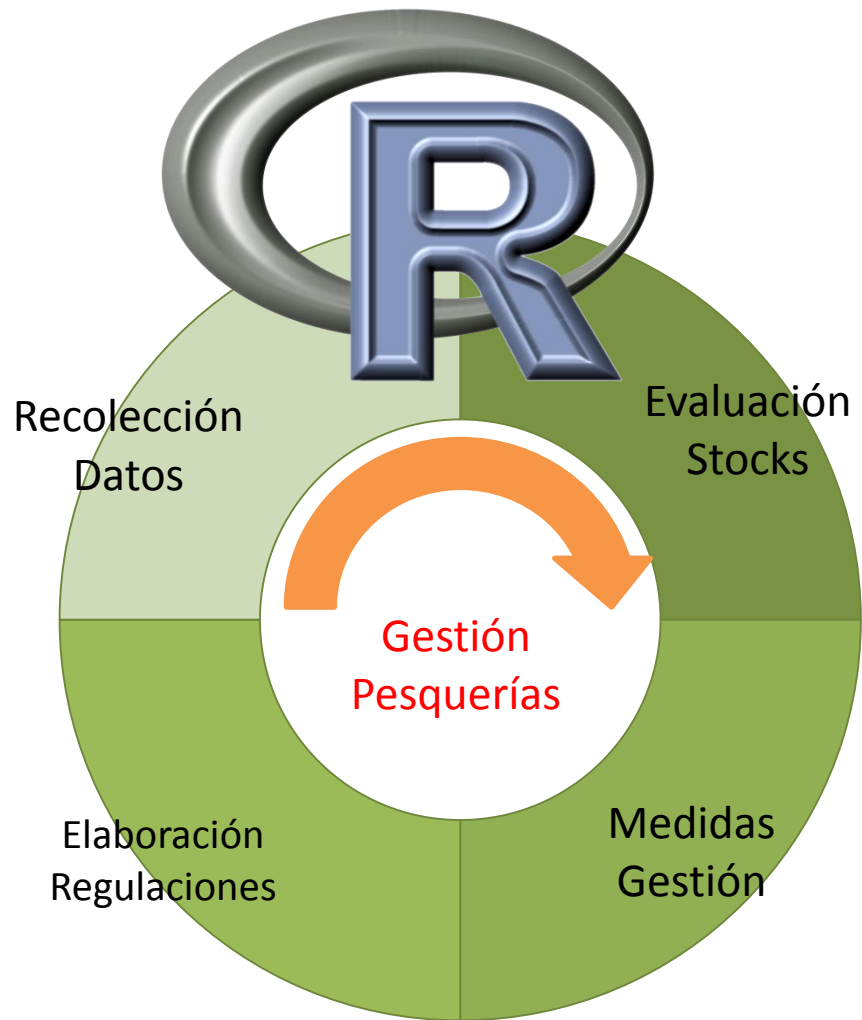


Aplicación de R en la evaluación de stocks pesqueros

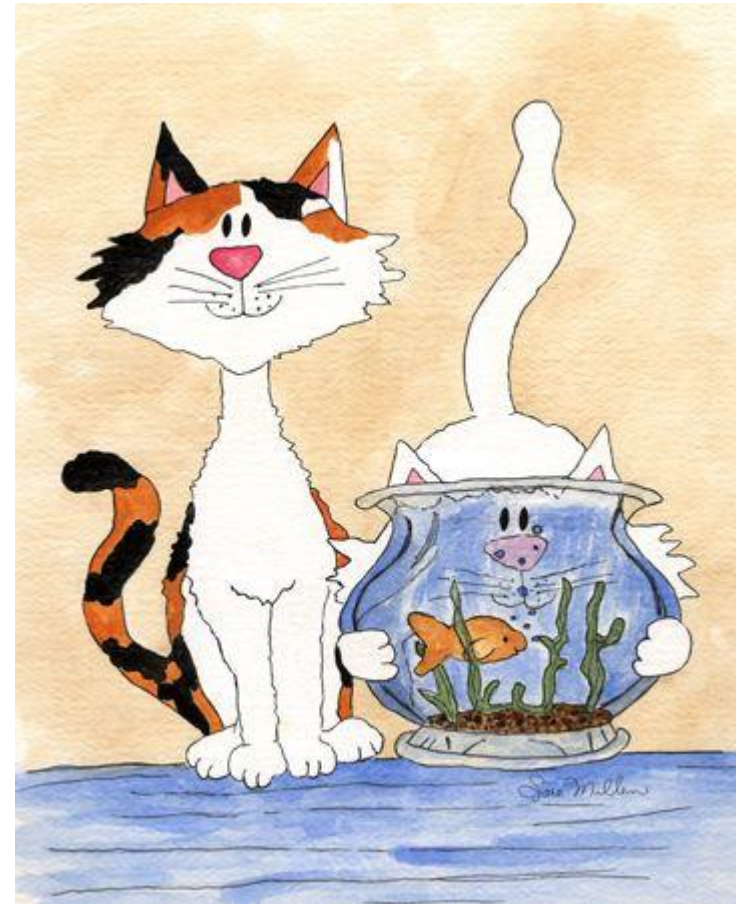


Paz Sampedro, Gersom Costas
Instituto Español de Oceanografía





- Los stocks son compartidos: internacional
- Repite anualmente
- Proceso transparente



paquete INBIO

Información biológica especies con incertidumbre asociada

Estandarizar metodologías de estimación a nivel nacional

Ajusta los modelos más comunes de relación talla-peso, madurez, crecimiento y sexratio.

Incertidumbre: bootstrap no paramétrico.

paquete INBIO

```
# crecimiento(especie = "nombre especie", cl = 1, unid="cm", sex = F, b = 3, Li = 80,  
Lfija=F, Ki = 0.7, T0i = -1, Wi = 2500, Wfijo=F, Kwi = 0.4, T0wi = -1, n = 1000)
```

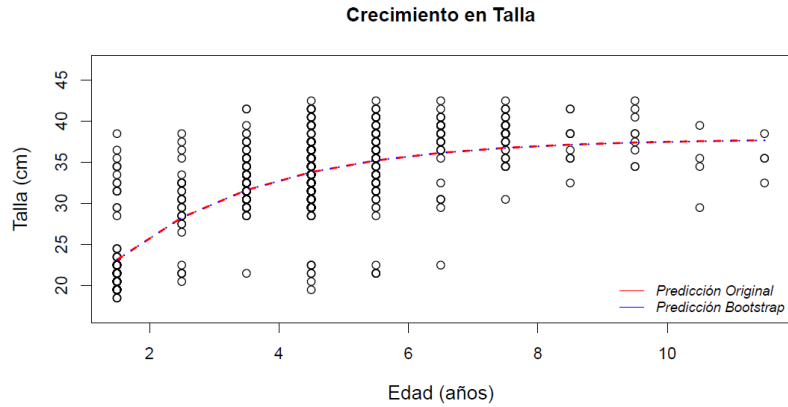
```
crecimiento (especie="caballa", sex=T)
```

Datos, fichero plano

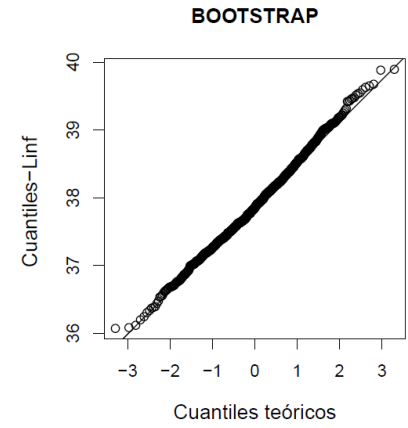
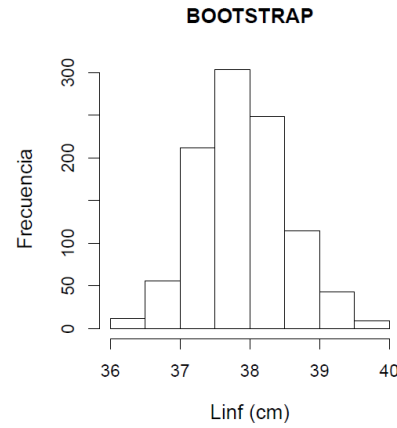
tal	pes	eda	mad	sex
38	432	7	1	2
37.5	408	6	1	2
35	331	8	1	1
38.5	446	9	1	2
36	385	7	1	1
35.8	323	8	1	2
38.5	434	5	1	1
38.5	447	8	1	1
36.8	409		1	2
39.9	463	7	1	2
33.5	292	4	1	2
34.7	343	4	1	1
35.8	381	5	1	2
35.2	324	5	1	2
36.4	365	7	1	1

paquete INBIO: outputs gráficas

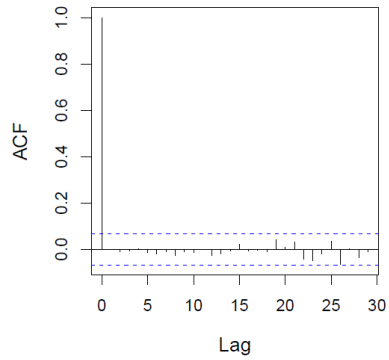
Crecimiento en Talla: Gráficos Diagnóstico



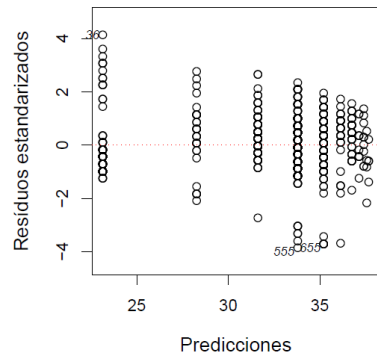
Crecimiento en Talla: Gráficos Diagnóstico



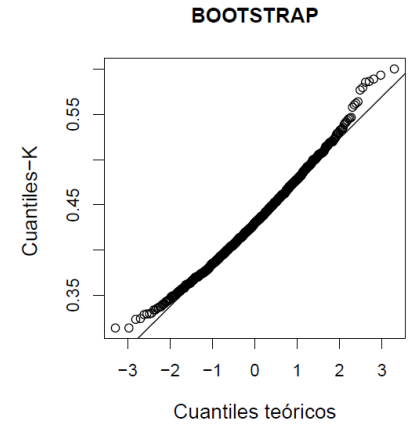
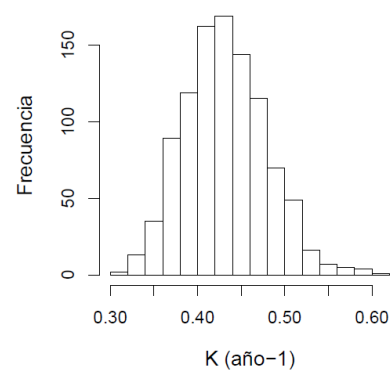
Correlograma



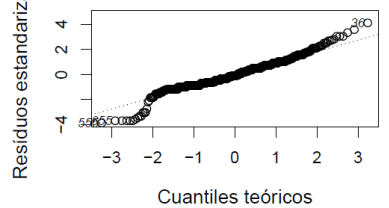
Residuos vs Predicciones



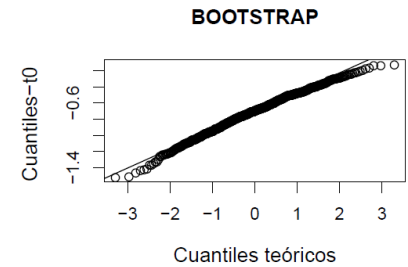
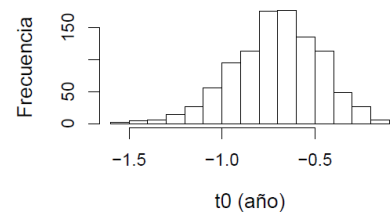
BOOTSTRAP



Normal QQ Plot



BOOTSTRAP



paquete INBIO: outputs txt

Día: 15-feb-2013 Hora: 14:51:40

CRECIMIENTO EN TALLA: von Bertalanffy

Especie: caballa

Sexo: Hembras

N: 838

Argumentos Rutina:

crecimiento(especie = "caballa", sex = T)

RESULTADOS AJUSTE (datos originales)

Nonlinear regression model

model: tal ~ L * (1 - exp(-K * (eda - T0)))

data: parent.frame()

L K T0

37.8763 0.4278 -0.7066

residual sum-of-squares: 11496

Number of iterations to convergence: 4

Achieved convergence tolerance: 1.964e-05

PARÁMETROS ESTIMADOS: ORIGINALES-BOOTSTRAP

	Estima original	Estima boot	CV boot
Linf (cm)	37.87626	37.85166	0.017
k (año-1)	0.427815	0.430047	0.109
t0 (año)	-0.706567	-0.696725	0.334

COST*: A Common Open Source Tool

La precisión de datos biológicos y estimas de parámetros:
capturas por talla y edad

COSTcore: clases de datos, funciones básicas

COSTeda: análisis exploratorio de datos

COSTdbe: estimaciones analíticas y bootstrap

COSTmbe: estimaciones bayesianas

COSTsim: simulaciones

[*http://wwz.ifremer.fr/cost](http://wwz.ifremer.fr/cost)

COSTcore: clases de datos, funciones básicas

Commercial sampling

TR (Trip)	
PK	<u>Record type</u>
PK	<u>Sampling type</u>
PK	<u>Landing country</u>
PK	<u>Vessel flag country</u>
PK	<u>Year</u>
PK	<u>Project</u>
PK	<u>Trip number</u>
	Vessel length
	Vessel power
	Vessel size
	Vessel type
	Harbour
	Number of sets/hauls on trip
	Days at sea
	Vessel identifier
	Sampling country
	Sampling method

HH (Fishing station)	
PK,FK1	<u>Record type</u>
PK,FK1	<u>Sampling type</u>
PK,FK1	<u>Landing country</u>
PK,FK1	<u>Vessel flag country</u>
PK,FK1	<u>Year</u>
PK,FK1	<u>Project</u>
PK,FK1	<u>Trip number</u>
PK	<u>Station number</u>
	Fishing validity
	Aggregation level
	Catch registration
	Species registration
	Date
	Time
	Fishing duration
	Pos.Start.Lat.dec.
	Pos.Start.Lon.dec.
	Pos.Stop.Lat.dec.
	Pos.Stop.Lon.dec.
	Area
	Statistical rectangle
	Sub polygon
	Main fishing depth
	Main water depth
	Fishing activity category National
	Fishing activity category European lvl 5
	Fishing activity category European lvl 6
	Mesh size
	Selection device
	Mesh size in selection device

CA (Sex-Maturity-Age-Weight-Length)	
PK,FK1	<u>Record type</u>
PK,FK1	<u>Sampling type</u>
PK,FK1	<u>Landing country</u>
PK,FK1	<u>Vessel flag country</u>
PK,FK1	<u>Year</u>
PK,FK1	<u>Project</u>
PK,FK1	<u>Trip number</u>
PK	<u>Station number</u>
PK	<u>Quarter</u>
PK	<u>Month</u>
PK	<u>Species</u>
PK	<u>Sex</u>
PK	<u>Catch category</u>
PK	<u>Landing category</u>
PK	<u>Commercial size category scale</u>
PK	<u>Commercial size category</u>
PK	<u>Stock</u>
PK	<u>Area</u>
PK	<u>Statistical rectangle</u>
PK	<u>Sub polygon</u>
PK	<u>Length class</u>
PK	<u>Age</u>
PK	<u>Single fish number</u>
	Length code
	Aging method
	Age plus group
	Otolith weight
	Otolith side
	Weight
	Maturity staging method
	Maturity scale
	Maturity stage

SL (Species List)	
PK,FK1	<u>Record type</u>
PK,FK1	<u>Sampling type</u>
PK,FK1	<u>Landing country</u>
PK,FK1	<u>Vessel flag country</u>
PK,FK1	<u>Year</u>
PK,FK1	<u>Project</u>
PK,FK1	<u>Trip number</u>
PK,FK1	<u>Station number</u>
PK	<u>Species</u>
PK	<u>Sex</u>
PK	<u>Catch category</u>
PK	<u>Landing category</u>
PK	<u>Commercial size category scale</u>
PK	<u>Commercial size category</u>
PK	<u>Subsampling category</u>
	Weight
	Subsample weight
	Length code

HL (Length)	
PK,FK1	<u>Record type</u>
PK,FK1	<u>Sampling type</u>
PK,FK1	<u>Landing country</u>
PK,FK1	<u>Vessel flag country</u>
PK,FK1	<u>Year</u>
PK,FK1	<u>Project</u>
PK,FK1	<u>Trip number</u>
PK,FK1	<u>Station number</u>
PK,FK1	<u>Species</u>
PK,FK1	<u>Catch category</u>
PK,FK1	<u>Sex</u>
PK,FK1	<u>Landing category</u>
PK,FK1	<u>Commercial size category scale</u>
PK,FK1	<u>Commercial size category</u>
PK,FK1	<u>Subsampling category</u>
PK	<u>Sex</u>
PK	<u>Length class</u>
	Number at length

CL (Landing statistics)	
PK	<u>Record type</u>
PK	<u>Landing country</u>
PK	<u>Vessel flag country</u>
PK	<u>Year</u>
PK	<u>Quarter</u>
PK	<u>Month</u>
PK	<u>Area</u>
PK	<u>Statistical rectangle</u>
PK	<u>Sub polygon</u>
PK	<u>Species</u>
PK	<u>Landing category</u>
PK	<u>Commercial size category scale</u>
PK	<u>Commercial size category</u>
PK	<u>Fishing activity category National</u>
PK	<u>Fishing activity category European lvl 5</u>
PK	<u>Fishing activity category European lvl 6</u>
PK	<u>Harbour</u>
PK	<u>Vessel length category</u>
	Unallocated catch weight
	Area misreported catch weight
	Official landings weight
	Landings multiplier
	Official landings value

CE (Effort statistics)	
PK	<u>Record type</u>
PK	<u>Vessel flag country</u>
PK	<u>Year</u>
PK	<u>Quarter</u>
PK	<u>Month</u>
PK	<u>Area</u>
PK	<u>Statistical rectangle</u>
PK	<u>Sub polygon</u>
PK	<u>Fishing activity category National</u>
PK	<u>Fishing activity category European lvl 5</u>
PK	<u>Fishing activity category European lvl 6</u>
PK	<u>Harbour</u>
PK	<u>Vessel length category</u>
	Number of trips
	Number of sets / hauls
	Fishing time / soaking time
	kW-days
	GT-days
	Days at sea

Commercial landings

Commercial effort

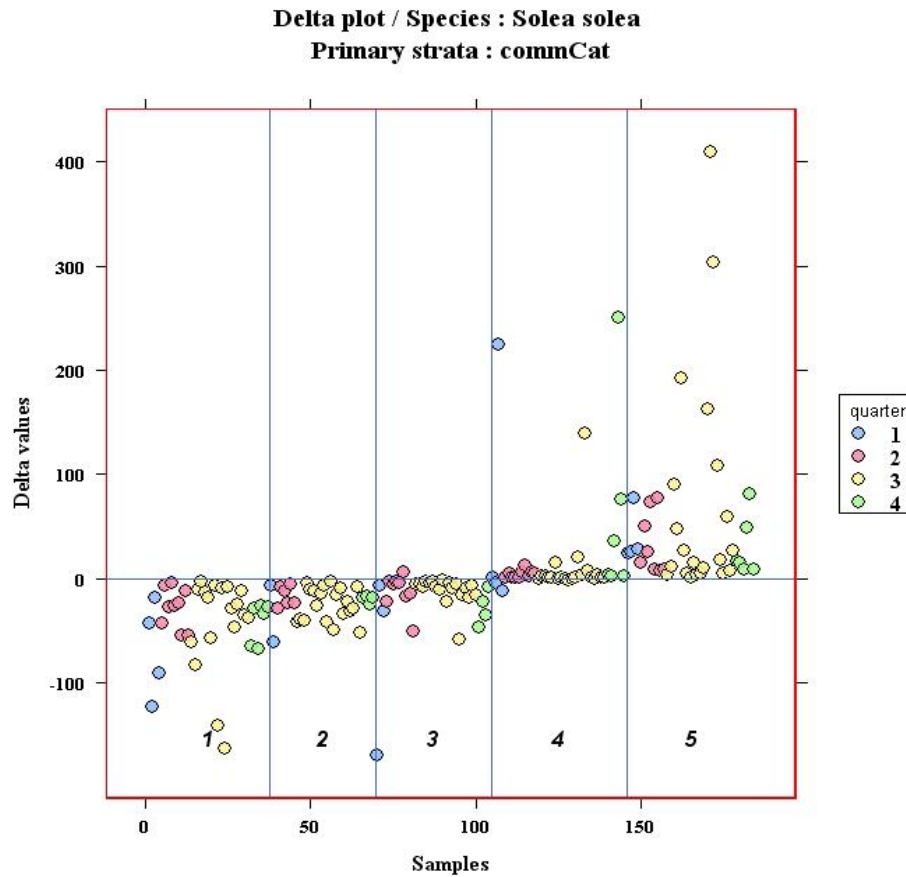
Legend:

Data type	
PK	<u>Primary key field</u>
	Meta data field
	Value field

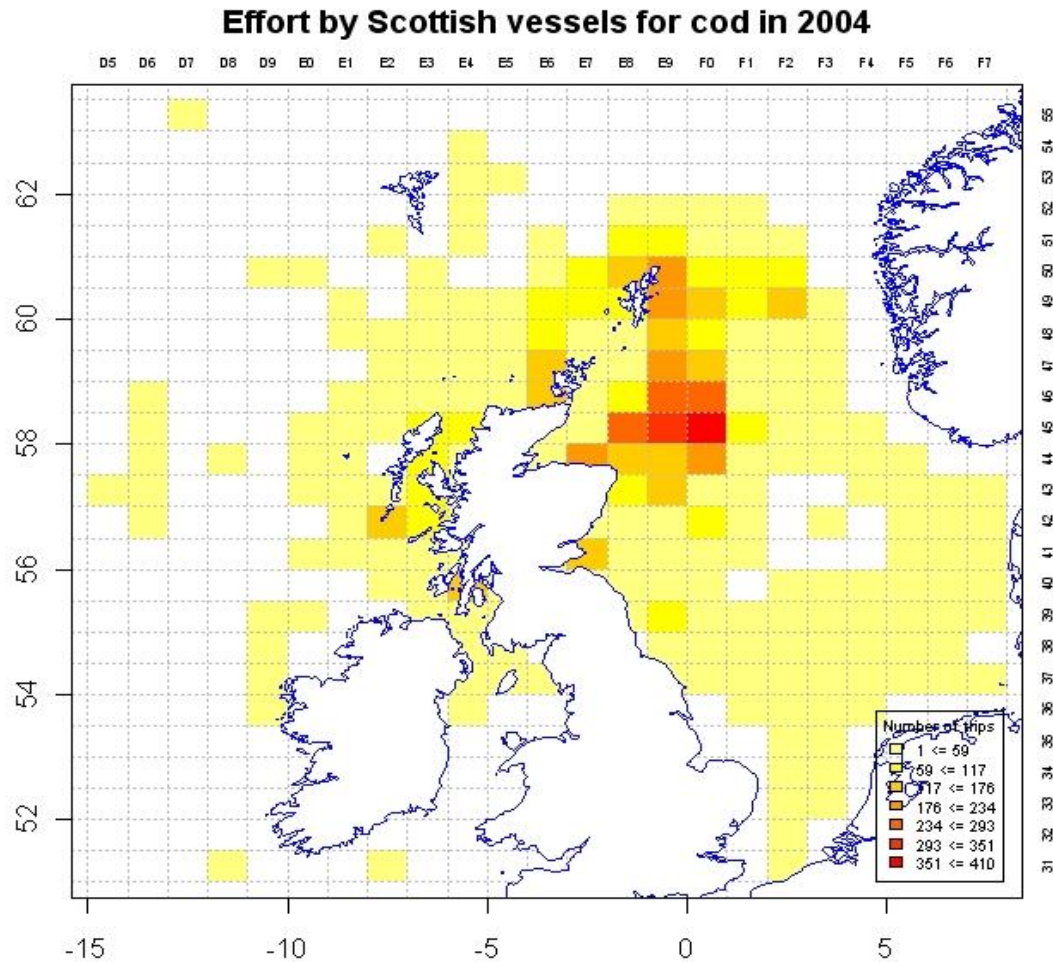
Data type	
PK	<u>Primary key field</u>
FK1	Foreign key field
	Meta data field
	Value field

One
To
many
relation

```
data(sole)
strDef <- strIni(timeStrata="quarter",techStrata="foCatEu5")
object <- csDataCons(csDataVal(sole.cs),strDef)
res <- disCorrPlot(object,aux="landings",techStrata=TRUE,l.col="steelblue")
```



```
data(cod2004)
spacePlot(cod2004ce,"trpNum","rect",sum,statrects=TRUE,scale.title="Number of
trips")
title("Effort by Scottish vessels for cod in 2004")
```



```

strD <- strIni(timeStrata="quarter",techStrata="commCat")

csObject <- csDataCons(csDataVal(subset(sole.cs,sampType%in%c("M","V"))),strD)

clObject <- clDataCons(clDataVal(sole.cl),strD)

dbeOutput <- dbeObject(species="Solea solea",catchCat="LAN",strataDesc=strD)

sol.dbe.boot <- RaiseLgthBoot (dbeOutput, csObject, clObject, B=1000)
sol.dbe.boot <- RaiseAgeBoot (dbeOutput = sol.dbe.boot, csObject = csObject,
type="p")

```

head([sol.dbe.boot@ageStruc\\$estim](#))

time	space	technical	age	value
2006 - 1	all	1	1	0.0000
2006 - 1	all	1	2	0.0000
2006 - 1	all	1	3	0.0000
2006 - 1	all	1	4	450.3181
2006 - 1	all	1	5	6450.1442
2006 - 1	all	1	6	10598.0905

head([sol.dbe.boot@ageNum\\$cv](#))

time	space	technical	age	value
2006 - 1	all	1	1	NaN
2006 - 1	all	1	2	NaN
2006 - 1	all	1	3	NaN
2006 - 1	all	1	4	1.8137208
2006 - 1	all	1	5	0.6464937
2006 - 1	all	1	6	0.6106700

Modelos Evaluación STOCKS PESQUEROS en R

FLR (Fisheries Libraries in R)*

Colección de herramientas para la ciencia pesquera cuantitativa.

Escrita en R y C++

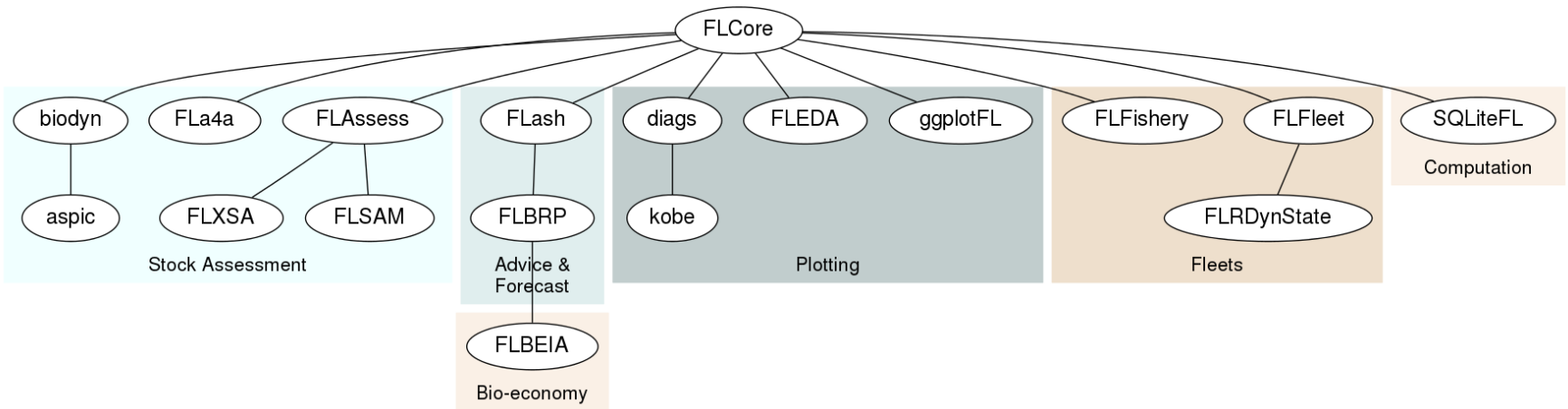
Basada en S4 clases

* <http://www.flr-project.org/>

Modelos

Evaluación STOCKS PESQUEROS

en R



Modelos ya desarrollados:

XSA: modelo estructurado por edad
(C++)

ASPIC: modelo dinámica de biomasa
(FORTRAN)

SAM: state-space model (ADMB)

Modelos nuevos en R:

Fla4a: assessment for all

* <http://www.flr-project.org/>

paquete FLXSA

Modelo más usado para la evaluación de stocks: XSA
(Extended Survivor Analysis)

Datos de entrada: mantienen el formato del programa
previo:

indexms.txt

catonms.txt

canumms.txt

wecams.txt

westms.txt

natms.txt

ogims.txt

fprms.txt

mprms.txt

fleet07.txt

paquete FLXSA

```
mon07 <- read.FLStock("indexms.txt")
```

```
mon07.ind <- read.FLIndices("fleet07.txt")
```

```
mon07.ind.sel <- mon07.ind[c(3,4)]
```

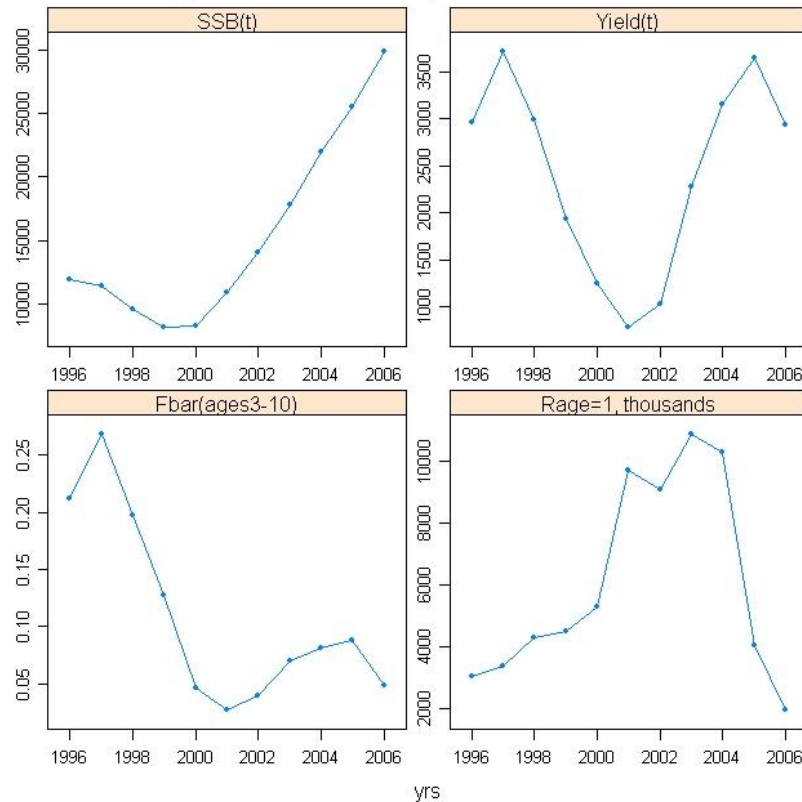
```
mon07.xsa.ctl <- FLXSA.control(maxit=30,fse = 0.5, rage = -1, qage = 10, shk.n =  
FALSE, shk.f = TRUE, shk.yrs = 5, shk.ages = 5, window = 100, tsrange = 100, tspower  
= 0, vpa = FALSE)
```

```
mon07.xsa <- FLXSA(mon07, mon07.ind.sel, mon07.xsa.ctl, "Assessment FLR L.  
piscatorius")
```

Resultados de evaluación de stocks

	Yield(t)	Fbar(ages3-10)	Rage=1, thousands	SSB(t)
1996	2955	0.212	3049	11916
1997	3715	0.269	3383	11373
1998	2981	0.197	4289	9538
1999	1932	0.128	4520	8130
2000	1259	0.046	5293	8232
2001	788	0.027	9702	10889
2002	1032	0.040	9069	14041
2003	2278	0.070	10860	17795
2004	3157	0.081	10258	21963
2005	3644	0.088	4038	25522
2006	2932	0.048	1973	29943

Summary plot for Southern *L. piscatorius* assessment



ichthyoanalysis*

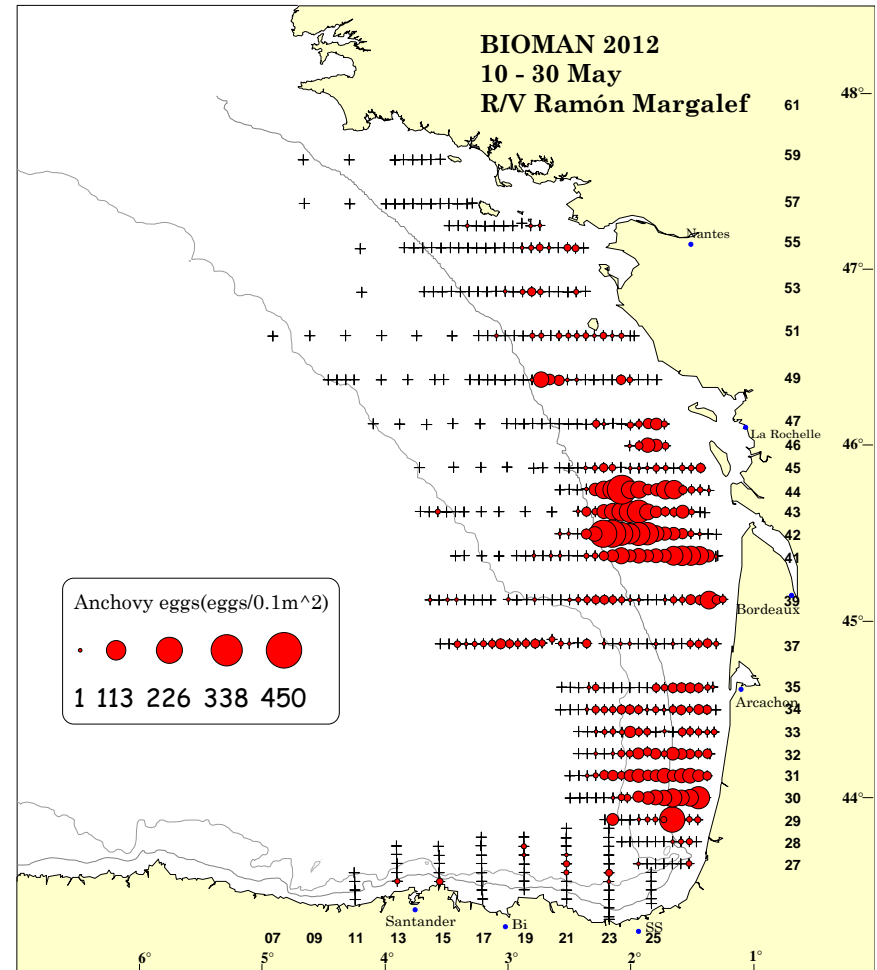
Paquetes:

geofun: estimación de área representada por cada estación de muestreo

egg: modelos multinomiales para estimar la producción total de huevos

eggsplore: glm binomiales

shachar: caracterización áreas de puesta T^a y salinidad



Abundancia media
(huevos estado 1/ m²)

paquete egg:



Modelo de desarrollo

$$p_{i,t} = f(\text{Edad, Temperatura})$$

Producción diaria de huevos
(huevos/m²/día)

fit.inc.model (data, formula = ~Age * Stage +
Temp * Stage + Age * Temp, link = "probit")



Elevado al
Área y Periodo
de Puesta

Producción Total
Anual de Huevos

Parameter	IPIMAR		IEO		AZTI*
	South	W Portugal	NW and N Spain	France (to 44.9°N)	(43.4° 47.6°)N (-4.2° -1.5°)W
P0 (eggs/m ² /day)	584.06 (29)	242.26 (23)	134.9 (15)	160.6 (21)	176.6 (9)
Z (hour ⁻¹)	0.034 (46)	0.029 (22)	0.016 (21)	0.019 (23)	0.013 (19)
P0 tot (eggs/day) (x10 ¹²)	5.25 (29)	4.89 (23)	3.66 (15)	1.28 (21)	5.97 (9)
Survey area (Km ²)	18670	31895	48704	9953	69150
Positive area (Km ²)	8977	20175	27149	7964	33807

CONCLUSIONES

- Uso de R:
- + efectividad
- tiempo: scripts
- + colaboración

