Physical and technical requirements for establishing fisheries science

Case Study– the Falklands

Falkland Islands Government
Directorate of Natural Resources
Fisheries Department

Falkland Islands Government

FISHERIES DEPARTMENT

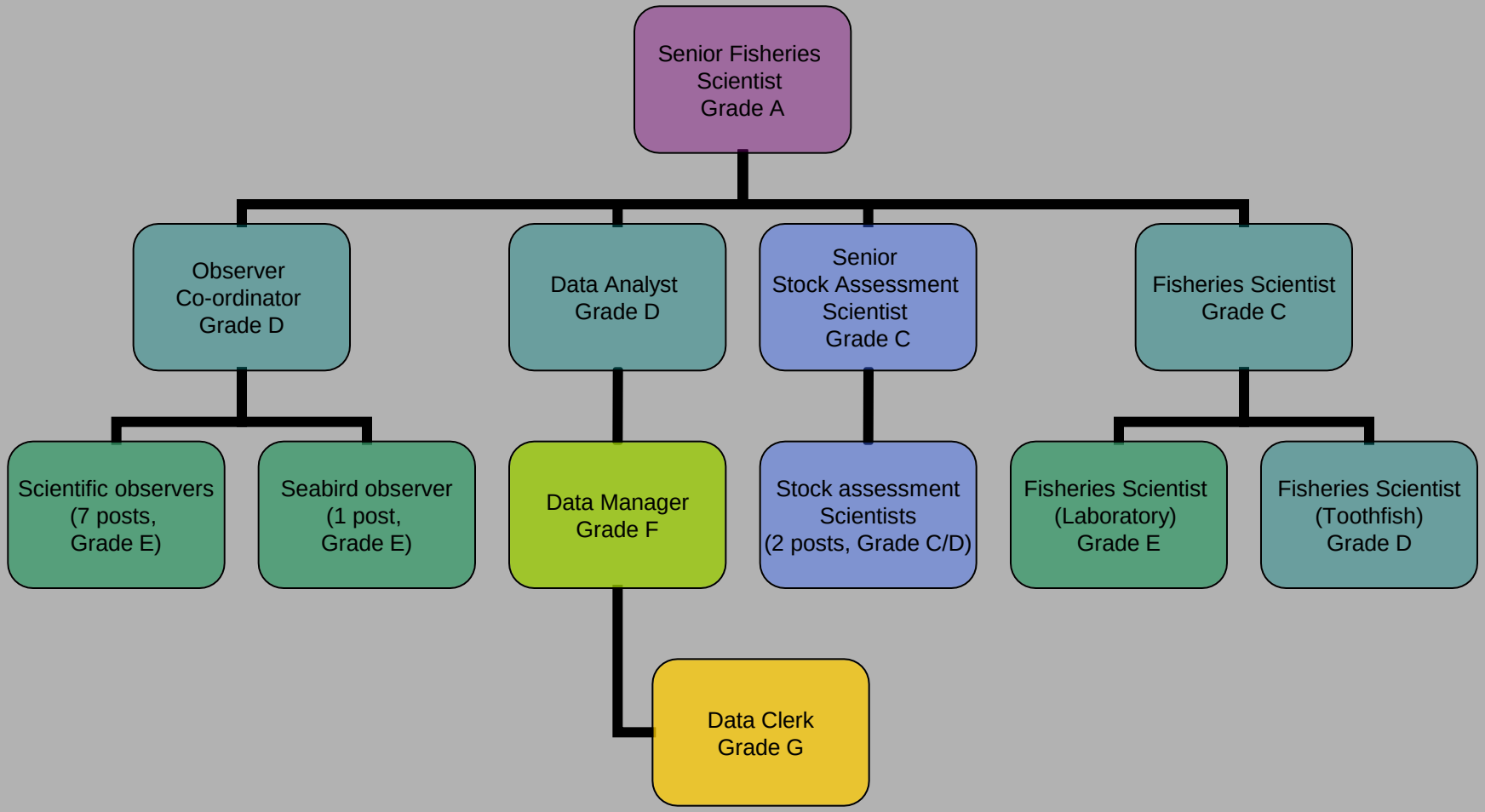
Managing Falkland Islands fisheries since 1987

MISSION: The Fisheries Department's primary mission is wealth creation by achieving the maximum sustainable yield from fish and squid stocks in Falkland and adjacent waters. This process is to be underpinned by effective Fisheries Science, Fisheries Protection and Administration.

Main objectives
Scientific Section
(from the FIFD Business Plan)

- To carry out stock assessment and biomass estimates of main commercial species of fish and squid.
- To collect and analyse all available commercial data and produce licensing advice including recommended TAE or TAC for all commercial stocks.
- To study the biology, ecology and life cycles of the main commercial marine species inhabiting waters around of the Falkland Islands.
- To study key parameters and dynamics of marine ecosystems in the Falkland Conservation Zones and adjacent waters.
- To produce fisheries reports for Government and fishing industry and publish scientific papers based on the results of research carried out within the department.

Scientific crew

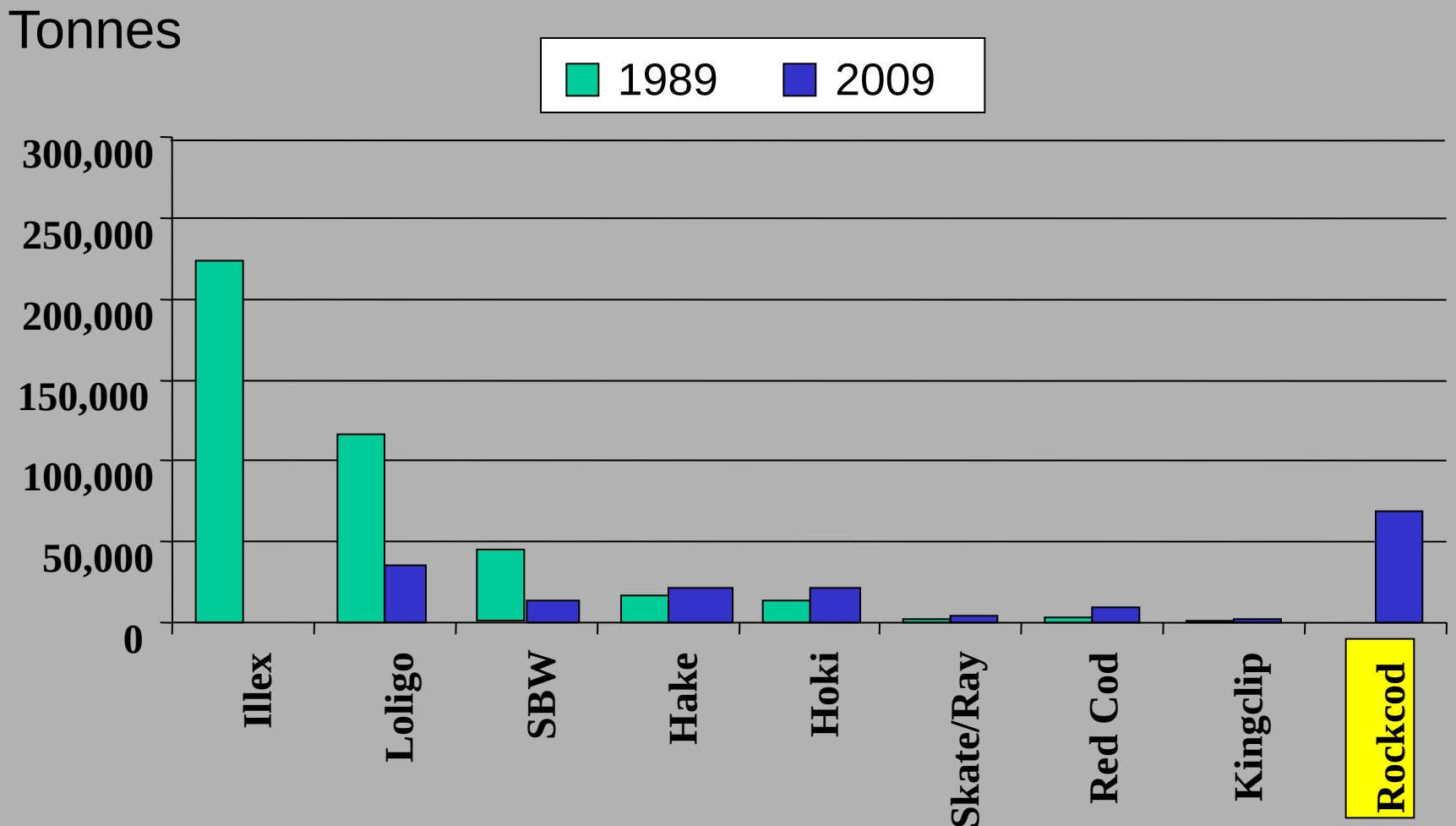


Total personnel in the Scientific Section:

19 people

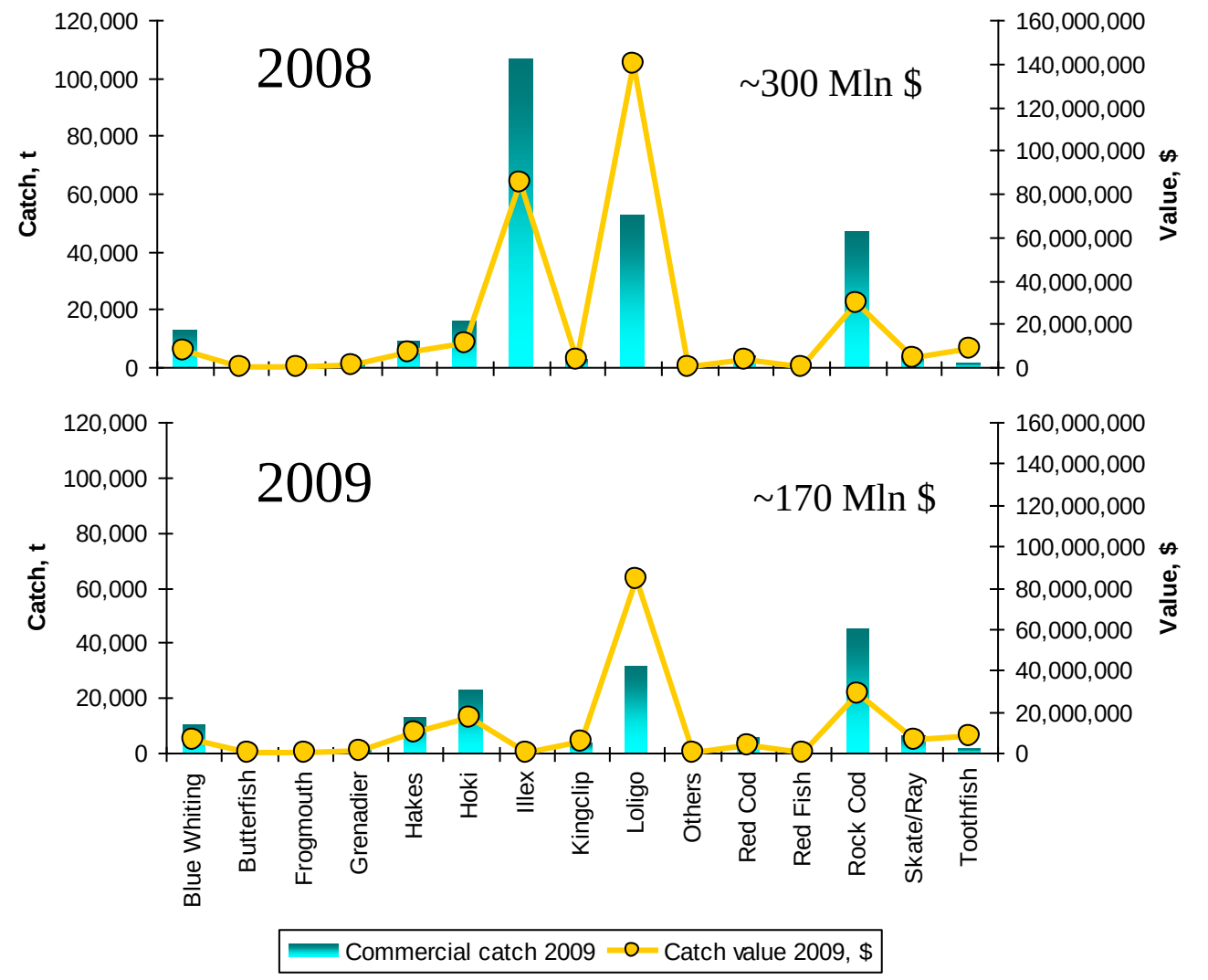
Main commercial stocks

Catch composition (FICZ/FOCZ)



Main commercial stocks

Catch value



Commercial squid and fish

- Straddling stocks

  'Shared with Argentina' and other South American countries

  Migrate into the Falkland waters seasonally

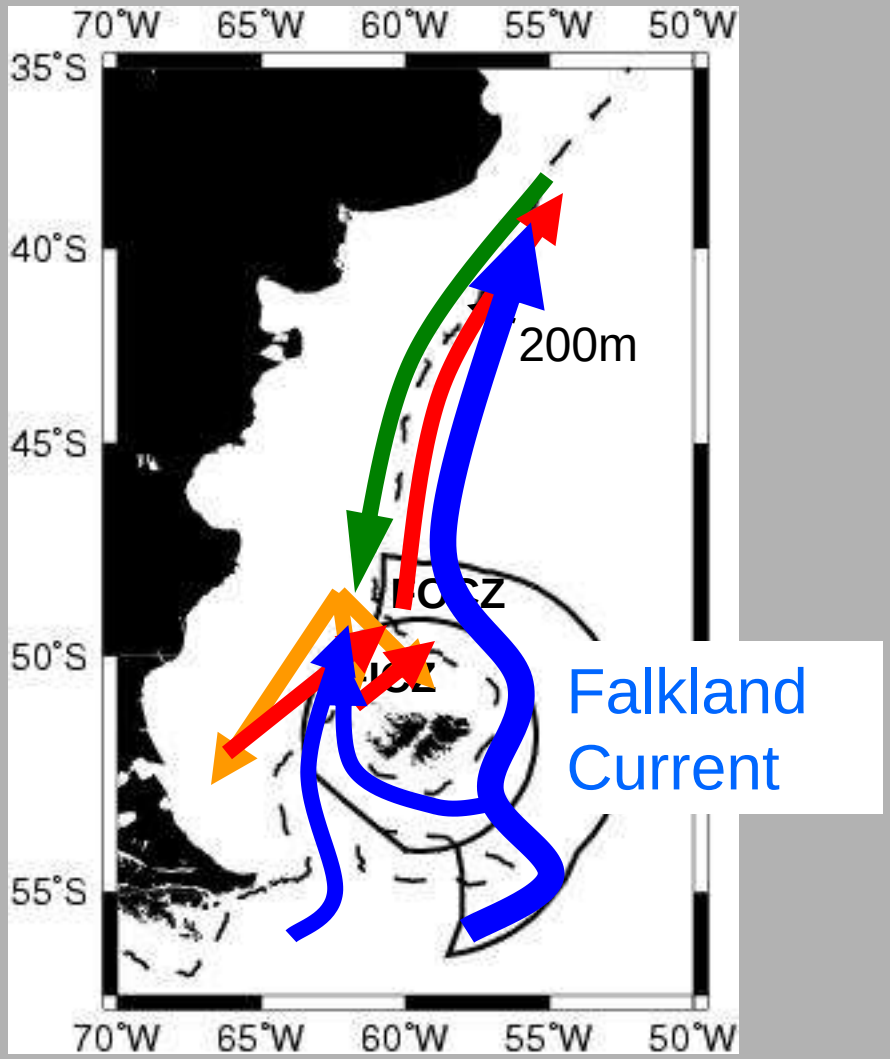
- Domestic stocks

  Live in Falkland waters all their life

Straddling stocks

- Use FICZ/FOCZ as feeding grounds
  - *Illex* squid
  - Hoki
  - Hakes
  - Kingclip
  - Some skates
- Use FICZ/FOCZ as spawning grounds
  - Southern blue whiting
  - Some skates

Illex argentinus migrations



Domestic stocks

- Live their whole life in FICZ/FOCZ
  - *Loligo*
  - Red cod
  - Falkland herring
  - Some skates

Domestic stocks

Loligo - *Doryteuthis gahi*

Loligo Box

How to estimate how much fish and squid is in the water?
Stock Assessment Models

- Straddling stocks

Swept-area method

VPA (virtual population analysis)

ASPM (Age structured production model)

Acoustic surveys

- Domestic stocks

Swept-area method

Depletion model

Acoustic surveys

What data do we need to feed the models?

Species identification

FIFD species code : **ALF**

Scientific name : *Allothunnus fallai*

Common name : Slender tuna

Description : D XV-XVIII, 12-13 + 6-7 finlets; A 13-14 + 6-7 finlets; P 24-26; GR 70-80; vertebrae 20 + 20 = 40. Body robust, elongate and rounded. Teeth very small and conical, 40 to 55 on each side of upper and lower jaw. Body naked ventrally behind the long anterior corselet; dorsal half of body to lateral line covered with small scales; caudal peduncle slender with a well developed lateral keel between the two smaller keels on each side. Swimbladder absent. Pectoral fins very short, never reaching lateral line or past 6th spine on first dorsal fin.

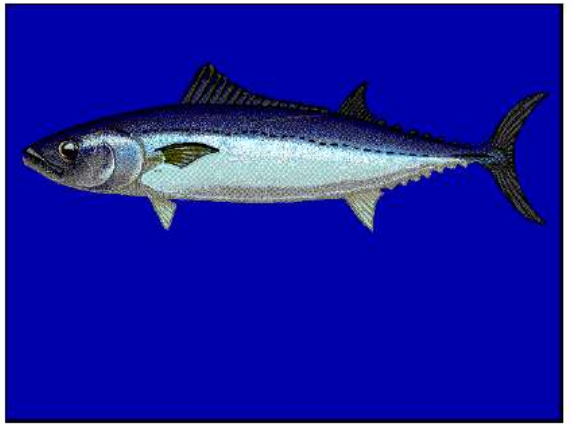
Size range : 65 to 96 cm fork length.

Distribution : Circumglobal in the Southern Ocean from 20° to 50°S. Sporadically found throughout the Zone from February to May.

Depth range : Surface to about 300 m.

Fishery status : Caught occasionally by trawlers but mainly by pelagic trawlers targeting *Illex*.

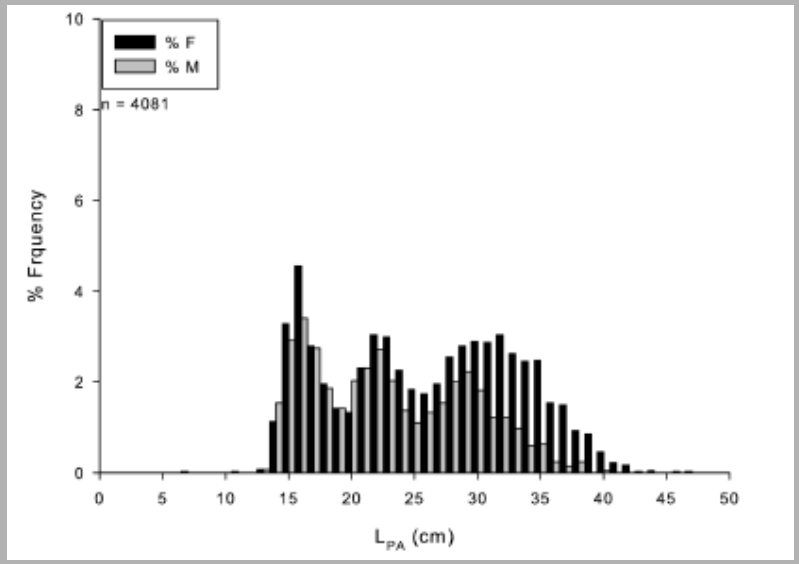
Comments : Has the largest number of gill rakers of all scombrids (GR 70-80). Counting the gill rakers is therefore the main diagnostic feature when distinguishing between TUN and ALF. Maximum body weight is 10 kg. An epipelagic species, the slender tuna preys mainly on krill and also on squids and small fishes.



What data do we need to feed the models?

Species identification

Size and weight

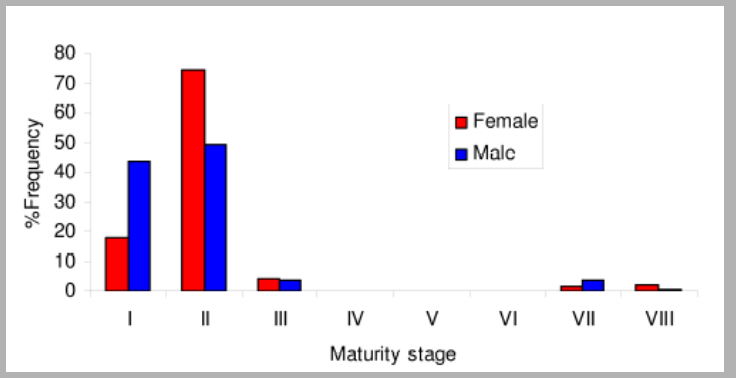


What data do we need to feed the models?

Species identification

Size and weight

Maturity



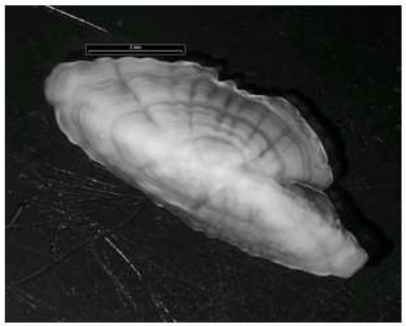
What data do we need to feed the models?

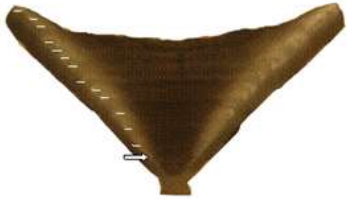
Species identification

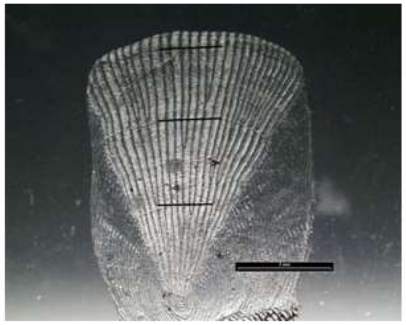
Size and weight

Maturity

Age sampling







Who does collect these data?

Species identification

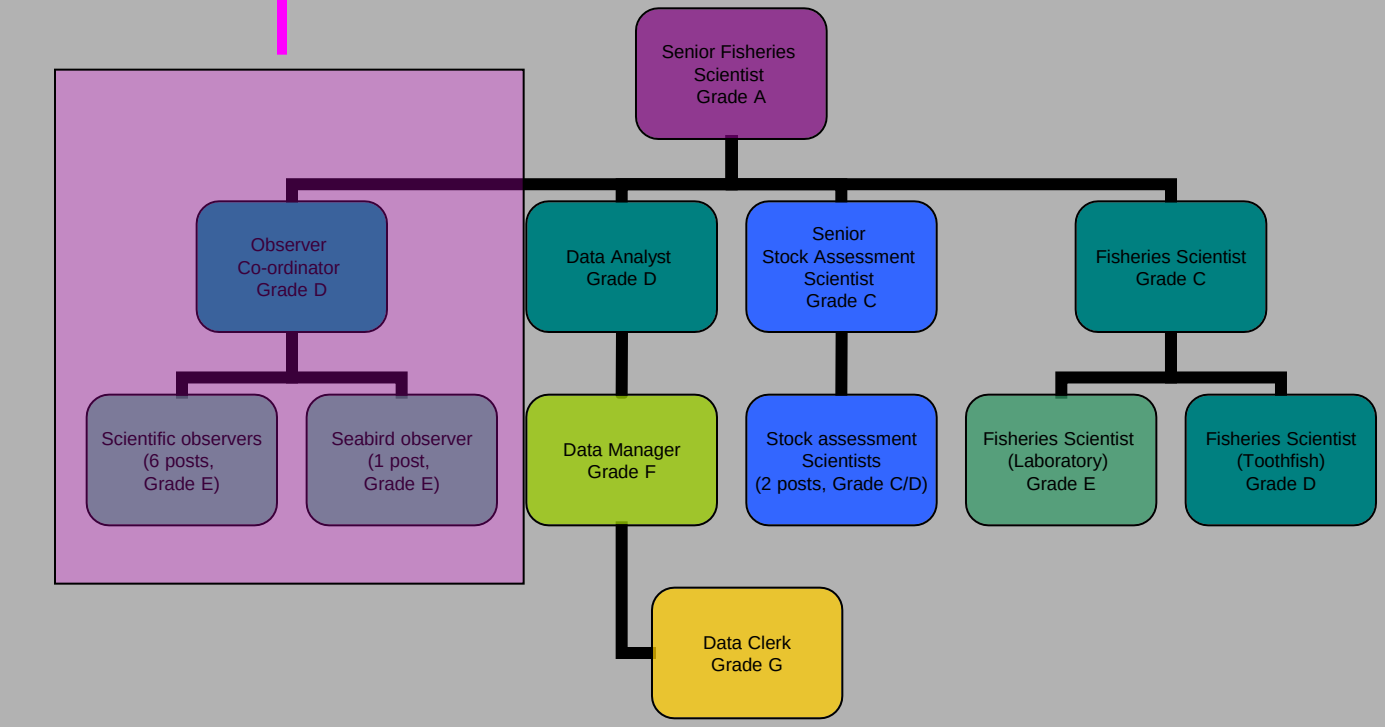
Size and weight

Maturity

Age sampling

Compliance role

Seabird mitigation



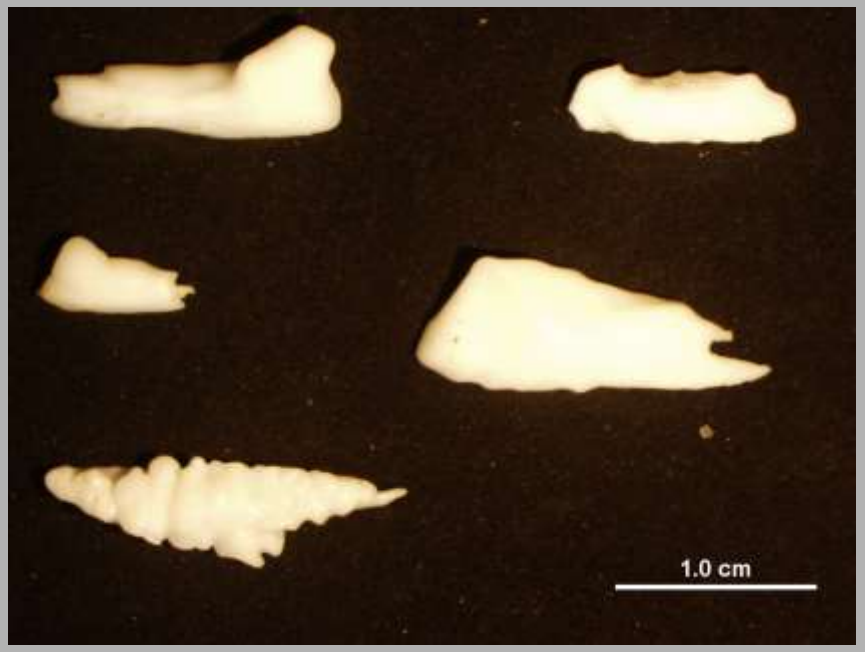
Scientific Observer Group (commercial vessels)

All Scientific Staff (research cruises)

What data do we need to feed the models?

- Species identification
- Size and weight
- Maturity
- Age sampling

Age estimations



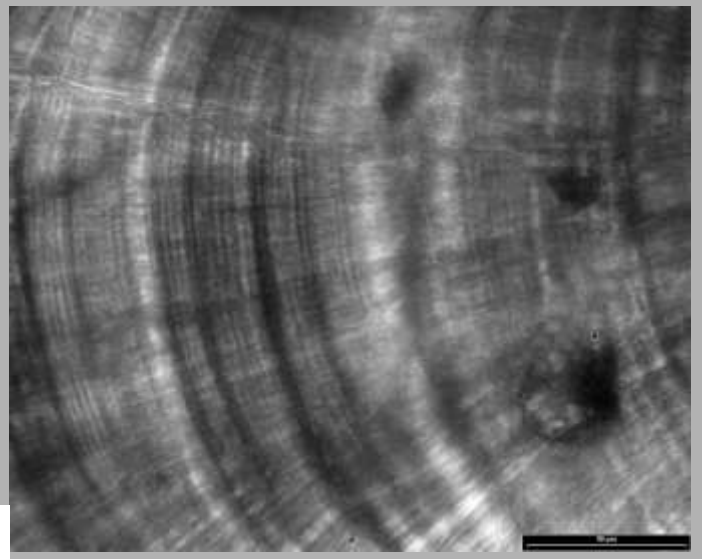
What data do we need to feed the models?

- Species identification
- Size and weight
- Maturity
- Age sampling

Age estimations

Increment width = 0.1 to ~1 mm

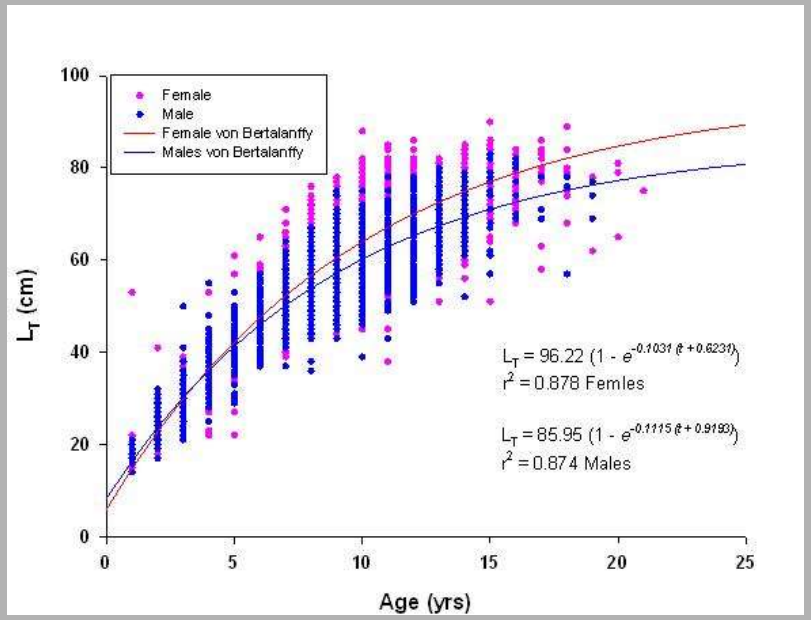
Increment width = 0.002 to ~0.005 mm

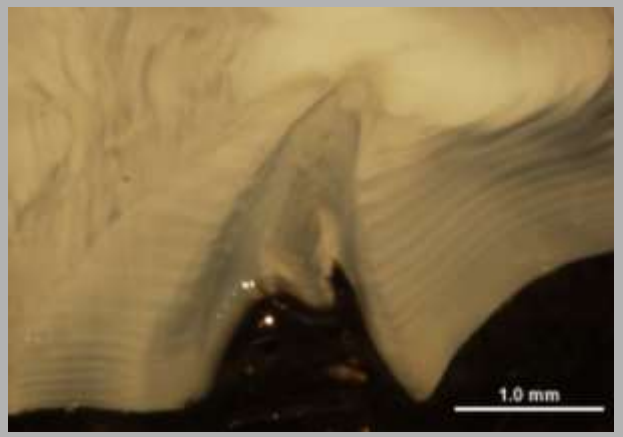


What data do we need to feed the models?

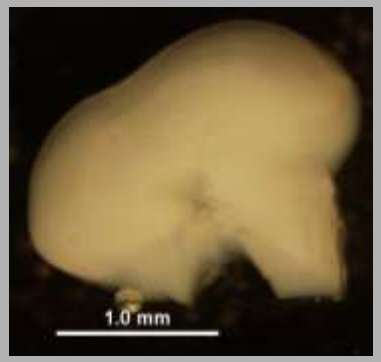
- Species identification
- Size and weight
- Maturity
- Age sampling

- Age estimation
- Growth rate estimation

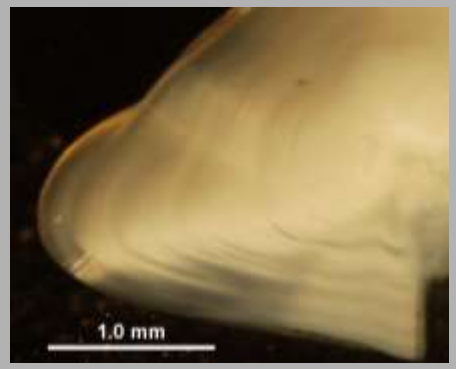




17 years old



2 years old



6 years old

What data do we need to feed the models?

- Species identification
- Size and weight
- Maturity
- Age sampling
- Age estimation
- Growth rate estimation
- Natural mortality estimation

Who does process and analyze these data?

Species identification

Size and weight

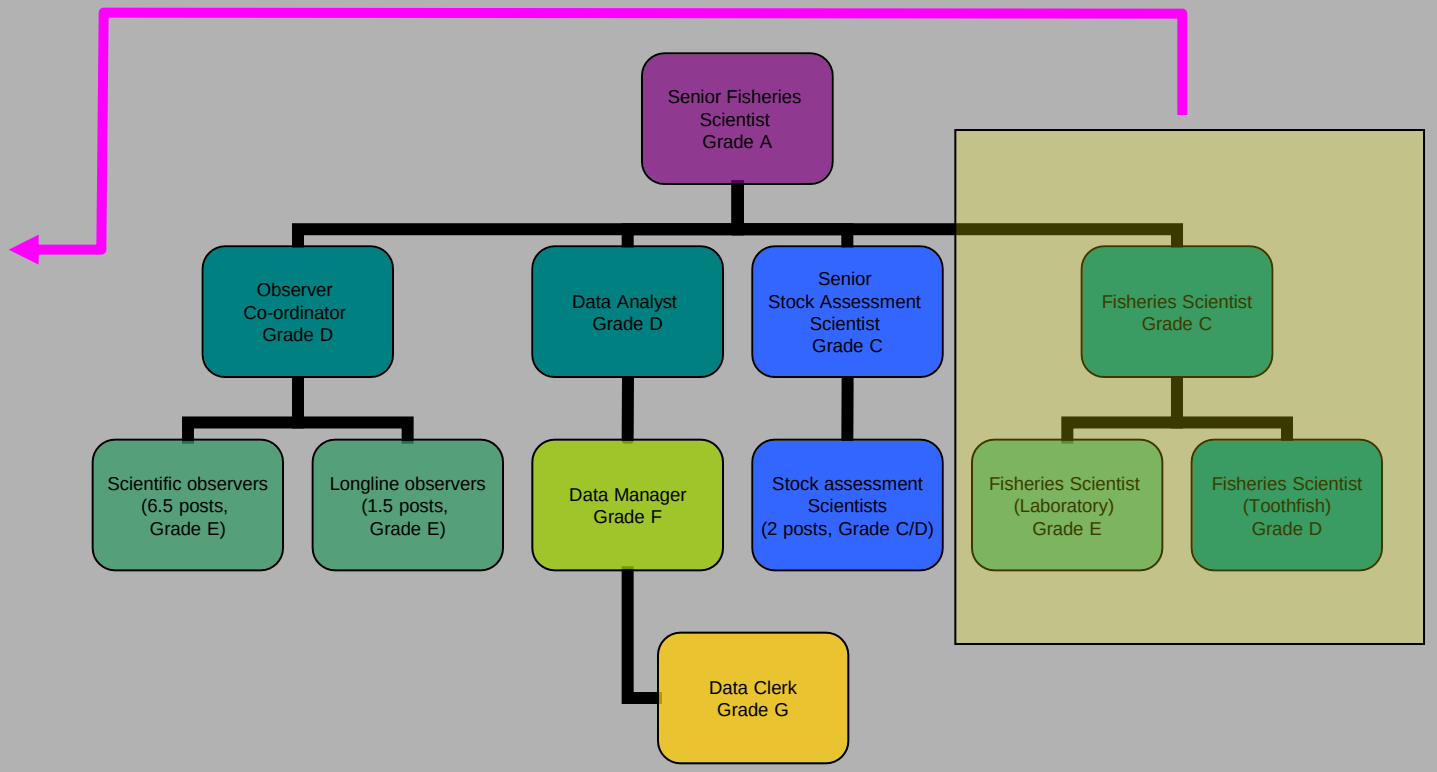
Maturity

Age sampling

Age estimation

Growth rate estimation

Natural mortality estimation



Fisheries Biology Group

External contractors (a portion of commercial otoliths only)

What data do we need to feed the models?

- Species identification
- Size and weight
- Maturity
- Age sampling

- Age estimation
- Growth rate estimation
- Natural mortality estimation

- Catch data
- Catch composition data
- CPUE
- Vessel location
- Licence type

Daily catch report

B	21/03/2010		
C	Y		
D	XVAJ		
E	XVAJ		
F	12 : 05		
I	55,831		
J	0		
K	0		
L	0		
M	0		
N	0		
O	0		
P	0		
Q	0		
R	0		
S	0		
T	22/03/2010	06:10	
U	XVAJ		
V	177		
LIC	C		

B	21/03/2010		
C	Y		
D	XVAJ		
E	XVAH		
F	11 : 55		
I	66,549		
J	0		
K	0		
L	0		
M	0		
N	0		
O	0		
P	0		
Q	0		
R	0		
S	300		
T	22/03/2010	07:30	
U	XVAJ		
V	195		
LIC	C		

B	21/03/2010		
C	Y		
D	XVAH		
E	XVAH		
F	11 : 55		
I	55,067		
J	0		
K	0		
L	0		
M	0		
N	0		
O	0		
P	0		
Q	0		
R	0		
S	0		
T	22/03/2010	08:50	
U	XVAJ		
V	210		
LIC	C		

What data do we need to feed the models?

Species identification

Size and weight

Maturity

Age sampling

Age estimation

Growth rate estimation

Natural mortality estimation

Catch data

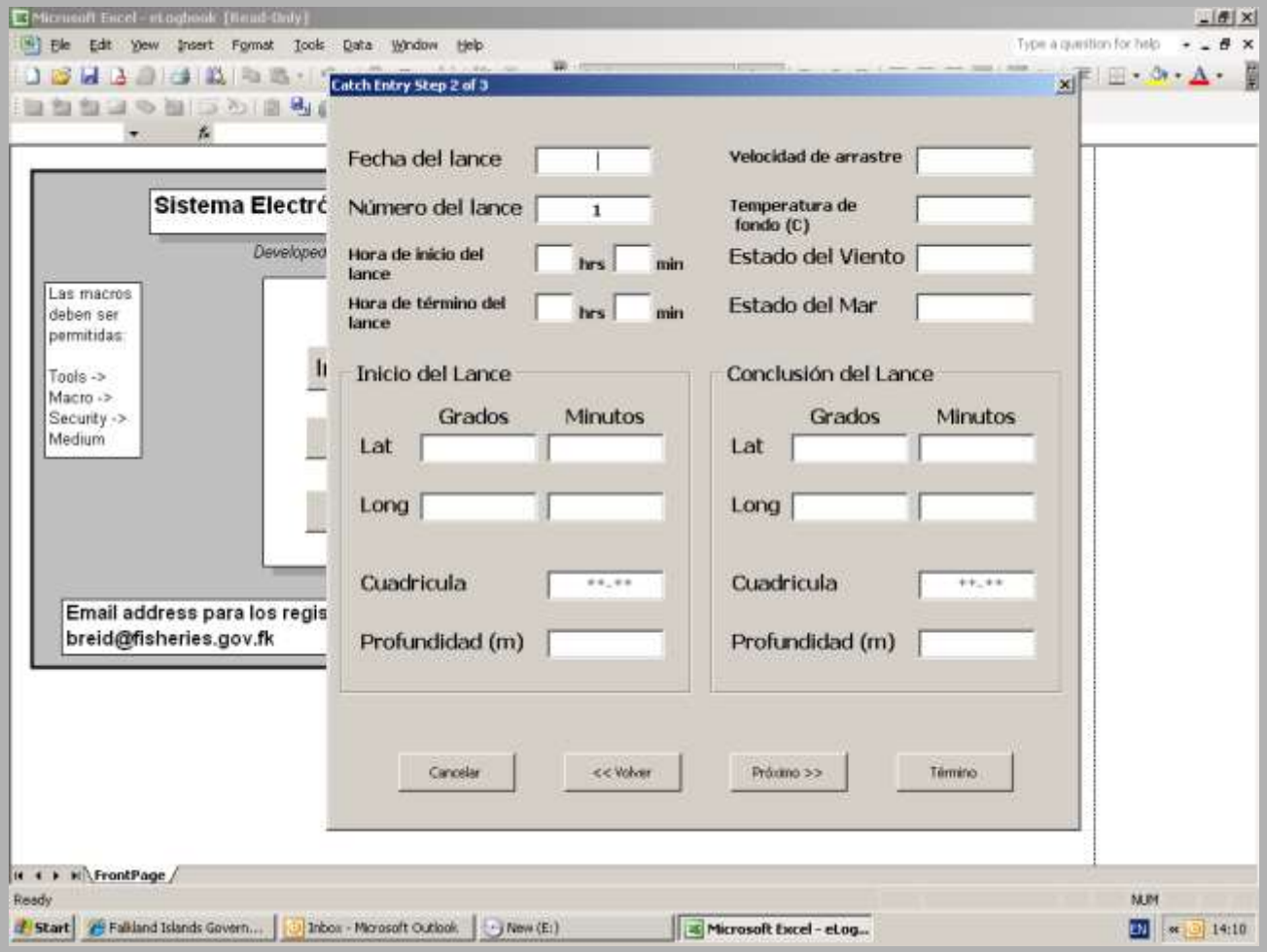
Catch composition data

CPUE

Vessel location

Licence type

Electronic daily logbook

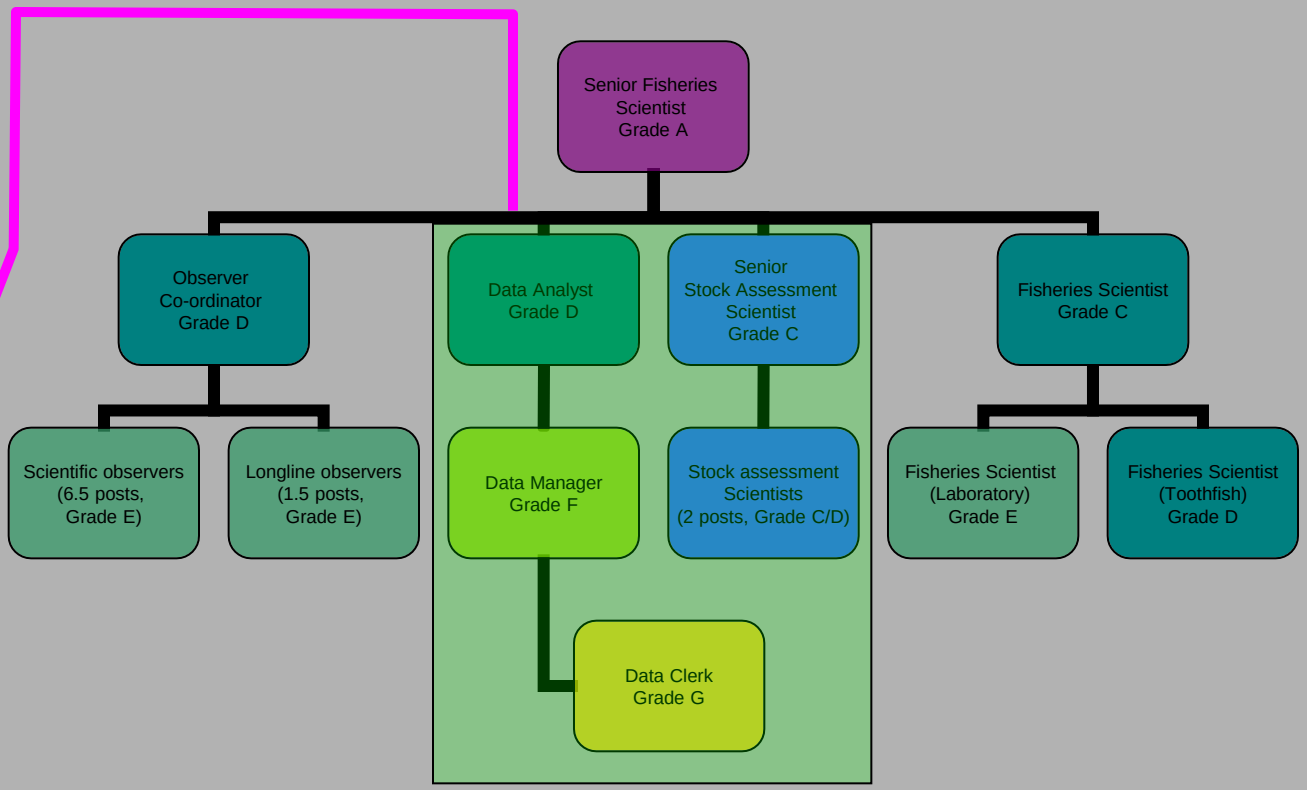


Who does process and analyze these data?

- Species identification
- Size and weight
- Maturity
- Age sampling

- Age estimation
- Growth rate estimation
- Natural mortality estimation

- Catch data
- Catch composition data
- CPUE
- Vessel location
- Licence type



Data Management Group

Stock Assessment Group

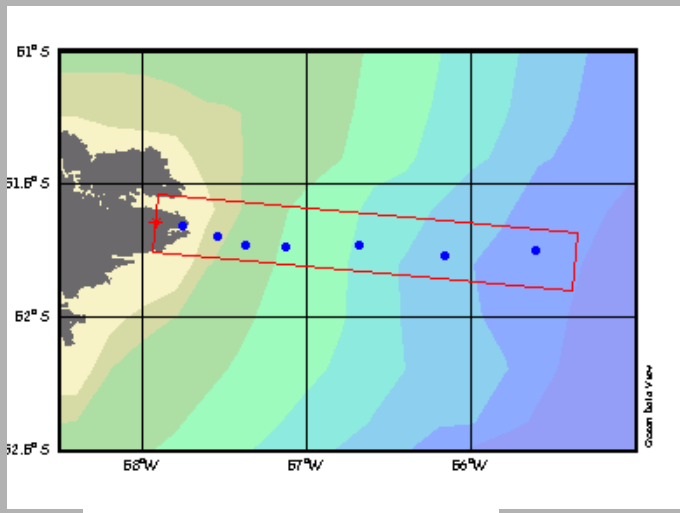
What data do we need to feed the models?

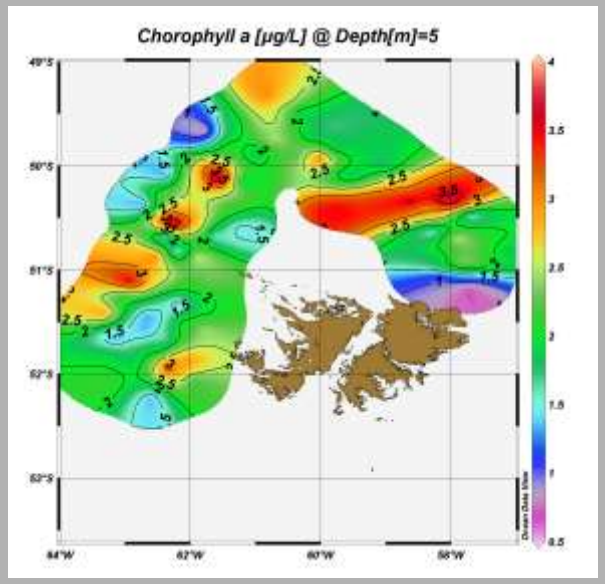
- Species identification
- Size and weight
- Maturity
- Age sampling

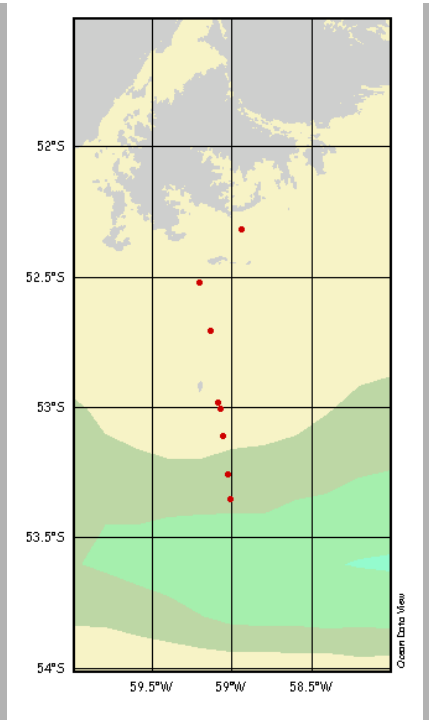
- Age estimation
- Growth rate estimation
- Natural mortality estimation

- Catch data
- Catch composition data
- CPUE
- Vessel location
- Licence type

- Environmental studies
  - Oceanography







What data do we need to feed the models?

Species identification

Size and weight

Maturity

Age sampling

Age estimation

Growth rate estimation

Natural mortality estimation

Catch data

Catch composition data

CPUE

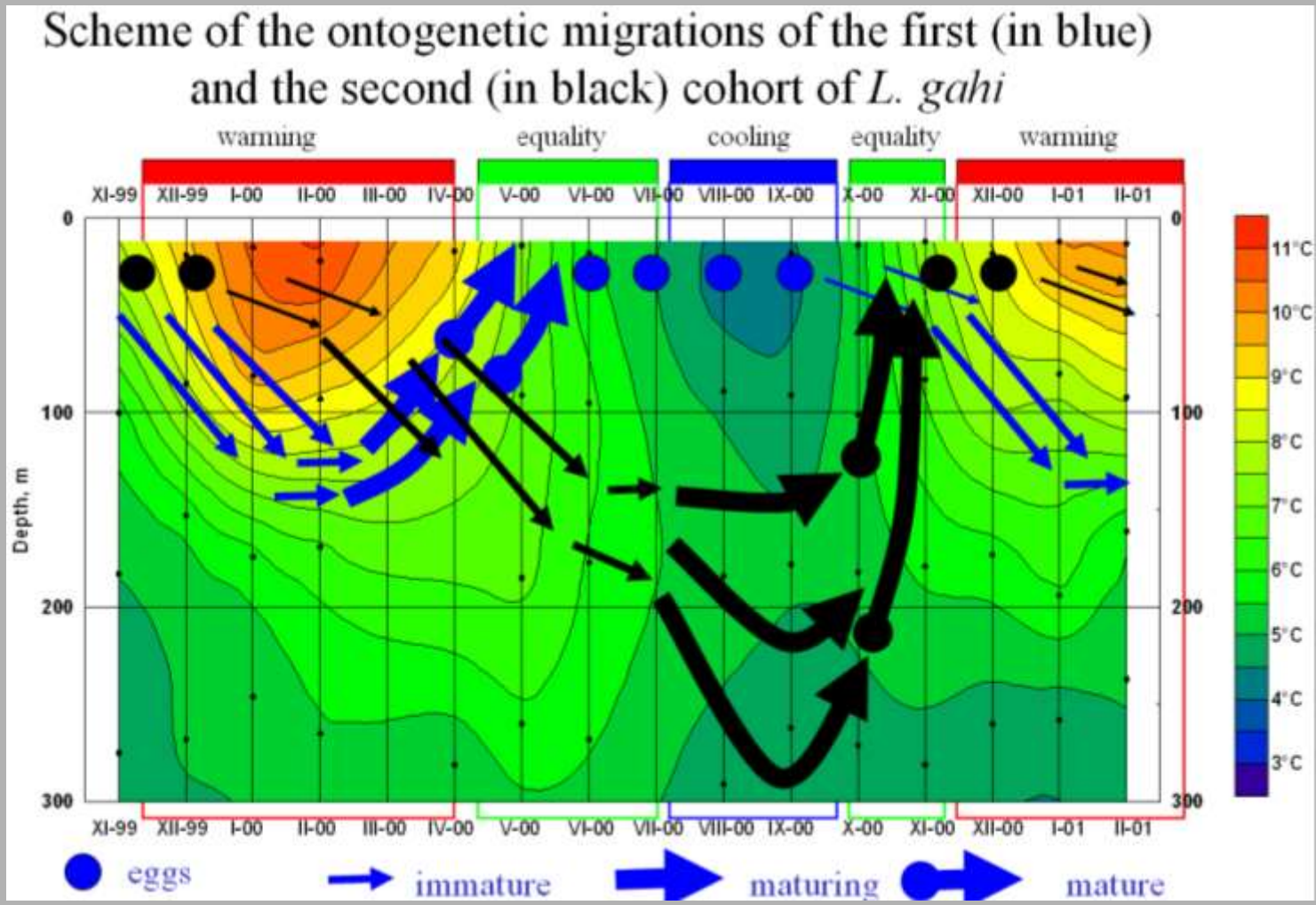
Vessel location

Licence type

Environmental studies

Oceanography

Life history studies



What data do we need to feed the models?

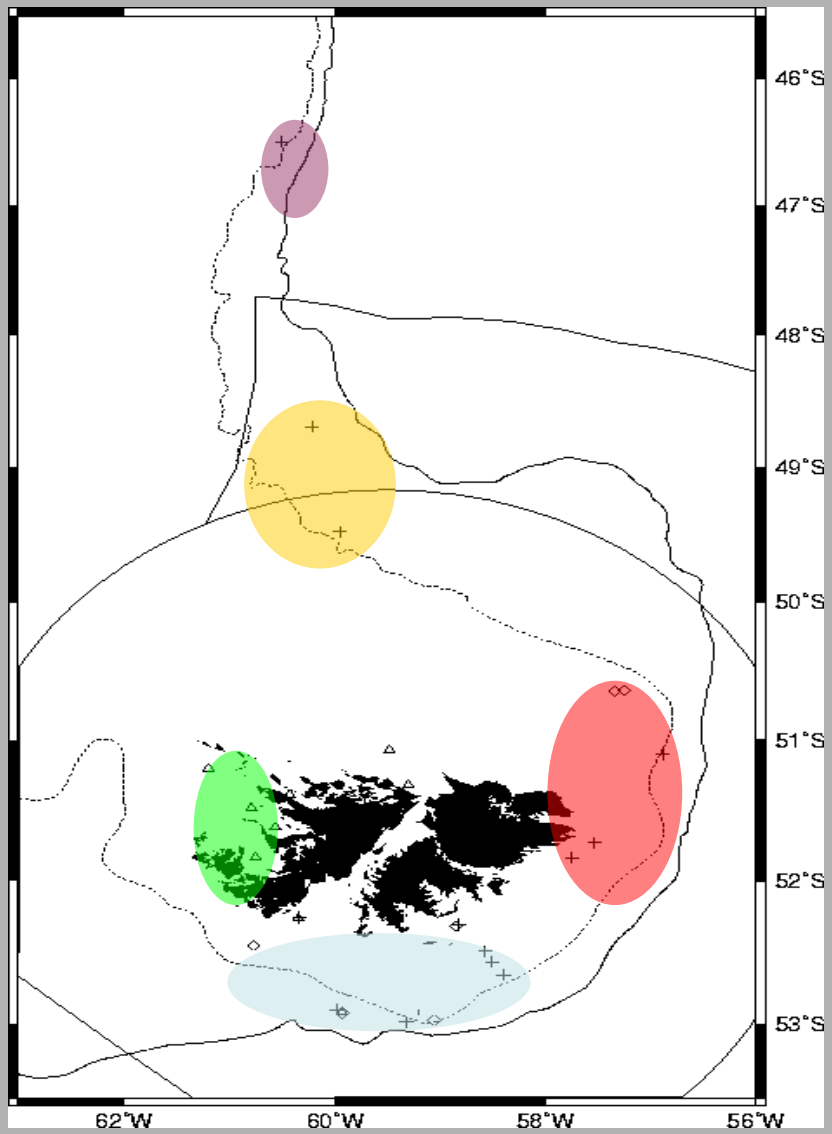
- Species identification
- Size and weight
- Maturity
- Age sampling

- Age estimation
- Growth rate estimation
- Natural mortality estimation

- Catch data
- Catch composition data
- CPUE
- Vessel location
- Licence type

- Environmental studies
  - Oceanography
- Life history studies
- Stock identification studies

Loligo squid from different areas belong to the same population stock?



Who does process and analyze these data?

Species identification

Size and weight

Maturity

Age sampling

Age estimation

Growth rate estimation

Natural mortality estimation

Catch data

Catch composition data

CPUE

Vessel location

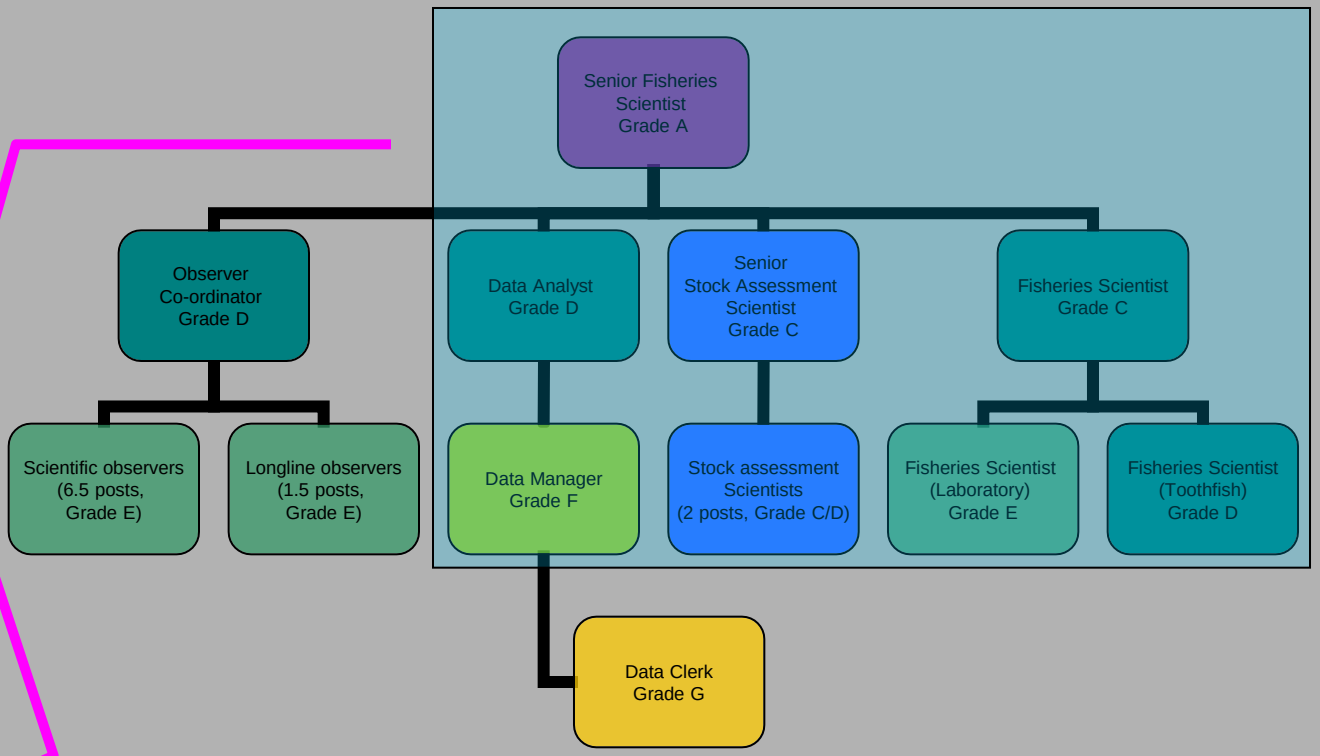
Licence type

Environmental studies

Oceanography

Life history studies

Stock identification studies



All scientists of the Scientific Section

External contractors

How do the Stock Assessment Models work after getting all necessary data?

- Straddling stocks

Swept-area method

VPA (virtual population analysis

ASPM (Age structured production model)

Acoustic surveys

- Domestic stocks

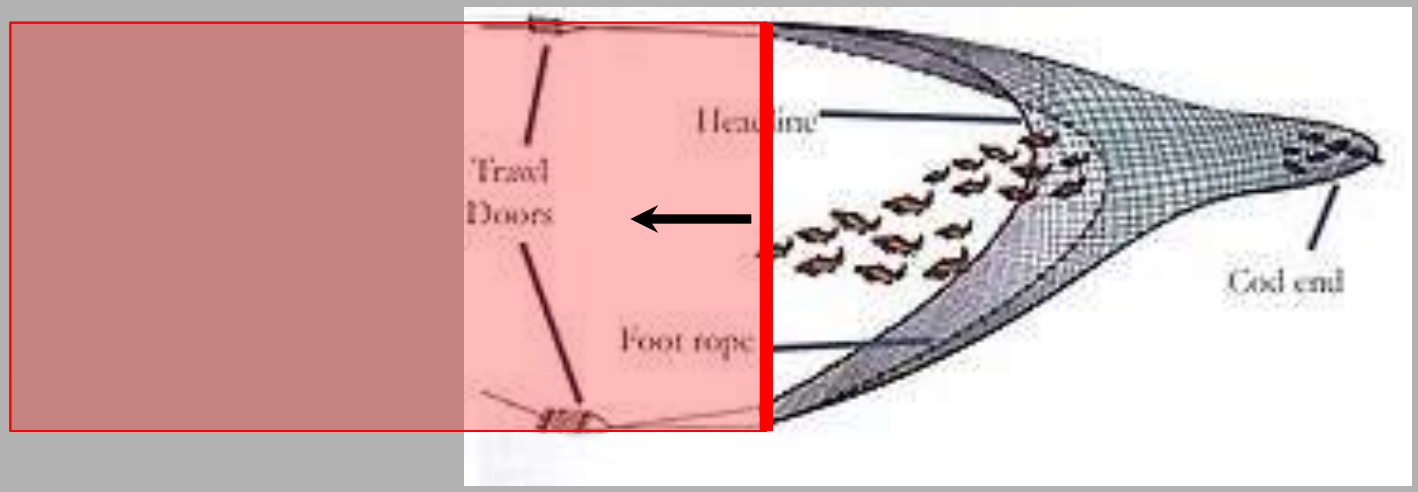
Swept-area method

Depletion model

Acoustic surveys

Swept-area method

Used mainly during finfish, skate and *Loligo* surveys on research vessel
Main task – to estimate density over the survey area



Horizontal spread of the trawl = W

Trawling speed = V

Trawling time = T

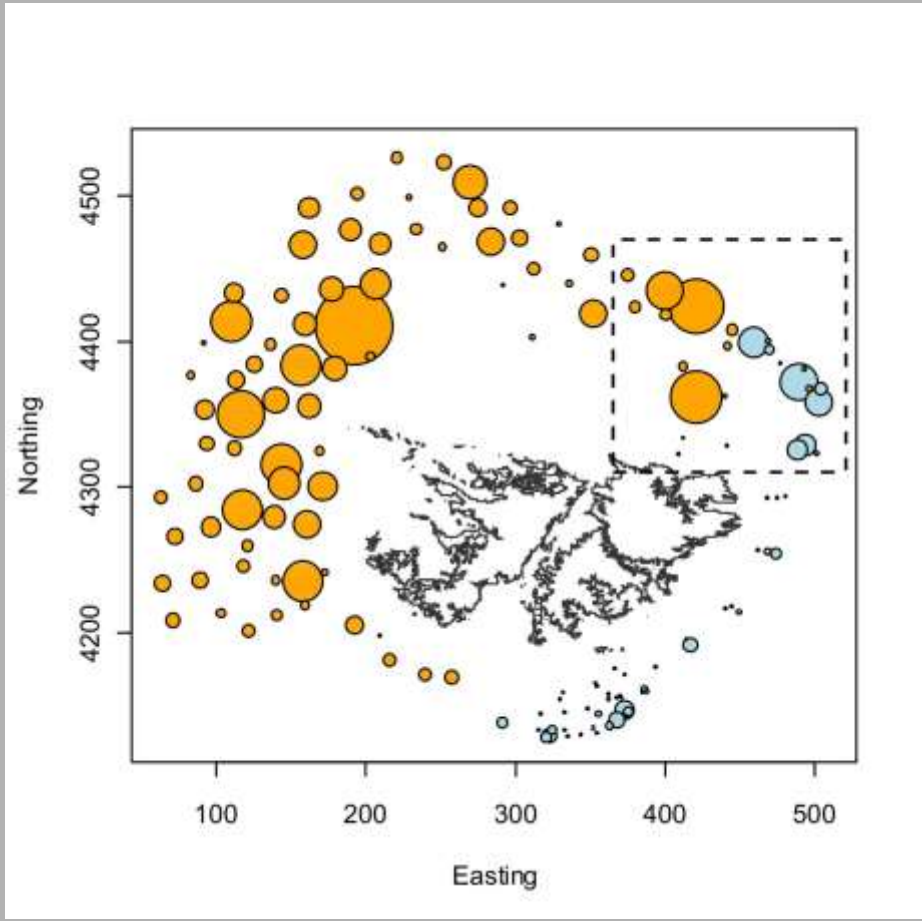
Swept area by trawling = A=W*V*T

Total catch of fish = C

Fish density over the area fished

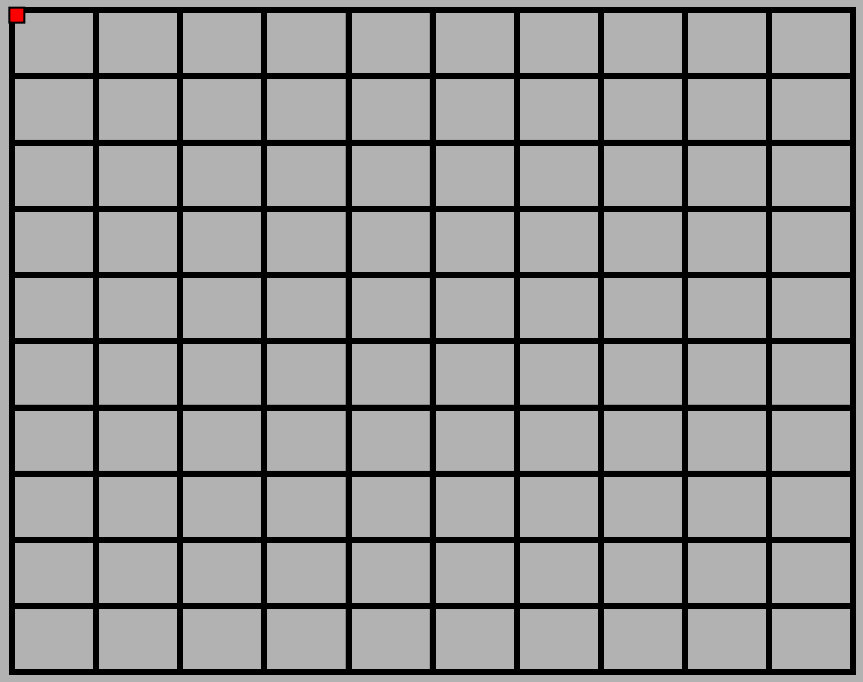
D = C/A

Swept-area method
2010 Rockcod survey



Mean density = 6,592 kg/km^2

- **If the distribution is even,**
  Biomass = Density x Total Area

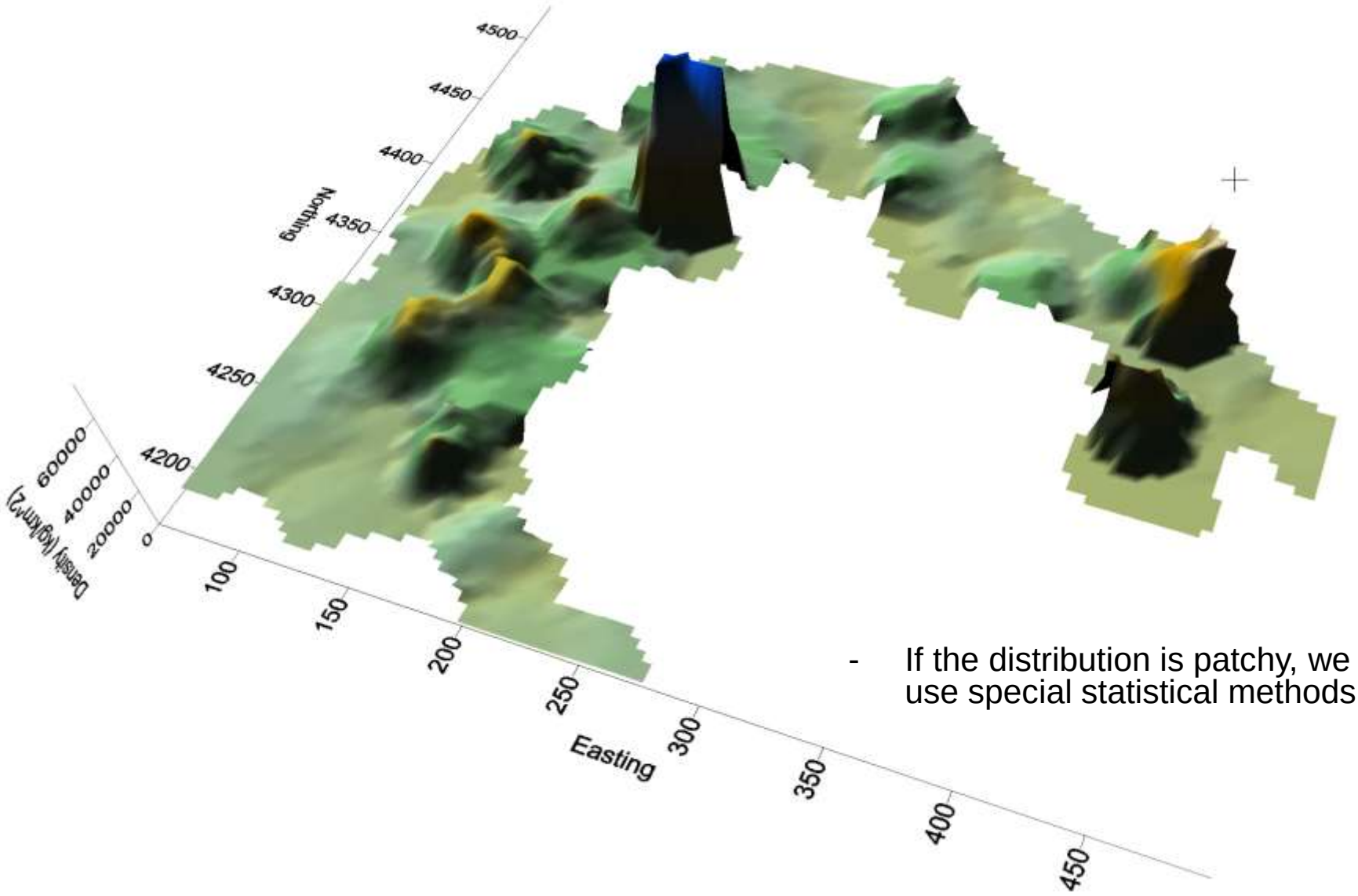


Area covered by 1 trawl = 0.19 km^2

Total area covered by 90 trawl = 17 km^2

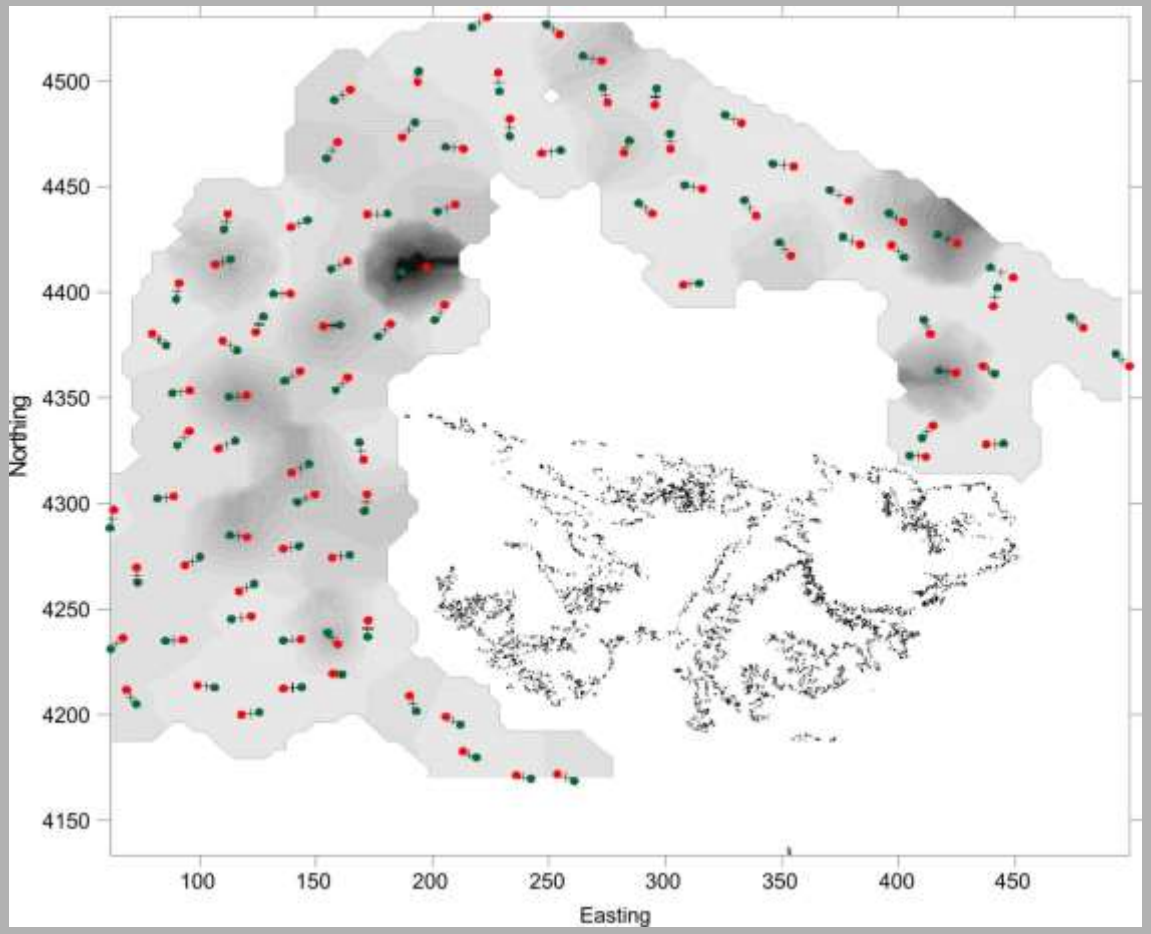
Total survey area = 65,721 km^2

Swept-area method 2010 Rockcod survey



- If the distribution is patchy, we use special statistical methods

Swept-area method
2010 Rockcod survey



- Surfer kriging interpolation
- Total biomass = 445,000 tonnes

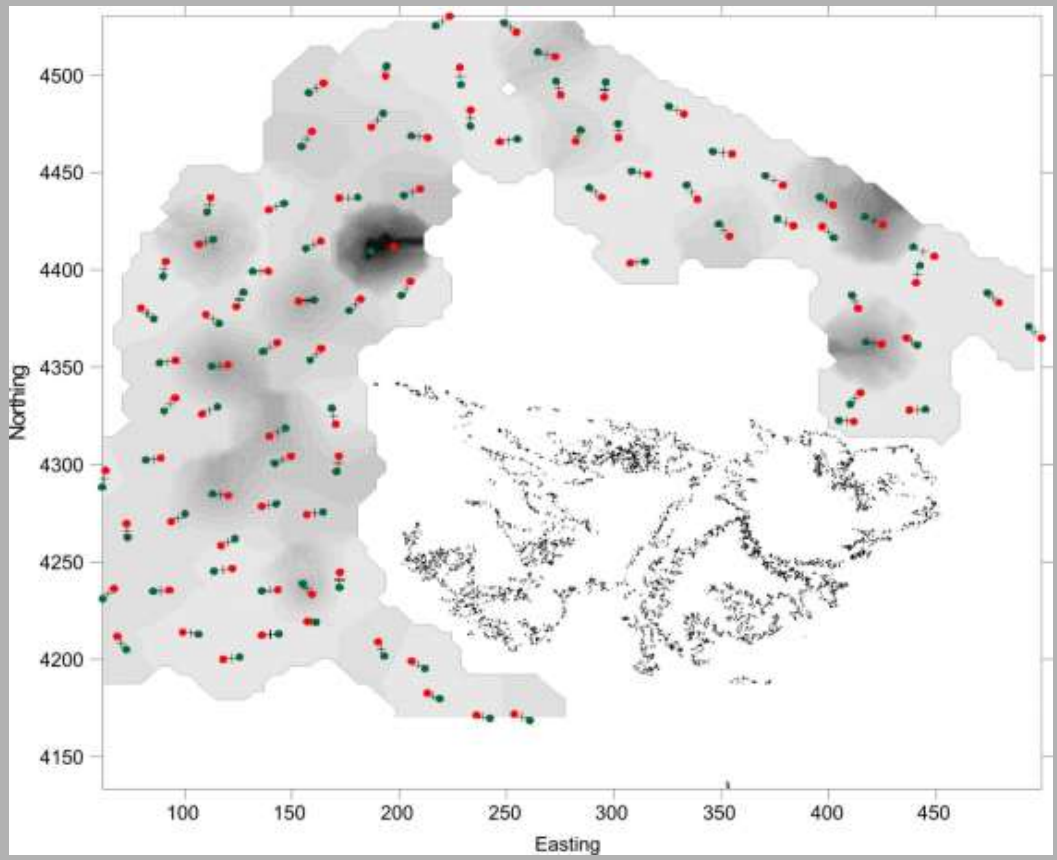
What data are used in swept-area method?

Species identification
Size and weight
Maturity
Age sampling

Age estimation
Growth rate estimation
Natural mortality estimation

Catch data
Catch composition data
CPUE
Vessel location
Licence type

Environmental studies
Oceanography
Life history studies
Stock identification studies



No commercial catch data

How do the Stock Assessment Models work after getting all necessary data?

- Straddling stocks

Swept-area method

VPA (virtual population analysis

ASPM (Age structured production model)

Acoustic surveys

- Domestic stocks

Swept-area method

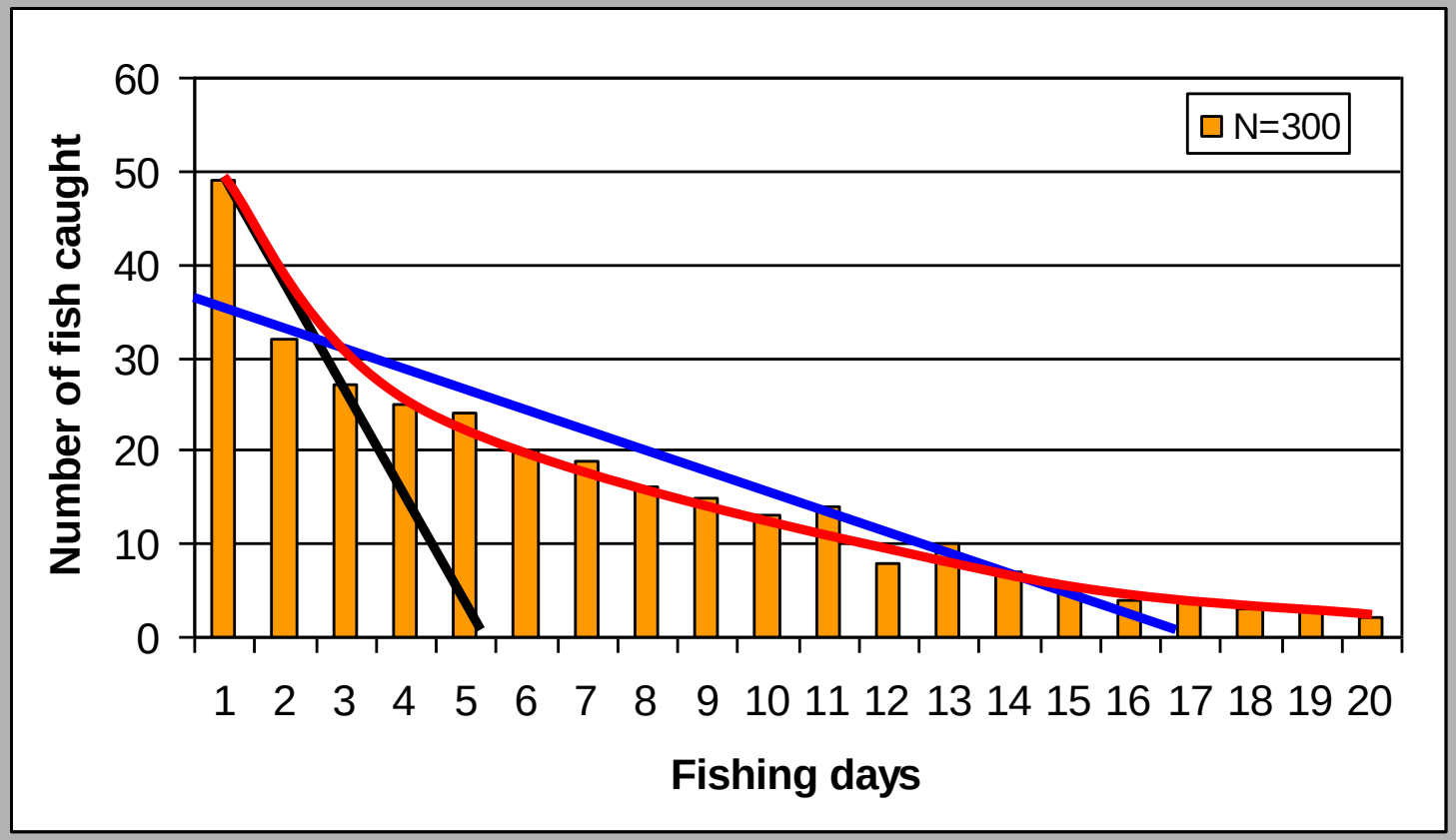
Depletion model

Acoustic surveys

DeLury method
Depletion model

- Is used mainly during *Loligo* squid fishing season

Main task – to estimate *Loligo* squid biomass in the beginning of the season and to assess the biomass left after the season (Spawning Stock Biomass)



What data are used in depletion method?

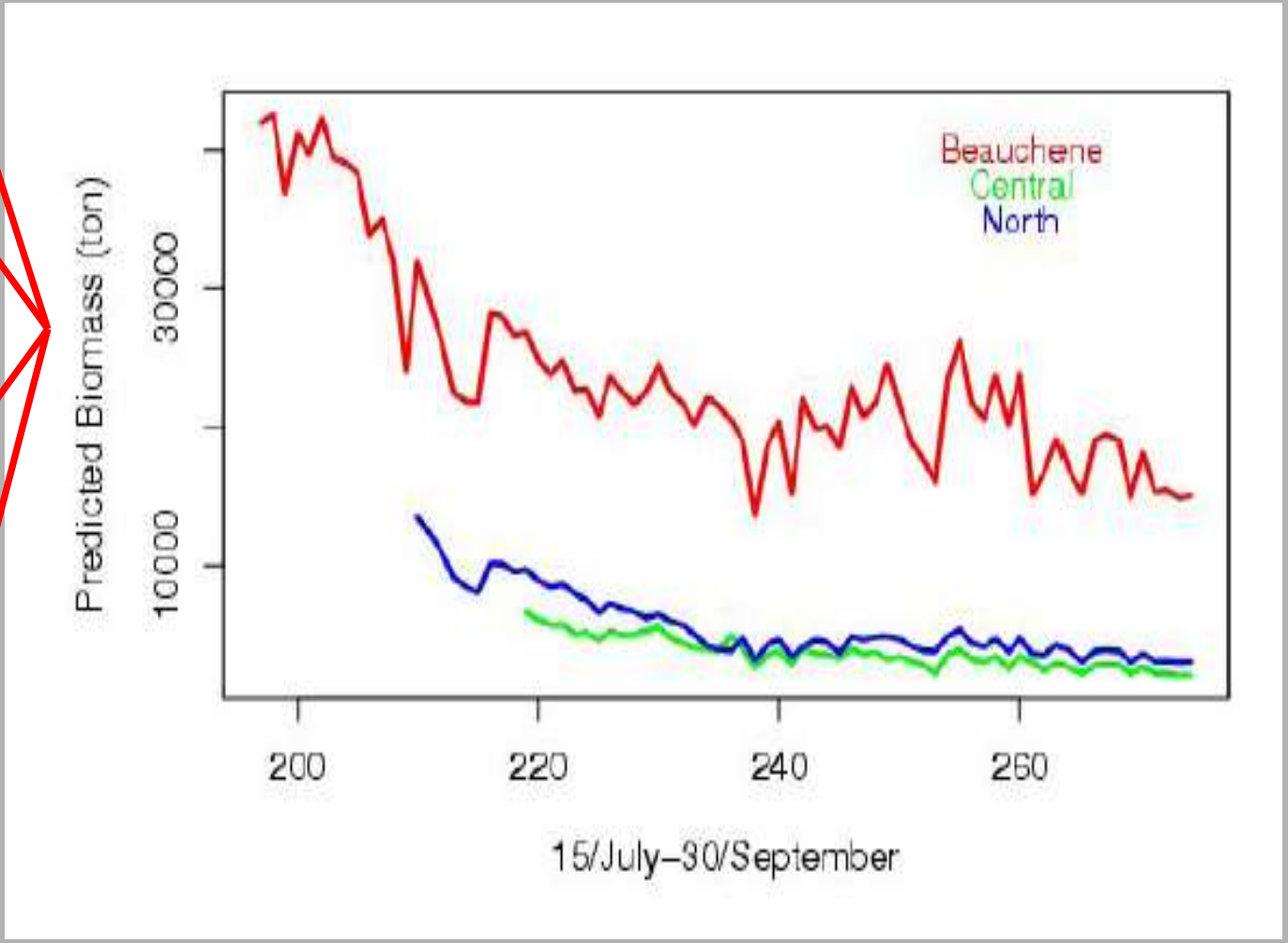
- Species identification
- Size and weight
- Maturity
- Age sampling

- Age estimation
- Growth rate estimation
- Natural mortality estimation

- Catch data
- Catch composition data
- CPUE
- Vessel location
- Licence type

- Environmental studies
  - Oceanography
- Life history studies
- Stock identification studies

‘Data hungry model’



The stock size has been estimated!

Total stock size (biomass) = SB

Maximum Sustainable Yield = MSY

Total Allowable Catch = TAC

Total Allowable Effort = TAE

Conservation measures

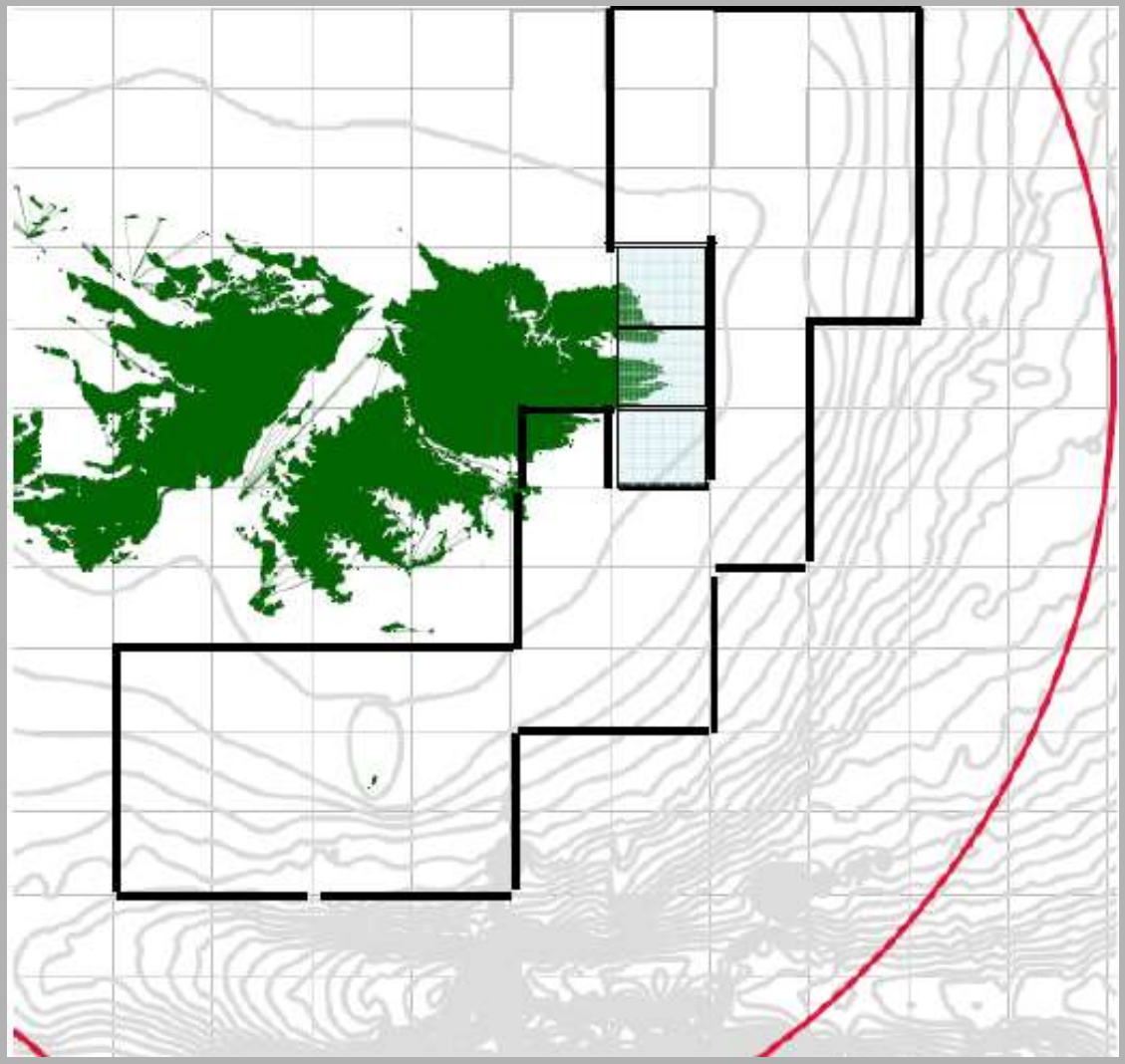
Management Advice

What to do to make the resources sustainable?

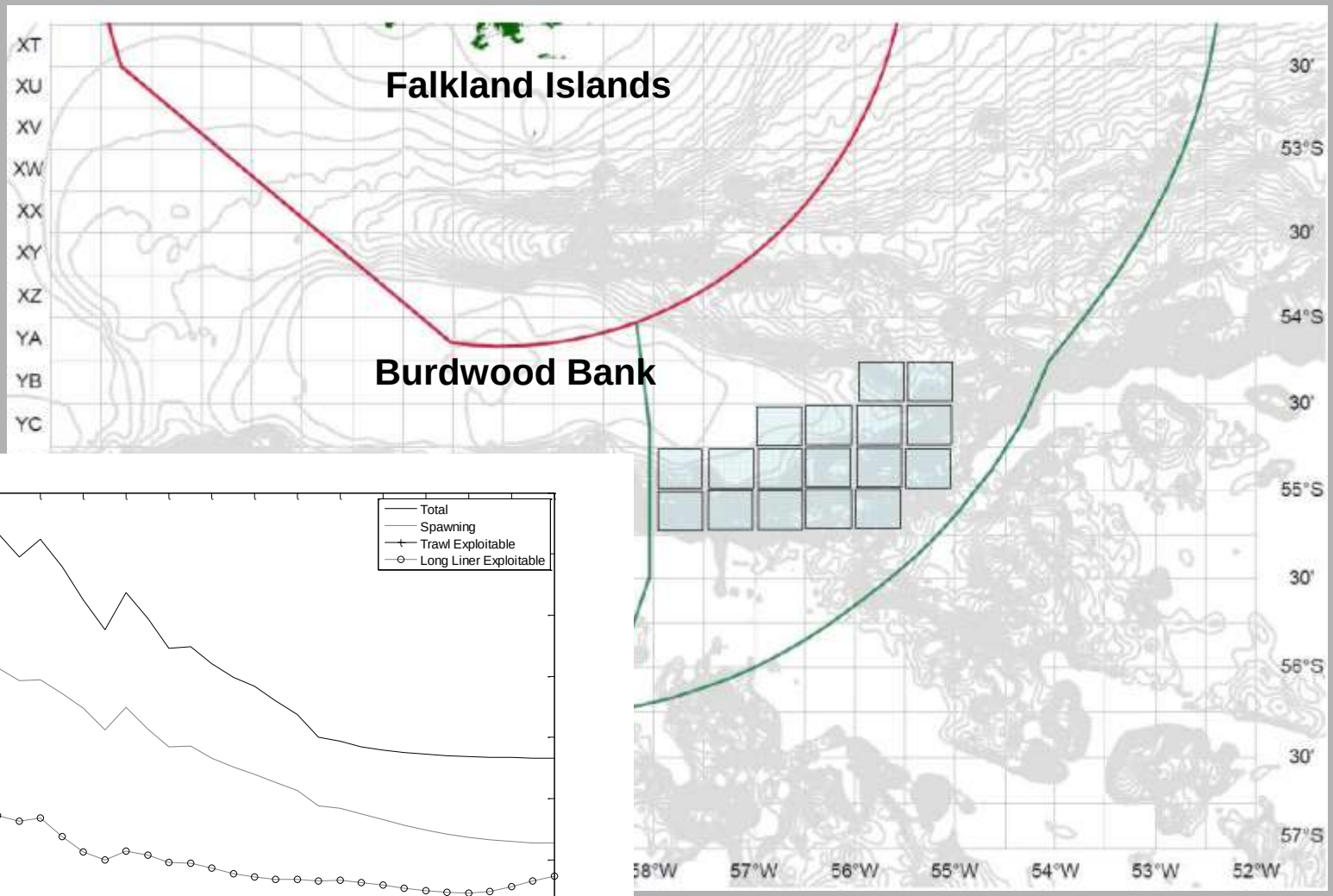
It looks like a simple task – do not overfish them!

- Regulate exploitation rate by ‘precautionary approach’ in establishing TAC and TAE
- Constantly monitor the stock status
- Ease the fishing pressure by allowing appropriate fishing gear (mesh size, ground rope design etc)
- Protect the nursery grounds to allow the juveniles to grow
- Protect spawning grounds to allow spawning animals to release their eggs

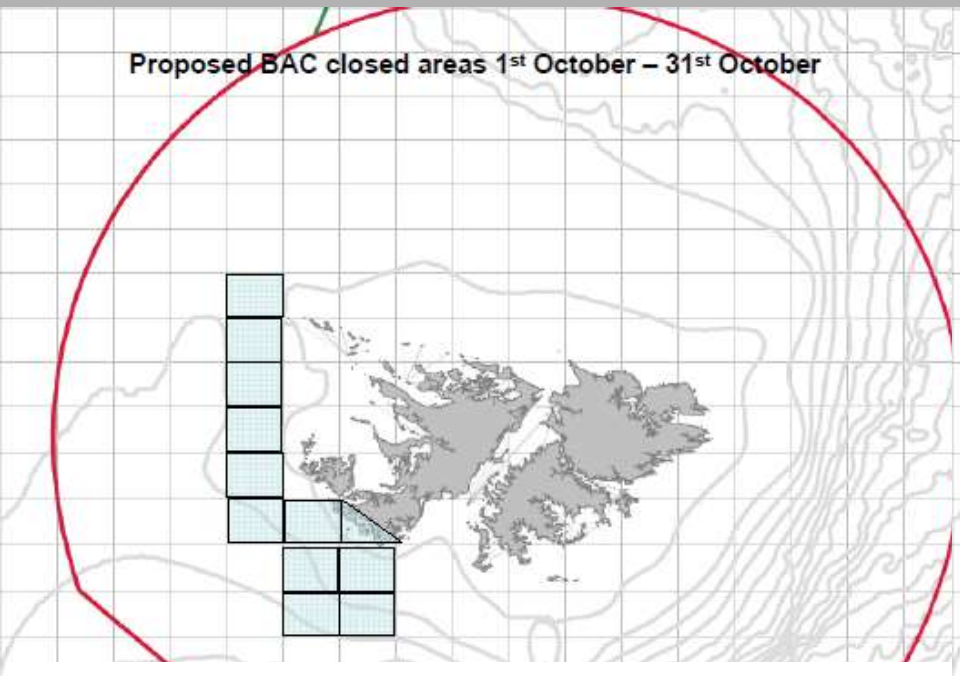
Fishing ban in nursery grounds of Loligo since 2000

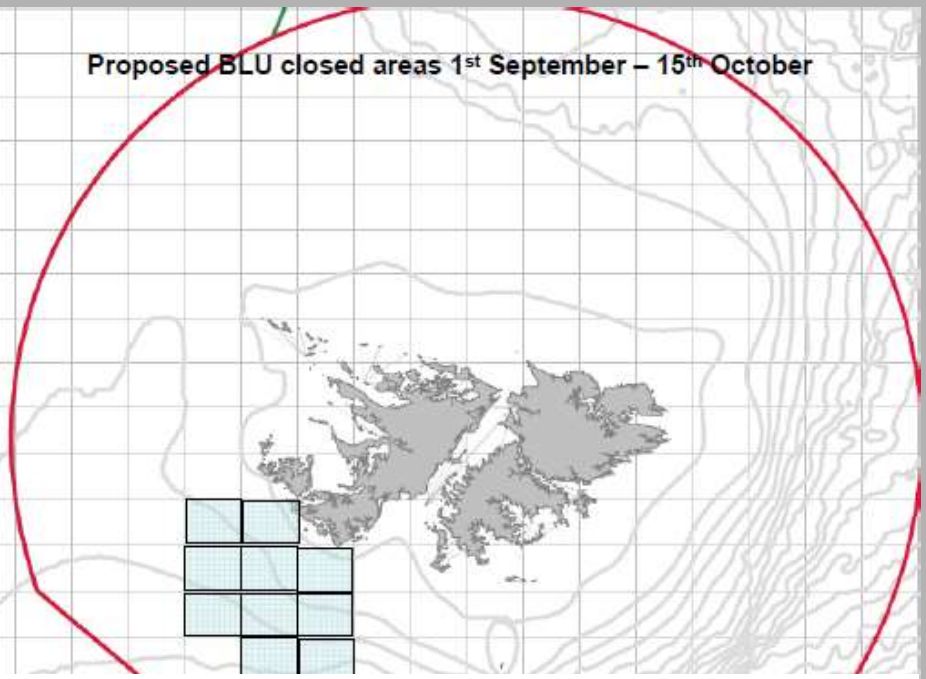


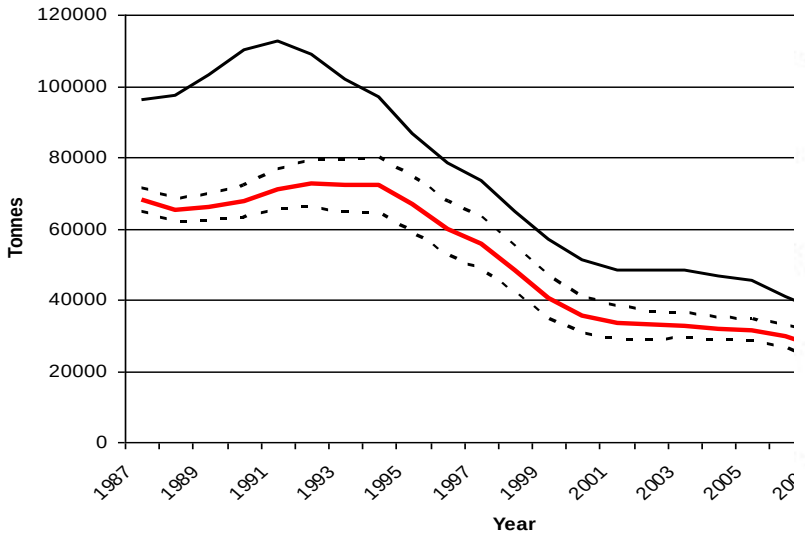
Toothfish spawning area closed July & August (since 2005)

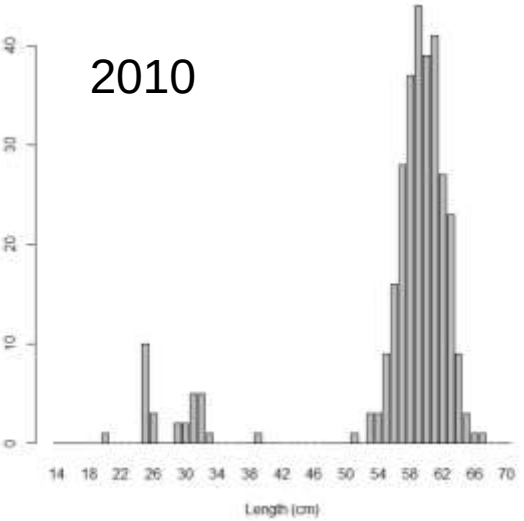


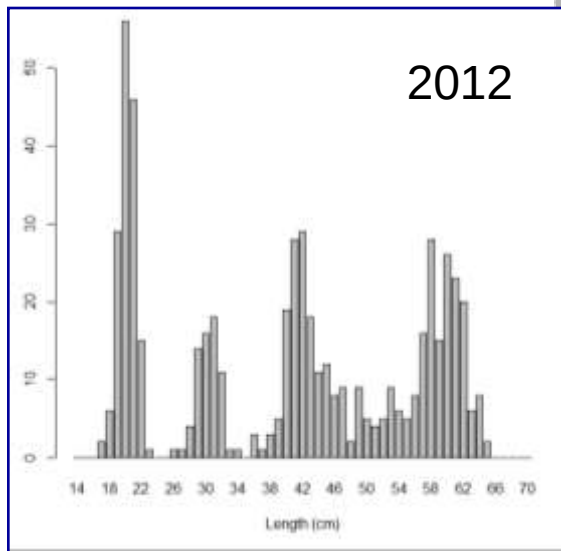
Closure of spawning grounds of red cod and southern blue whiting (since 2010)











Our responsibility

U.N. Convention on the Law of the Sea

- ARTICLE 61. Conservation of the living resources “The coastal State, taking into account the best scientific evidence available to it, shall ensure through proper conservation and management measures that… the living resources.. are not endangered by over-exploitation.”

- Reliable and sound scientific advice leading to sustainable fishery and rational exploitation of fishery resources will maximize economic return from a well managed fishery.

Transfer of science delivery and development of science capacity in FIFD in 25+ years

Species identification

Size and weight

Maturity

Age sampling

Age estimation

Growth rate estimation

Natural Mortality estimation

Catch data

Catch composition data

CPUE

Vessel location

Licence type

Environmental studies

Oceanography

Life history studies

Stock identification studies

Stock assessment

- ASPM
- Depletion
- VPA

Surveys

- Research surveys
- Biomass surveys
- Acoustic surveys

Compliance

- Bird mitigation
- Catch
- Gear

Licensing advice

- TAC
- TAE

Conservation measures

- Gear restriction
- Area closures
- Temporal closures

Management advice

- ITQ values
- *Illex*