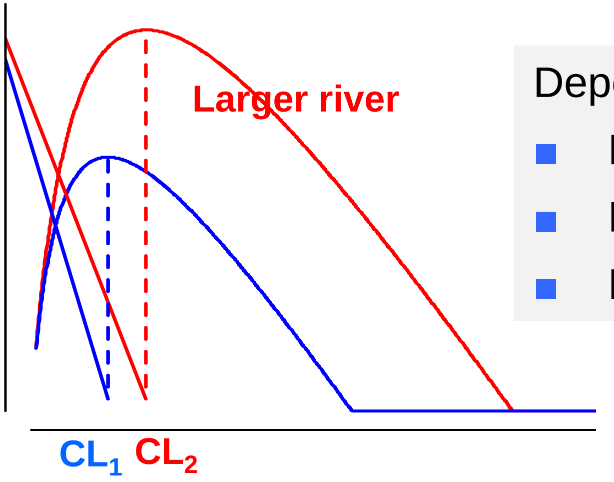
**<u>In Europe</u>, Conservation Limits (*CLs*) = tradeoffs between conservation and exploitation**

**= Eggs deposition that produces MSY**




- ***CLs* are derived from pop. dyn. models = Stock-recruitment models**

**Surplus** = fraction of the population that can be harvested while maintaining an equilibrium




Depends on

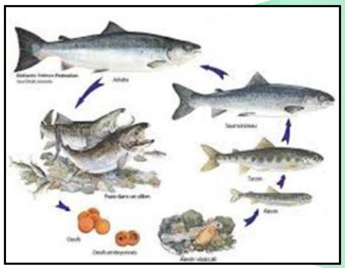
- River size (surface of suitable habitat)
- River productivity
- Marine survival rate

## Establishing *CLs* for all rivers ?

# Conservation limits (*CLs*)

**Only a few rivers with scientific monitoring (« index rivers »)**

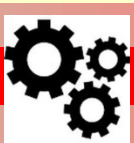
**Most of the rivers with scarse data**

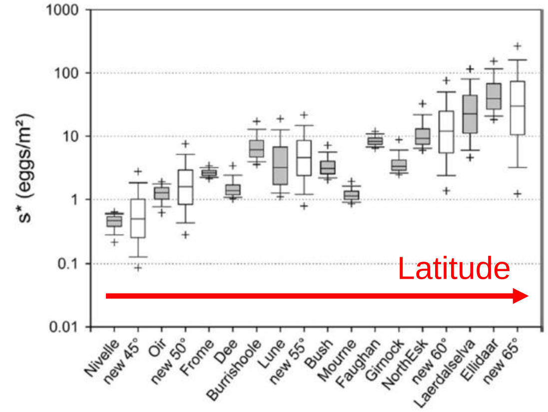


Eggs-to-Eggs pop. dyn model

***CLs***

**Statistical models to predict *CLs* for all rivers**





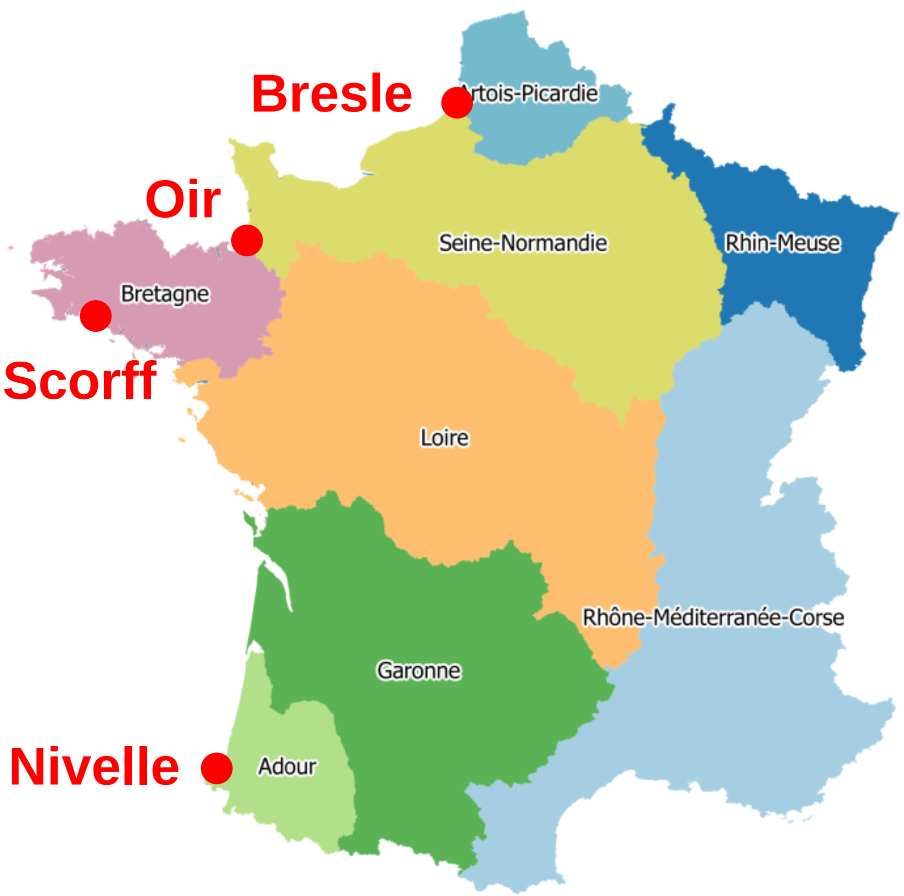

Prévost et al., ICES J. Mar. Sci, 2003

## Example

# France

# 4 index rivers in France

- **58 salmon rivers in France** (NASCO)
- **4 index rivers**



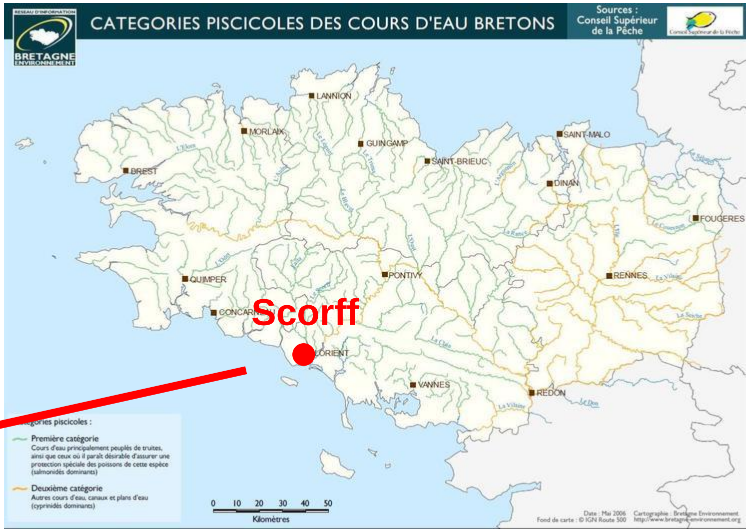

## Monitoring programs since 20 or 30 years

AGENCE FRANÇAISE POUR LA BIODIVERSITÉ
MINISTÈRE DE L'ENVIRONNEMENT

INRA SCIENCE & IMPACT

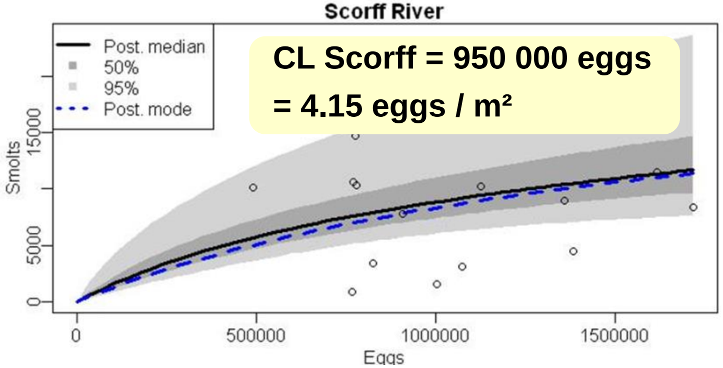
| | Parrs (electrofishing) | Smolt (trapping + mark/recapture) | Adults (trapping + mark/recapture) |
|---|---|---|---|
| Bresle | ✗ | ✓ | ✓ |
| Oir | ✓ | ✓ | ✓ |
| Scorff | ✓ | ✓ | ✓ |
| Nivelle | ✓ | ✗ | ✓ |

# Definition of *CLs* in Britany and lower Normandy




**Survey data**

**Population dynamic model (SR)**




**CL Scorff = 950 000 eggs = 4.15 eggs / m²**

**Prediction of *CL* for 30 rivers using available data**

- **Surface of habitat**
- **Productivity (juveniles AI)**

# *CLs* and *TAC* in France

- **58 salmon rivers in France** (NASCO)
- **out of which 33 have a *CL* (in 2015)**
- ***CLs* used to defined TAC on a river-by river basis**

| Cours d'eau | TAC global (nombre d'œufs prélevables) | TAC Saumon de printemps | TAC Castillon | L.C. (cible de dépose d'œufs) En millions |
|---|---|---|---|---|
| *ARTOIS-PICARDIE* | | | | |
| CANCHE | NR | 0 | 10 | Pas de L.C. définie |
| AUTHIE | NR | 0 | 10 | Pas de L.C. définie |
| *SEINE-NORMANDIE* | | | | |
| *Haute-Normandie* | | | | |
| BRESLE | NR | 2 | 8 | 0.28 |
| ARQUES | NR | 2 | 8 | 0.13 |
| *Basse-Normandie* | | | | |
| TOUQUES | 25 381 | 2 | 8 | Pas de L.C. définie |
| VIRE | 22 000 | 2 | 8 | N.R. |
| SAIRE | 38 500 | 3 | 12 | Pas de L.C. définie |
| SIENNE | 479 500 | 34 | 155 | 0.65 |
| SEE ; SELUNE | 1 474 000 | 105 | 476 | 1.06 |
| *LOIRE-BRETAGNE* | | | | |
| *Bretagne Nord* | | | | |
| COUESNON | 188 350 | 10 | 91 | 0.46 |
| GOUET | 18 929 | 2 | 9 | Pas de L.C. définie |
| LEFF | 195 947 | 11 | 95 | 0.24 |
| TRIEUX | 572 804 | 31 | 278 | 0.74 |
| JAUDY | 146 963 | 8 | 71 | 0.49 |
| LEGUER | 903 556 | 49 | 438 | 0.91 |
| DOURON | 272 065 | 15 | 132 | 0.21 |
| QUEFFLEUTH | 460 401 | 25 | 223 | 0.19 |
| PENZE | 622 365 | 34 | 302 | 0.28 |
| DOURDUFF | 109 141 | 6 | 53 | 0.15 |
| JARLOT | 134 295 | 7 | 65 | 0.19 |
| FLECHE | 119 203 | 6 | 58 | 0.17 |
| ABER ILDUT | 145 614 | 8 | 71 | 0.20 |
| ABER BENOIT | 106 626 | 6 | 52 | 0.15 |
| ABER WRACH | 136 810 | 7 | 66 | 0.19 |
| ELORN | 899 257 | 48 | 436 | 0.54 |
| MIGNONNE | 107 880 | 6 | 52 | 0.18 |
| CAMFROUT | 104 148 | 6 | 50 | 0.11 |
| FAOU | 18 001 | 1 | 9 | 0.08 |
| AULNE | 214 760 | 12 | 104 | 1.20 |
| *Bretagne Sud* | | | | |
| GOYEN | 232 637 | 13 | 113 | 0.23 |
| ODET ; JET ; STEIR | 1 140 644 | 61 | 553 | 1.74 |
| BELON | 86 503 | 5 | 42 | 0.12 |
| AVEN | 420 924 | 23 | 204 | 0.36 |
| ELLE | 2 221 173 | 120 | 1 077 | 1.62 |
| SCORFF | 776 402 | 42 | 376 | 0.95 |
| BLAVET | 638 256 | 34 | 309 | 1.67 |
| KERGROIX | 53 598 | 3 | 26 | 0.12 |
| *ADOUR-GARONNE* | | | | |
| GAVE OLORON | | | | |
| GAVE MAULEON | | | | |
| GAVE DE PAU | | | Pas de T.A.C. | |
| NIVE | | | Pas de L.C. | |
| ADOUR | | | | |
| NIVELLE | | | | |

*Source* : Synthèse sur l'état des populations, des pressions et des modalités de gestion du Saumon Atlantique. INRA, AFB. Rapport intermédiaire Janvier 2017

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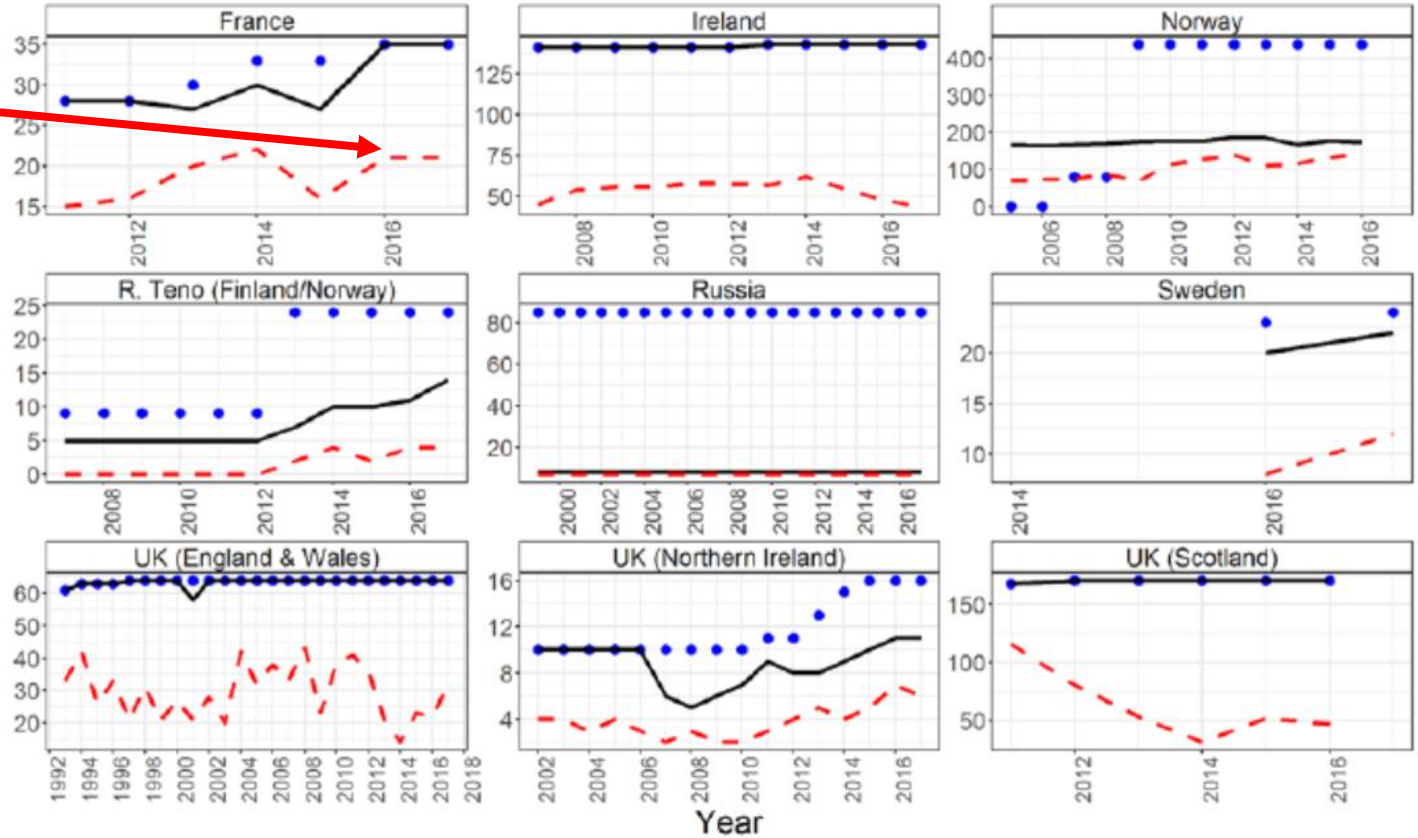
# Compliance to river-specific *CLs* - Europe

Number of rivers with CL
Number of rivers assessed annually
Number of rivers meeting CLs

Example Fr (2015)

60% = 20/33 have egg deposition > CL



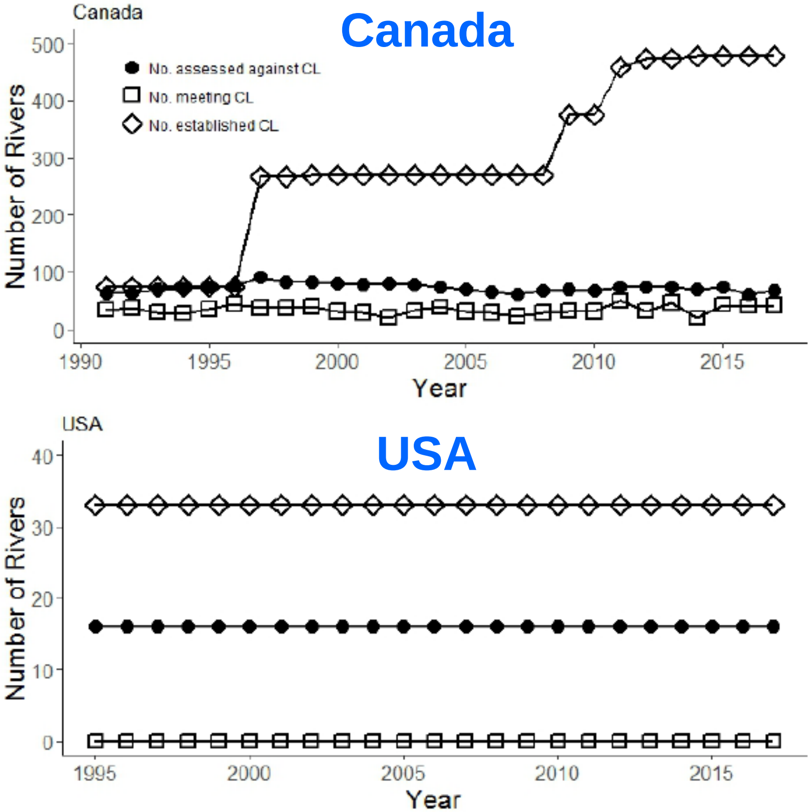

*Source* : ICES WGNAS Report 2018

# Compliance to river-specific *CLs* - North America

| | |
|---|---|
| ◇ | **Number of rivers with *CL*** |
| ● | **Number of rivers assessed annually** |
| □ | **Number of rivers meeting *CLs*** |

Definition of *CL* different than in Europe

- *CLs* correspond to the eggs deposition that produces ½ maximum recruitment
- Concern the 2SW fish component of the population only

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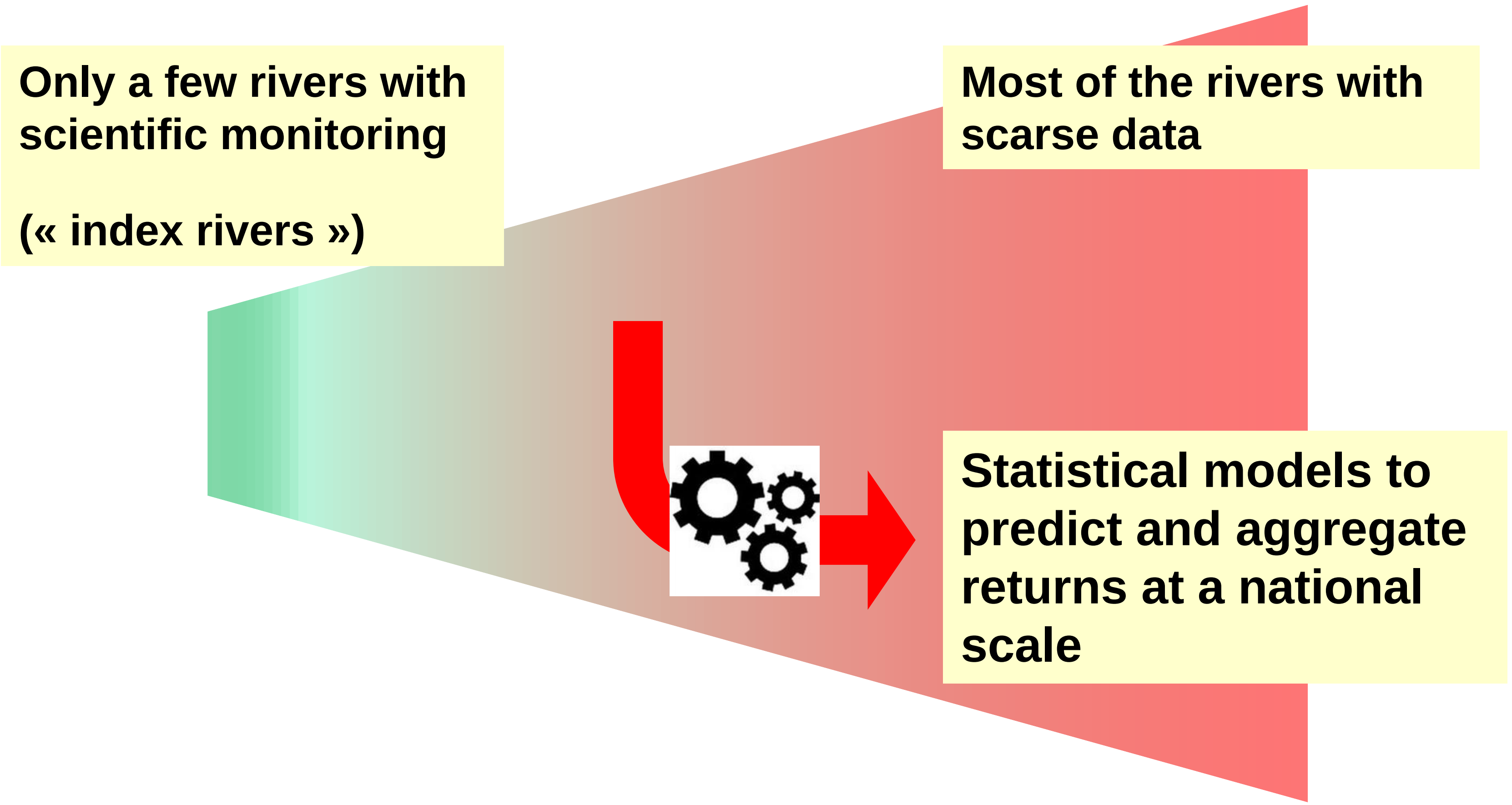
# Estimating returns at a national/regional scale



## Example

# France

# France - Estimates of total returns

- 4 index rivers
- Mandatory declaration of rod-and-line catches in all rivers
- Only a few rivers with reliable estimates of harvest rates

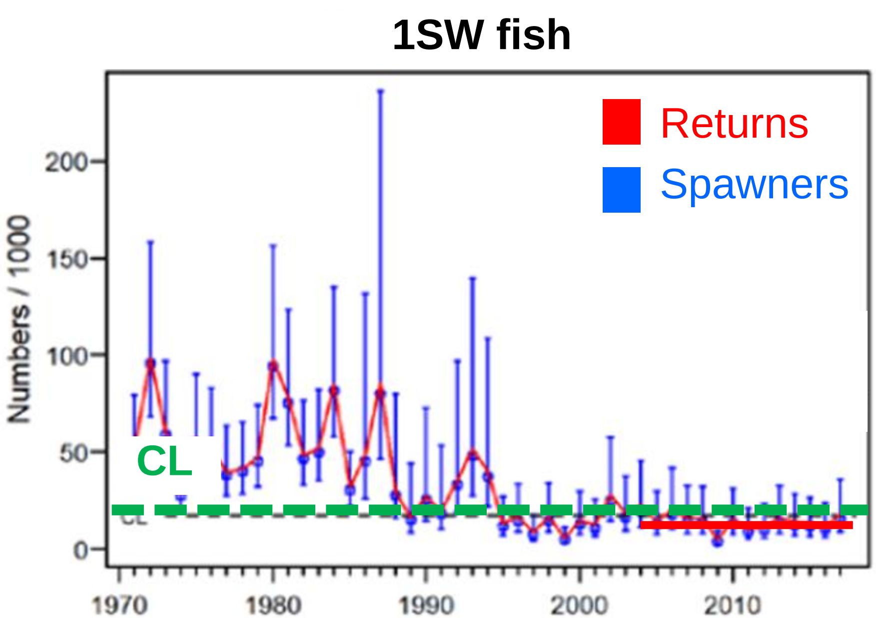

1SW and MSW separately

$$\text{Total returns} \sim \frac{\text{Total Catches}}{\text{Harvest rate} \times \text{Declaration rate}}$$

Expertize with uncertainty

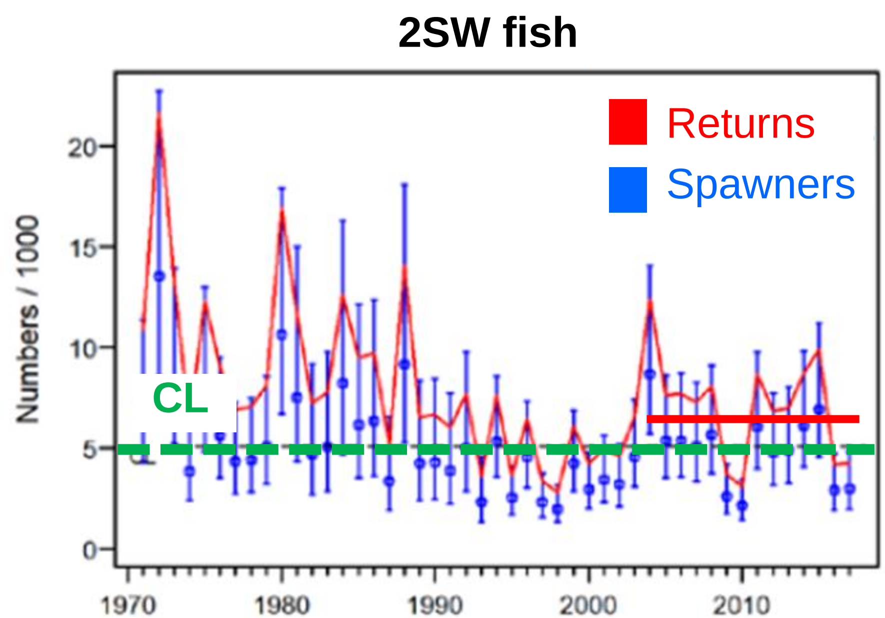
# France

## Estimates of total returns and spawners




CL = 17400 fish

average 2009-2018 ~ 16000




CL = 5100 fish

average 2009-2018 ~ 7000

*Source* : ICES WGNAS Report 2018

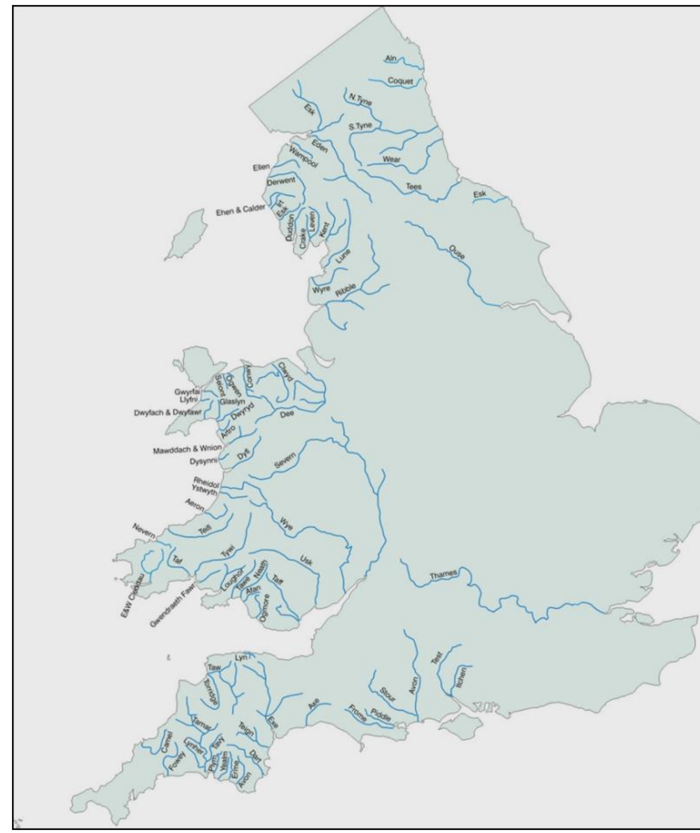
Example

# UK England and Wales

(with courtesy of Ian Russel and Jonathan Gibson, CEFAS, ICES WGNAS)

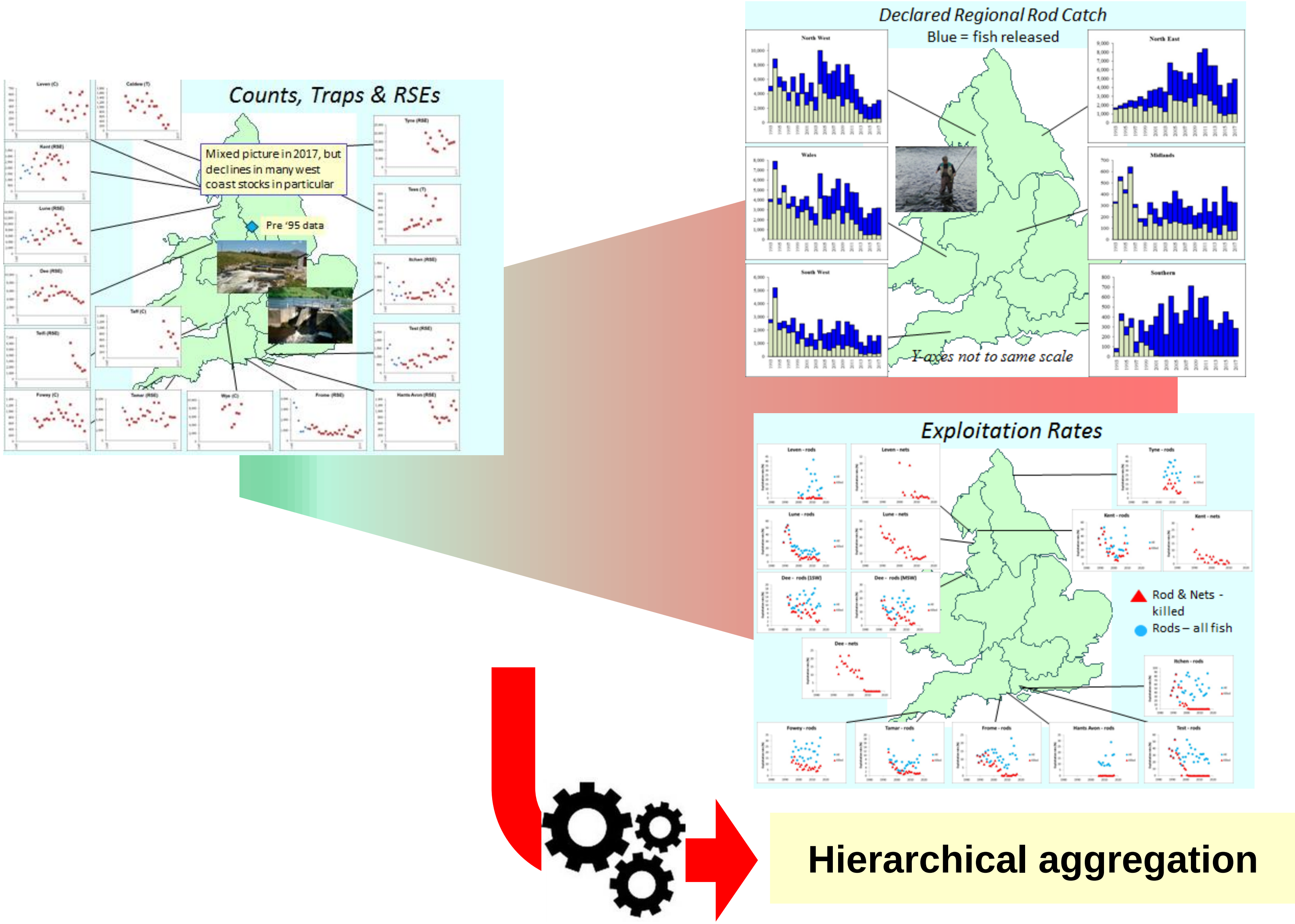
# UK E&W - Estimates of total returns


**~ 80 salmon rivers in UK E&W**




*Source* : ICES WGNAS 2018, Report for UK E&W

# UK E&W - Estimates of total returns

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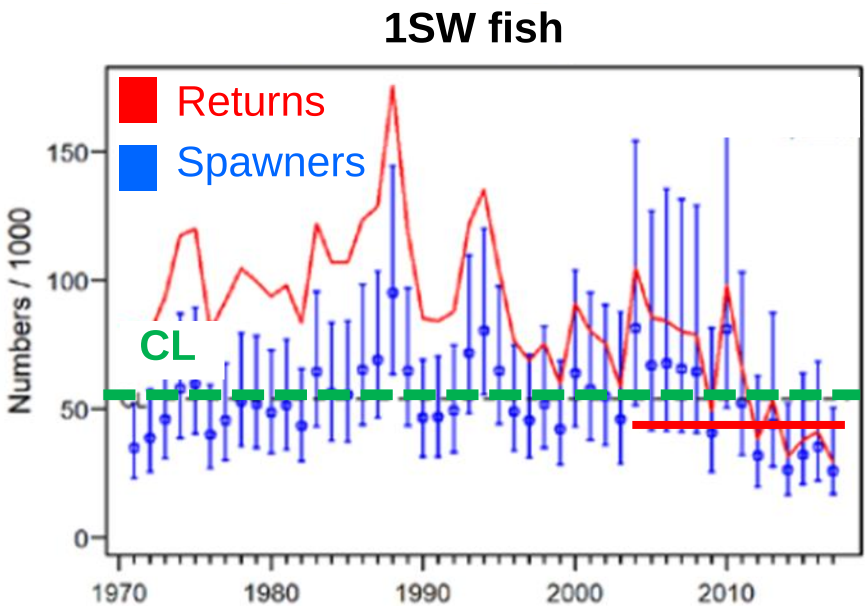
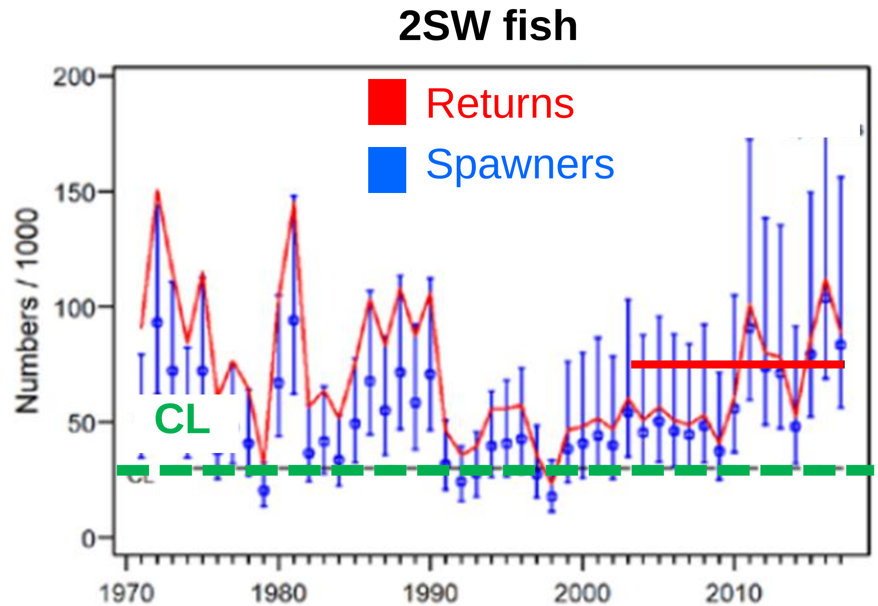
# UK England & Wales

## Estimates of total returns and spawners




CL = 54000 fish

average 2009-2018 ~ 45000




CL = 30000 fish

average 2009-2018 ~ 75000

*Source* : ICES WGNAS Report 2018

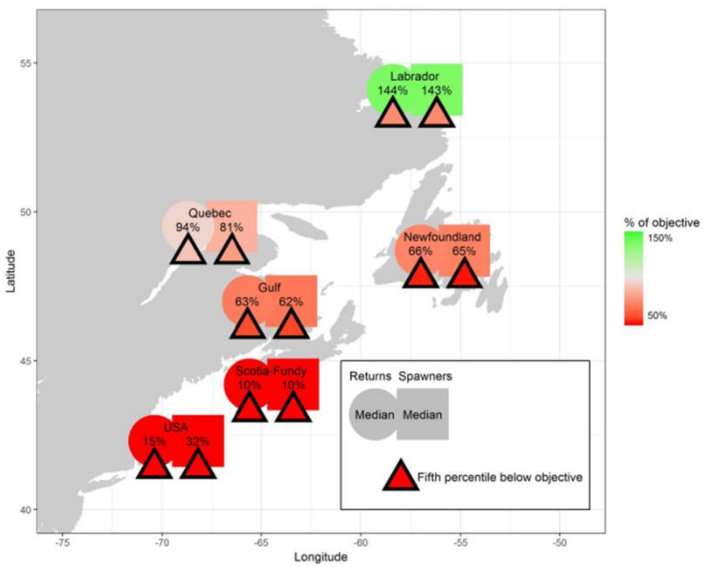
# Overview
# Europe and North America

# Prob. (Returns > *CLs*)

## N. America

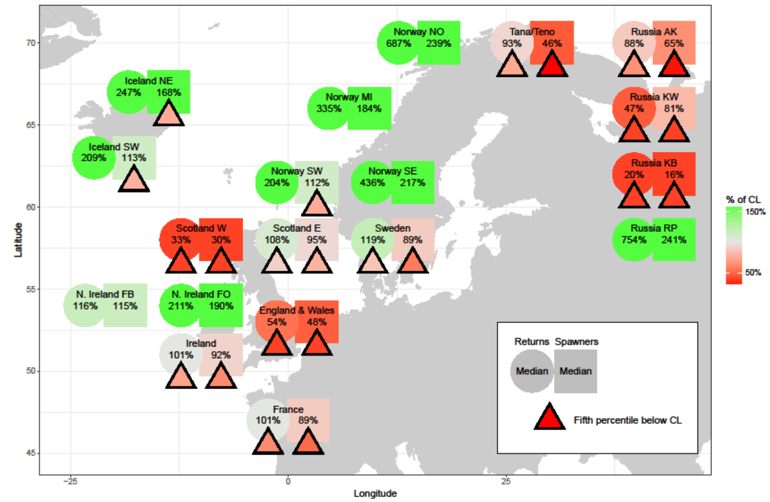
- Concern 2SW fish only
- Management objectives are not CLs for the two southern areas

### 2017 - MSW fish

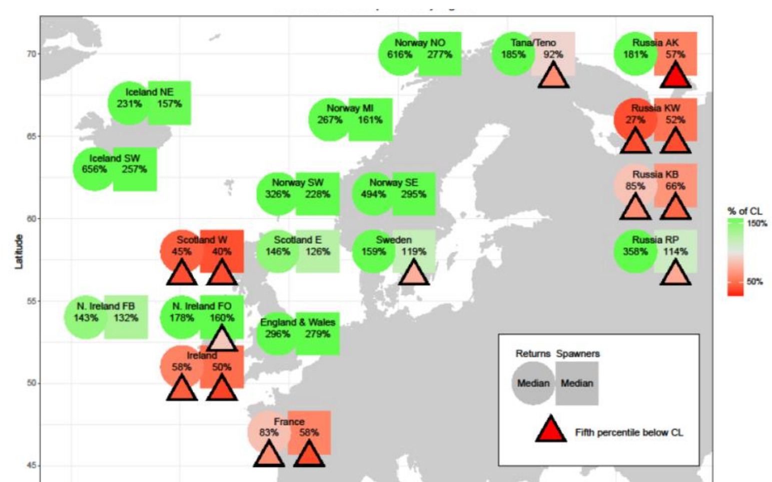



## Europe

### 2017 - 1SW fish




### 2017 - MSW fish




*Source* : ICES WGNAS Report 2018

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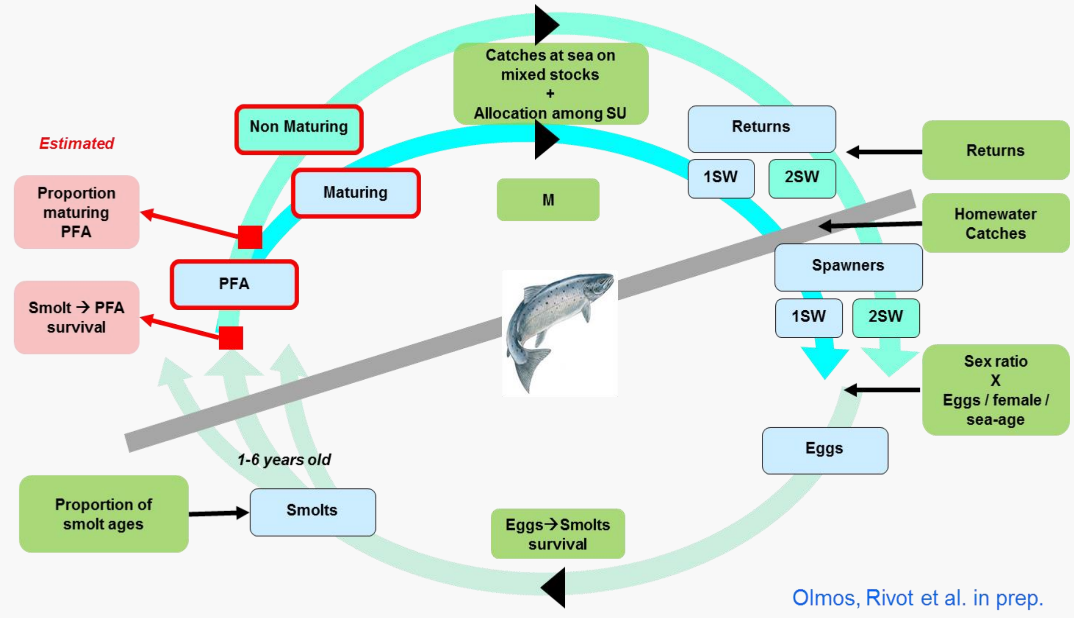
# Assessing salmon abundance at sea "PFA and Life Cycle Model"

- A population dynamic model
- Fitted to time series of "data" aggregated at the national/regional scale (1971-2017)
  - estimate abundance at sea before any marine fishery (PFA)
  - assess trends in post-smolt marine survival
  - predict home-water returns under several catch options at sea (Greenland and Faroes)
- Several versions
  - Bayesian state-space PFA models (NAC: Prévost et al., 2009; NEAC: Rivot et al., 2009)
  - Bayesian Life Cycle Model (Olmos, Rivot et al. in prep.)

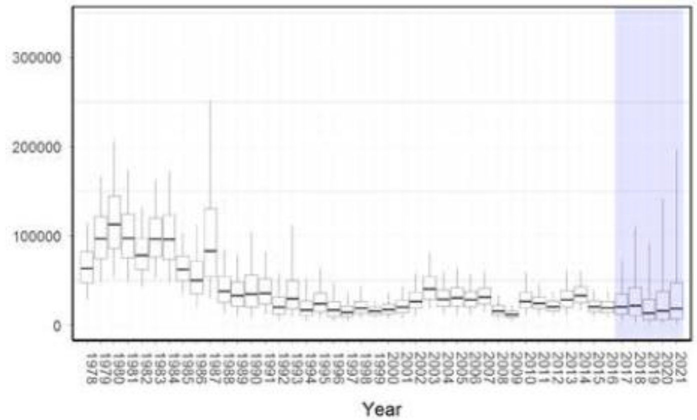



Olmos, Rivot et al. in prep.

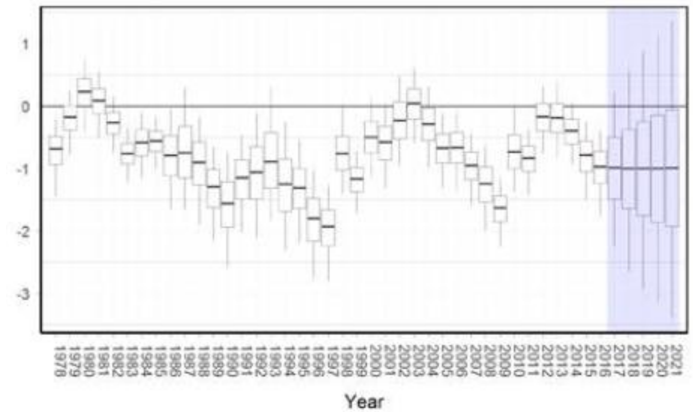
# Estimates of PFA and marine productivity France and UK *E&W*

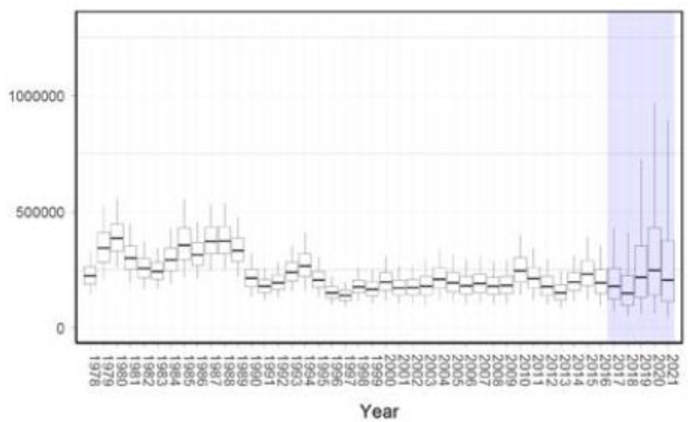
## Pre Fishery Abundance

## Eggs → PFA productivity

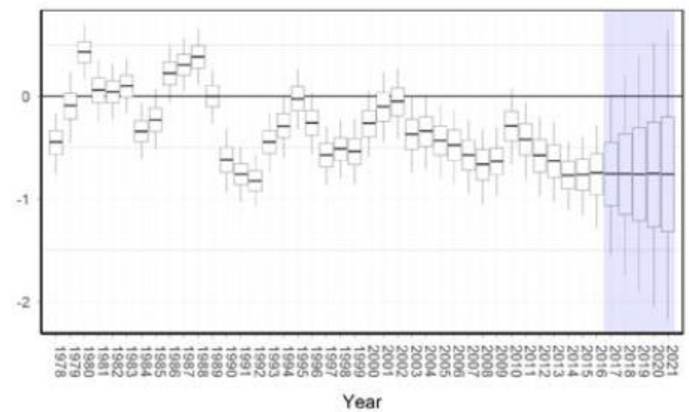



**France**




**UK E&W**

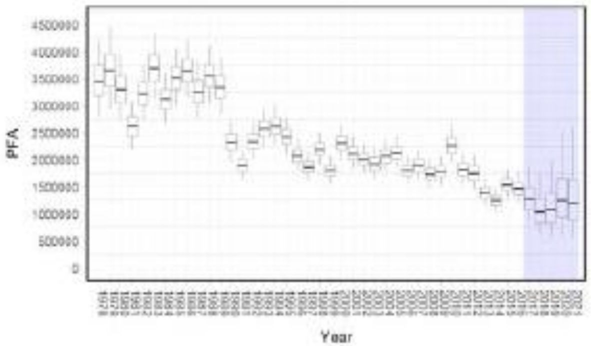


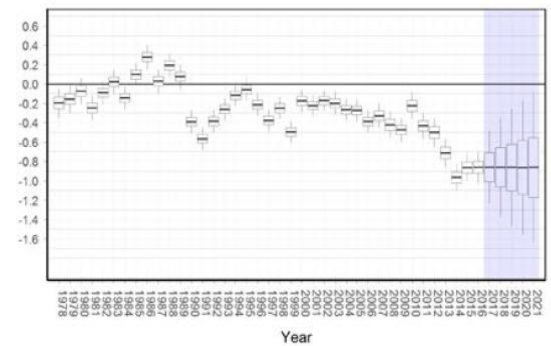

*Source* : ICES WGNAS 2018

# Estimates of PFA and marine productivity
# Continental stock groupings

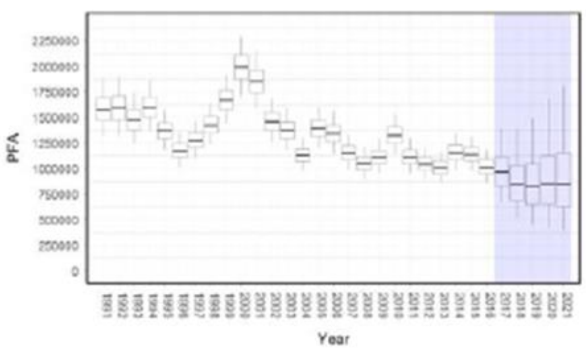
**Pre Fishery Abundance** | **Eggs → PFA productivity**

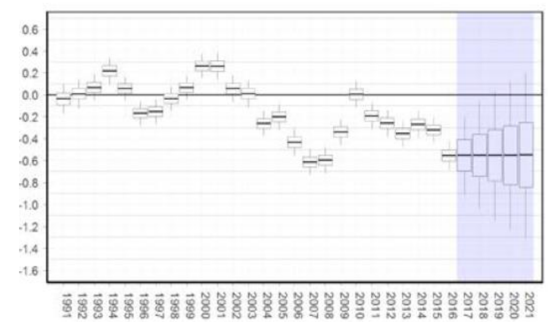
## S. Europe



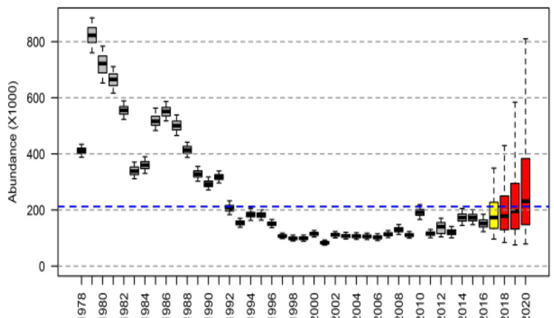



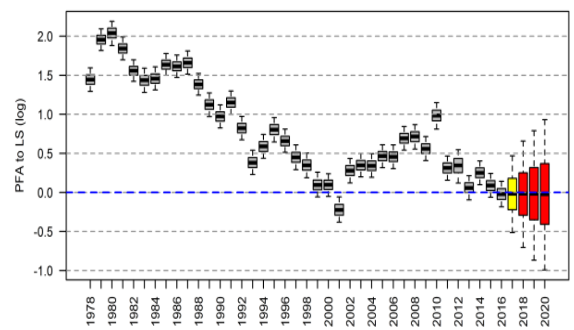

## N. Europe



## N. America




*Source* : ICES WGNAS Report 2018

# Scientific advices for managing mixed stock fisheries (W. Greenland and Faroes)

## Forecast of returns given under scenarios of catches

## N. America

*Scenario = 0 catches in Greenland*

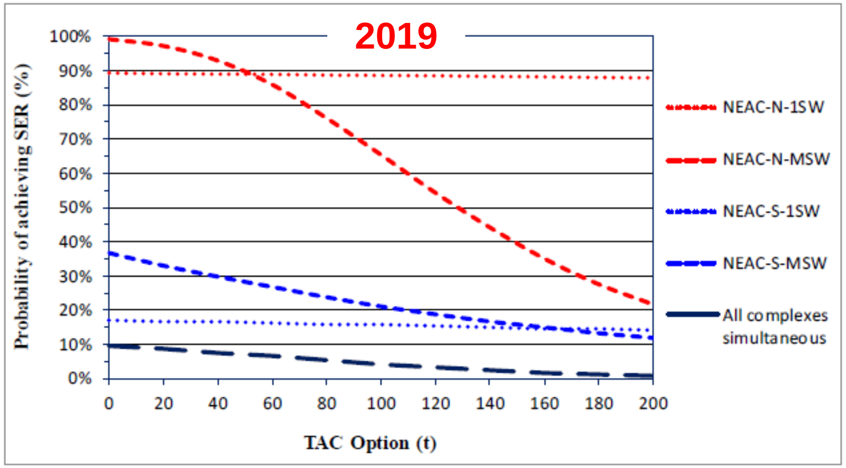
**Prob.(Returns > Objectives)**

| Region | 2SW Objective to NAC | Probability of meeting 2SW objectives in the absence of fisheries (2SW return year) | | | |
|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | 2021 |
| Labrador | 34 746 | 0.826 | 0.871 | 0.888 | 0.898 |
| Newfoundland | 4 022 | 0.100 | 0.308 | 0.289 | 0.392 |
| Québec | 29 446 | 0.391 | 0.387 | 0.271 | 0.316 |
| Gulf | 30 430 | 0.033 | 0.087 | 0.102 | 0.194 |
| Scotia-Fundy | 10 976 | <0.001 | 0.001 | 0.000 | 0.003 |
| USA | 4 549 | 0.000 | 0.001 | 0.002 | 0.006 |
| Simultaneous to North America | | 0.000 | 0.000 | 0.000 | 0.000 |

## Europe

*Scenarios = catches 0-200t in Faroes*

**Prob.(Returns > CLs)**




➔ Scientific advice: Quotas = 0

**W. Greenland: Quotas 2017 = 45t (~15000 fish)**

*Source* : ICES WGNAS Report 2018

# Outlines

- **Assessment at local scale (river-by-river)**
  - References points to assess abundance of returns on a river-by-river basis: *Conservation limits* (*CLs*)
- **Assessment at regional or national scale**
  - % of rivers with eggs deposition **>** *CL*
  - Total returns / national *CL*
- **Assessment at international scale**
  - Abundance at sea before any marine fishery (*Pre-Fishery Abundance, PFA*)
  - Scientific advices to manage mixed stock fisheries at sea
- **Conclusions and future prospects**

# Status of Atlantic salmon populations

- **Low stock status in the three continental stock groups**
  - Some exceptions e.g. northern Canada (Labrador)

- **Causes are multifactorial**

  - Recent declining trends in abundance largely attributed to poor environmental conditions at sea (Beaugrand and Reid, 2012, Friedland et al., 2013, Mills et al., 2013)

  - Reinforced by observations from Index rivers
    - No evidence for a general declining trend in smolt production
    - Evidence of declining smolt-to-adults return rates

- **Changes in life history traits**
  - Prop. 2SW has declined overall; **seems to do slightly better in the last decade**
  - Worrisome declining trends in mean length/weigh of fish observed in Europe (Bacon et al., 2009; od et al. 2010;Jonsson et al. 216; Bal et al. 2017)

# Status of Atlantic salmon populations

- **Scientific advice for fisheries management** ICES CIEM
  - **Keep harvest rate low !**

    - Marine mixed stock fisheries → Advice = zero quota

    - Coastal / freshwater fisheries → Limited + protection measures for 2SW

  - Cumulated harvest rate in late 2010's is low compared to the early 1980's

    ~ 10-15% ~ >50%

# Looking for a coherency across scales

**Much can be learned from improving consistency in assessment approaches across scales**

- **Harmonizing assessment approaches within Europe and between Europe and N. America**

| N. America | | Europe |
|---|---|---|
| - Eggs deposition that maximizes smolt production<br>- Currently 2SW only | **CLs**<br>**Harmonization under progress** | - Eggs deposition that produces MSY<br>- 1SW and 2SW<br>- Some SU still do not have river-specific *CLs* (*e.g.* Scotland) |

**Scientific advice to manage mixed stock fisheries**

**Developing one single model**

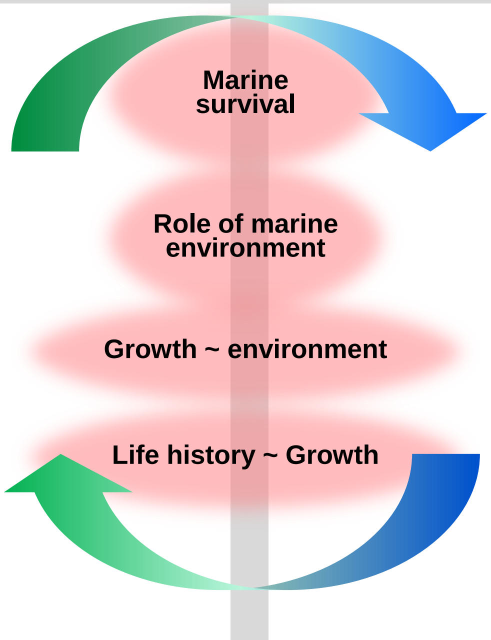
***Olmos, Rivot et al. in prep.***

# Looking for a coherency across scales

**Much can be learned from improving consistency in assessment approaches across scales**

- **Enhancing coherency between local and national/international scale: the key role of Index rivers**

| Local (index rivers) | National / international |
|---|---|
| Smolt return rates<br>Smolt tagging & acoustic tracking<br>Growth (Historical scale collection | Assessing the effect of marine fisheries and changes in marine ecosystems<br>- Maximizing environmental gradient<br>- Partitioning synchronous / asynchronous |




Interreg
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Gestion des salmonidés dans la Manche
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Thanks !