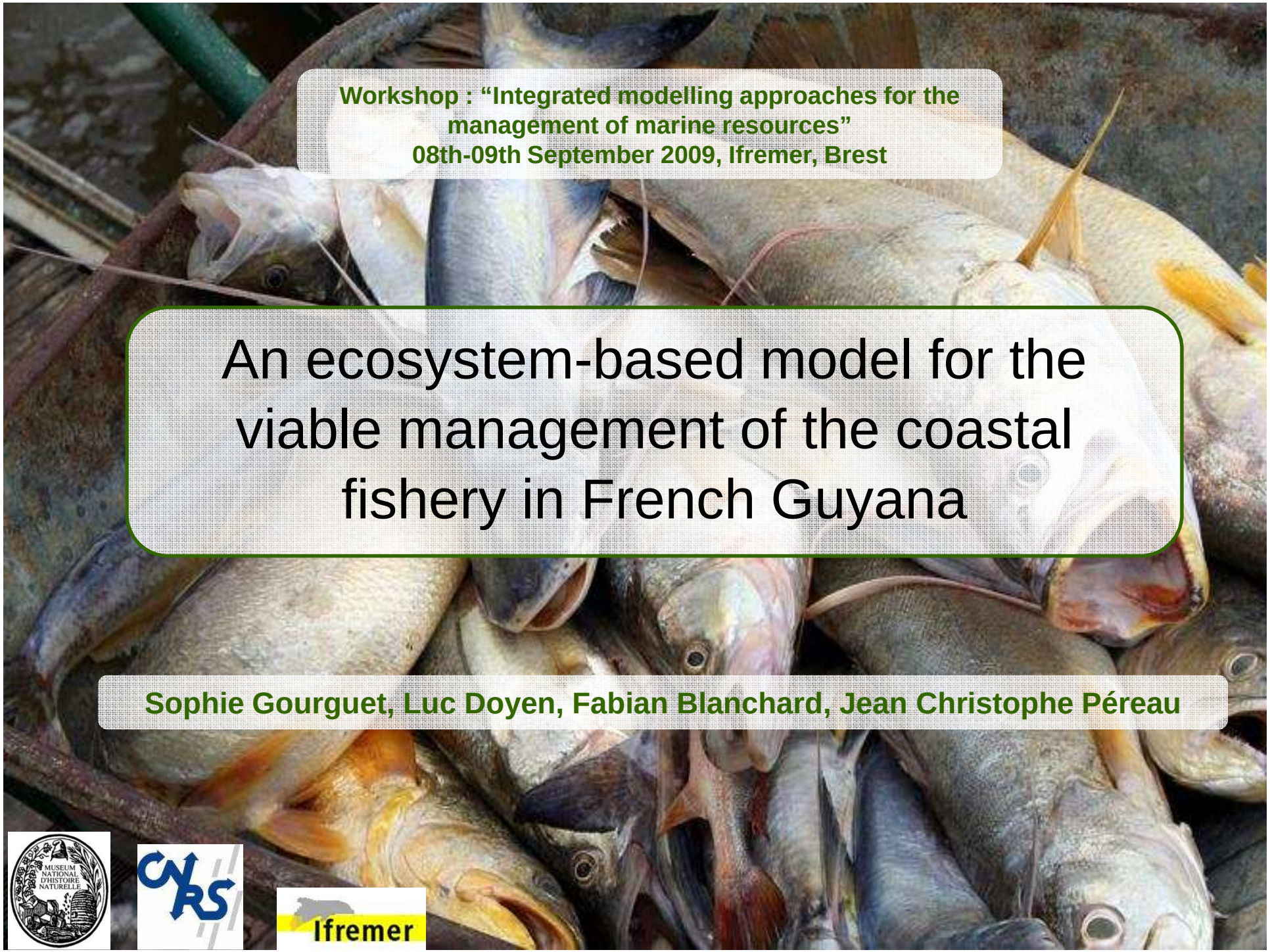
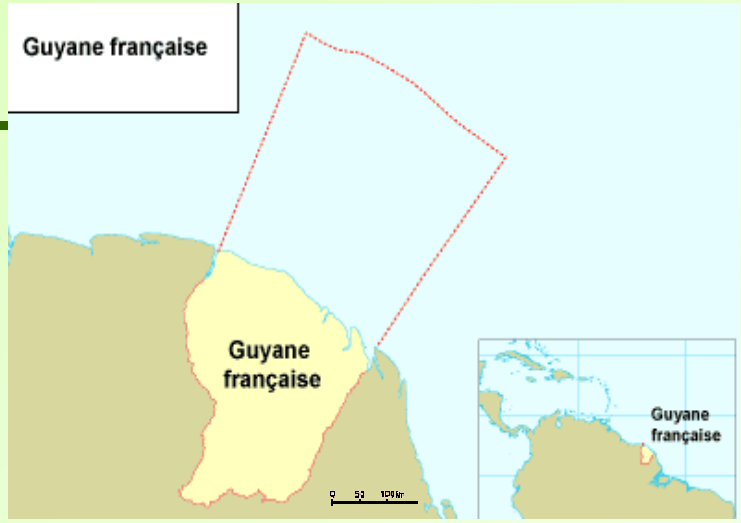


Workshop : "Integrated modelling approaches for the management of marine resources"
08th-09th September 2009, Ifremer, Brest

An ecosystem-based model for the viable management of the coastal fishery in French Guyana

Sophie Gourguet, Luc Doyen, Fabian Blanchard, Jean Christophe Péreau

« Case study »

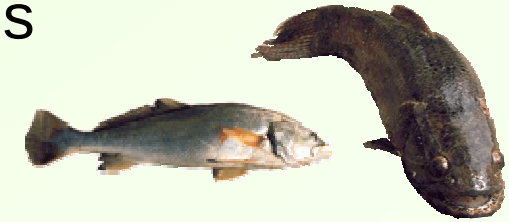


- Coastal fishery in French Guyana
  - Very informal area
  - Licences of exploitation

- 4 types of boat (fleets), small-scale fishery
  - « Pirogues » (P)
  - « Canots créoles » (CC)
  - « Canots créoles améliorés » (CCA)
  - « Tapouilles » (T)

- Biodiversity : around 30 exploited species

13 selected for the model



Issues

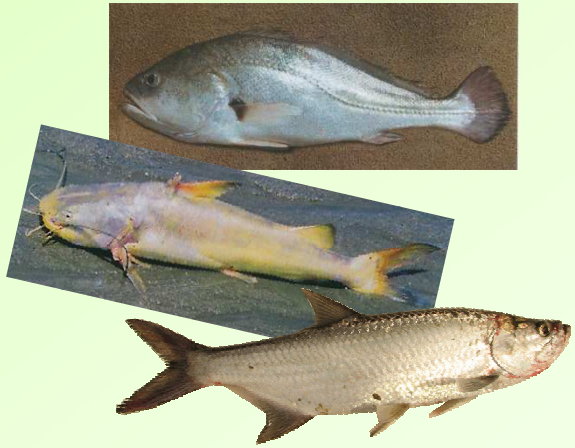
- Increase of the anthropogenic pressure

Which ecological and economic viability of the system ?

to preserve the biodiversity

to guarantee economic incomes

Ecosystem-based model



- Multi species and multi fleets model
- Discrete time (monthly)
- Dynamics of the exploited stocks which integrate :
  - Lotka-Volterra trophic interactions
  - Technical interactions through fishing mortalities (by the 4 fleets)

Inputs of the model

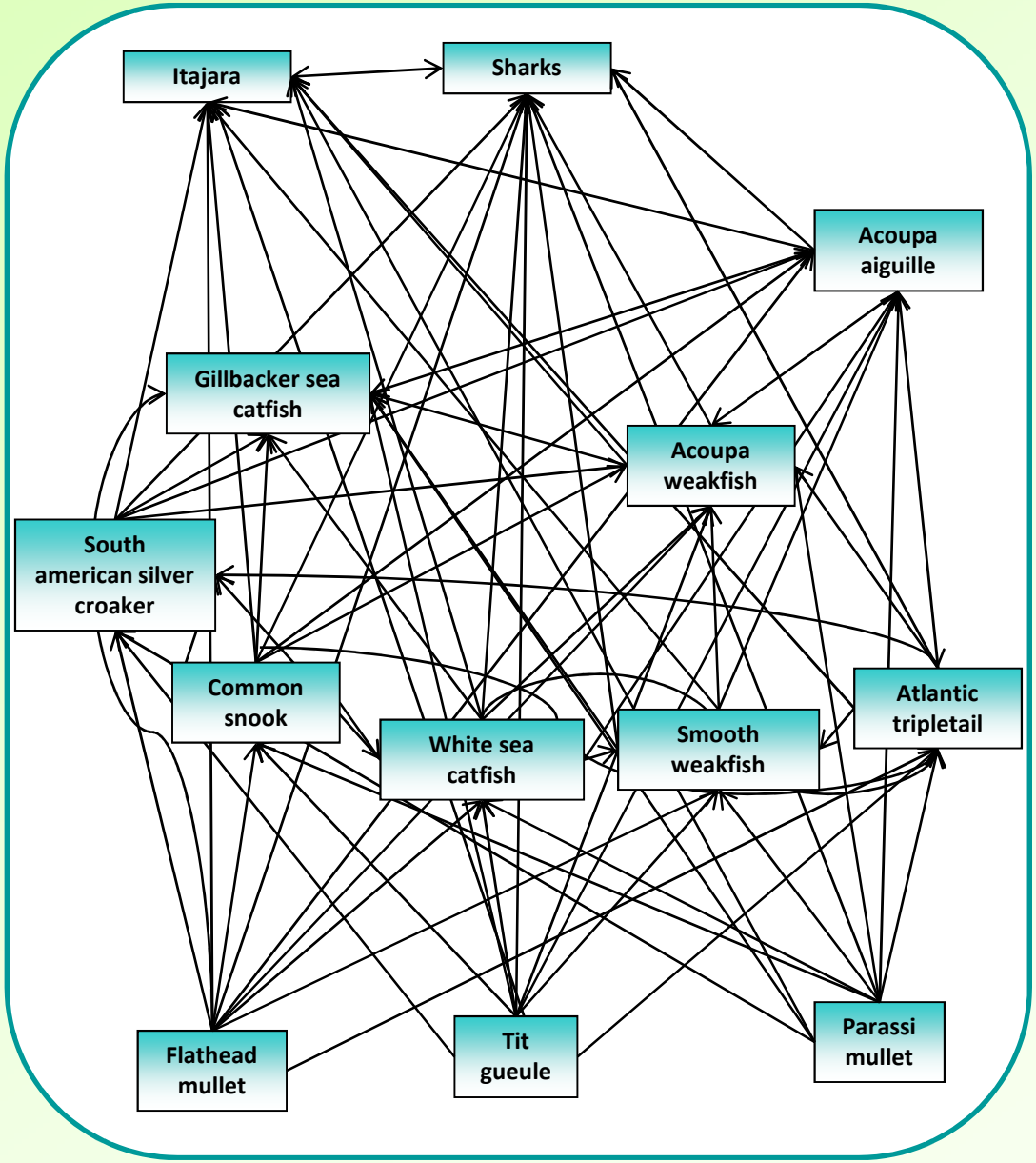
Data

✓Ifremer (2006-2008)

- Landings
- Fishing efforts

✓Literature
(Léopold, 2004 ; fishbase)

- Intrinsic rate of increase
- Qualitative trophic interactions



Calibration of the model

Algorithms of **optimization** to identify missing parameters

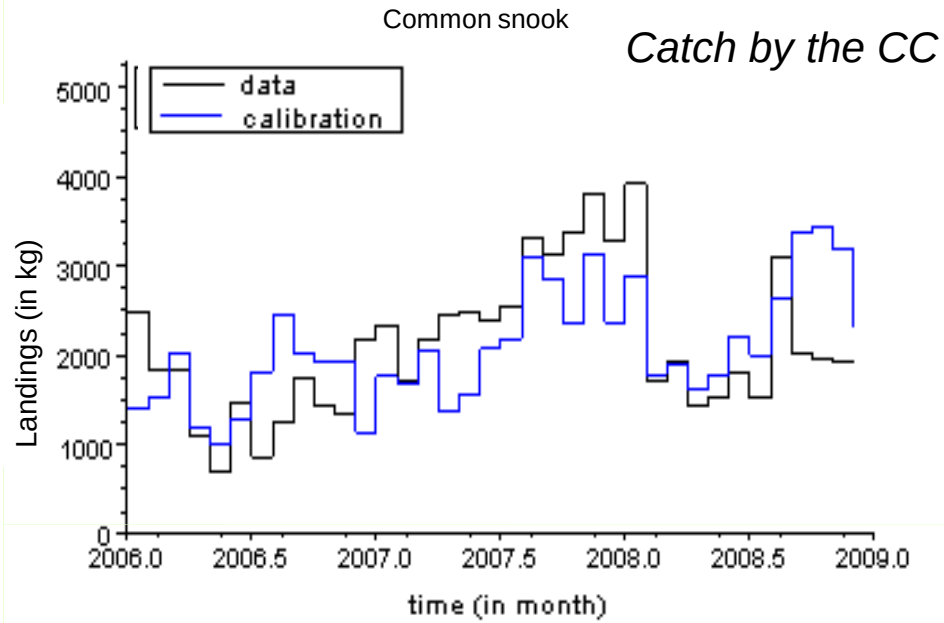
Initial stocks (december 2005)

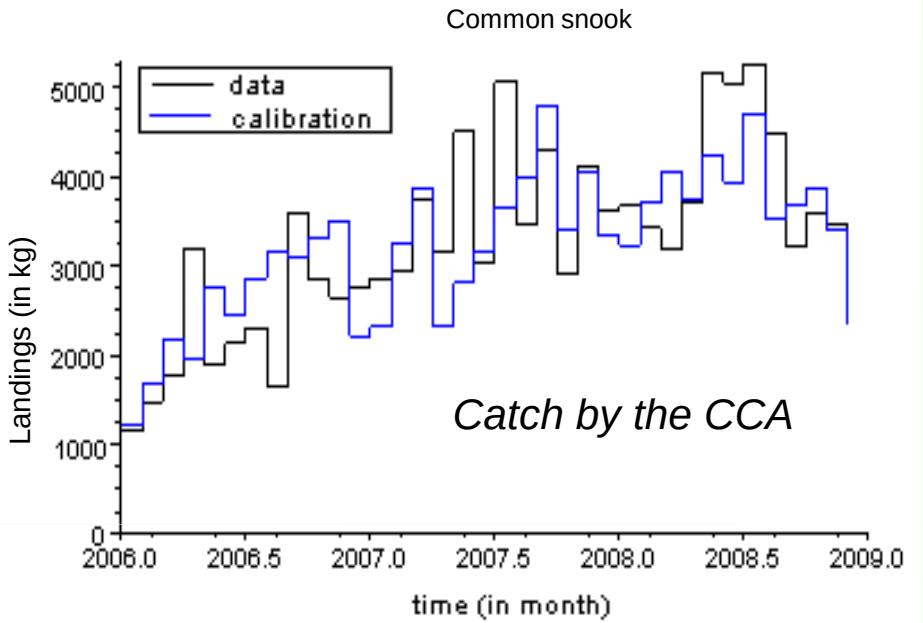
Catchabilities

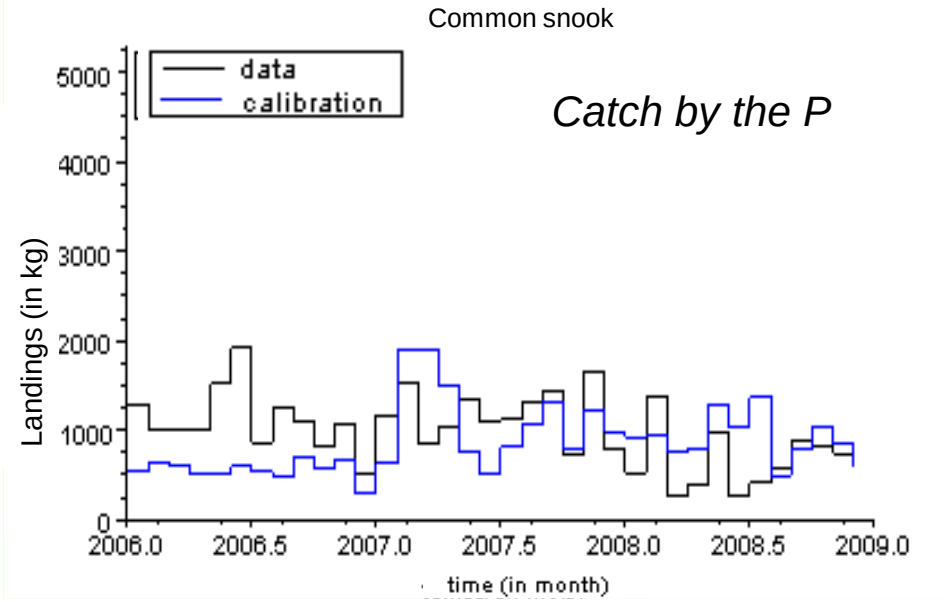
Trophic intensities

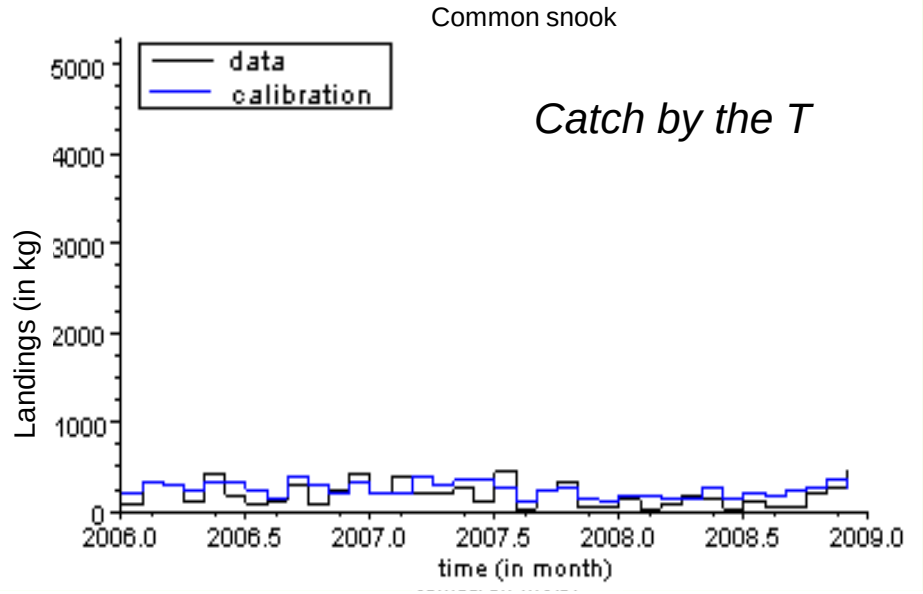
Calibration of the model

Calibration of the model









Output of the model

Data

✓Ifremer (2006-2008)

- Landings
- Fishing efforts

✓Bibliographie
(Léopold, 2004 ; fishbase)

- Intrinsic rate of increase
- Qualitative trophic interactions

Ecosystem-based model

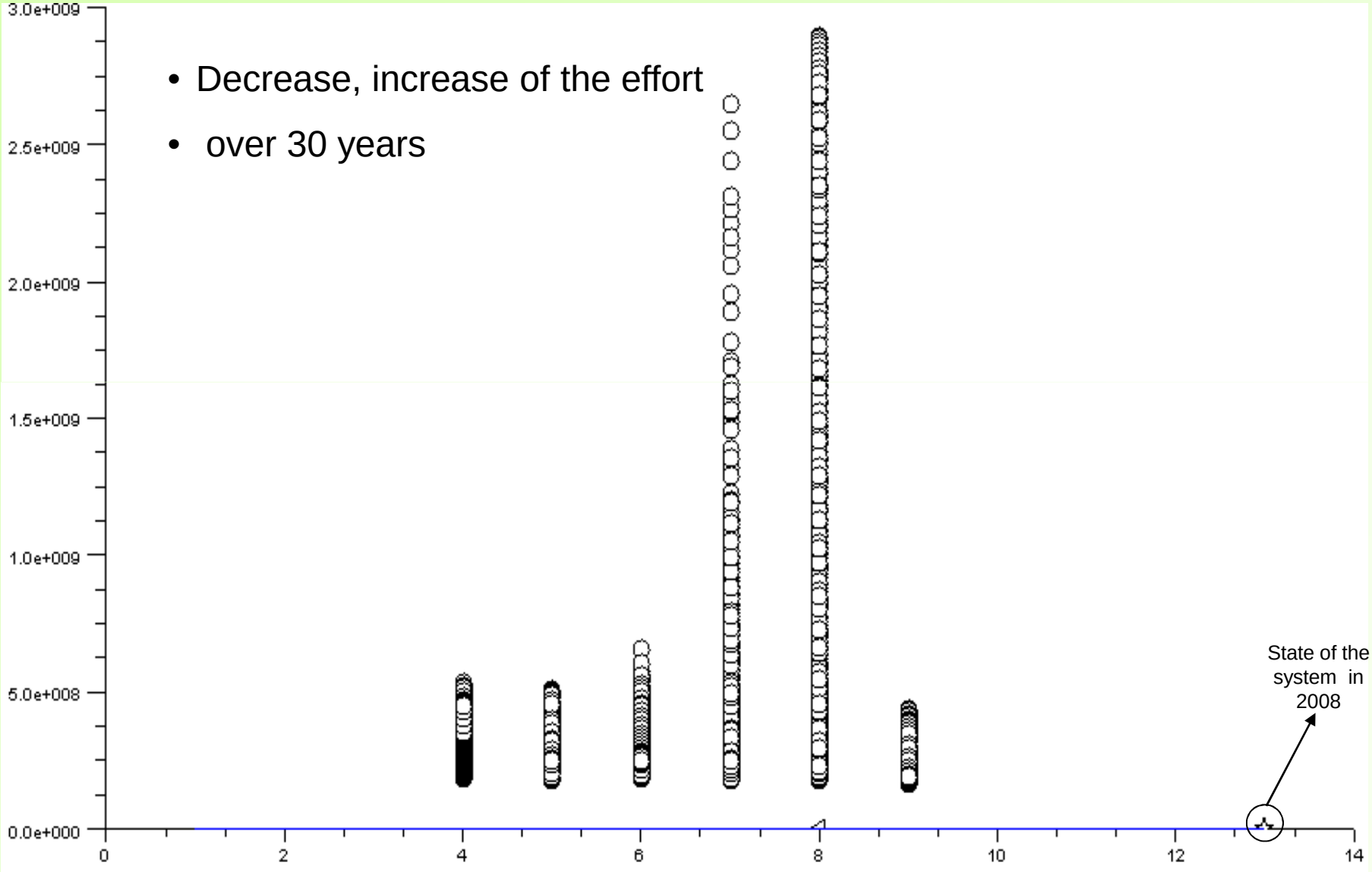
Calibration of the model

Ecological indicator
(specific richness)

Economic indicator
(annual total income)

Fishing scenarios

Economic

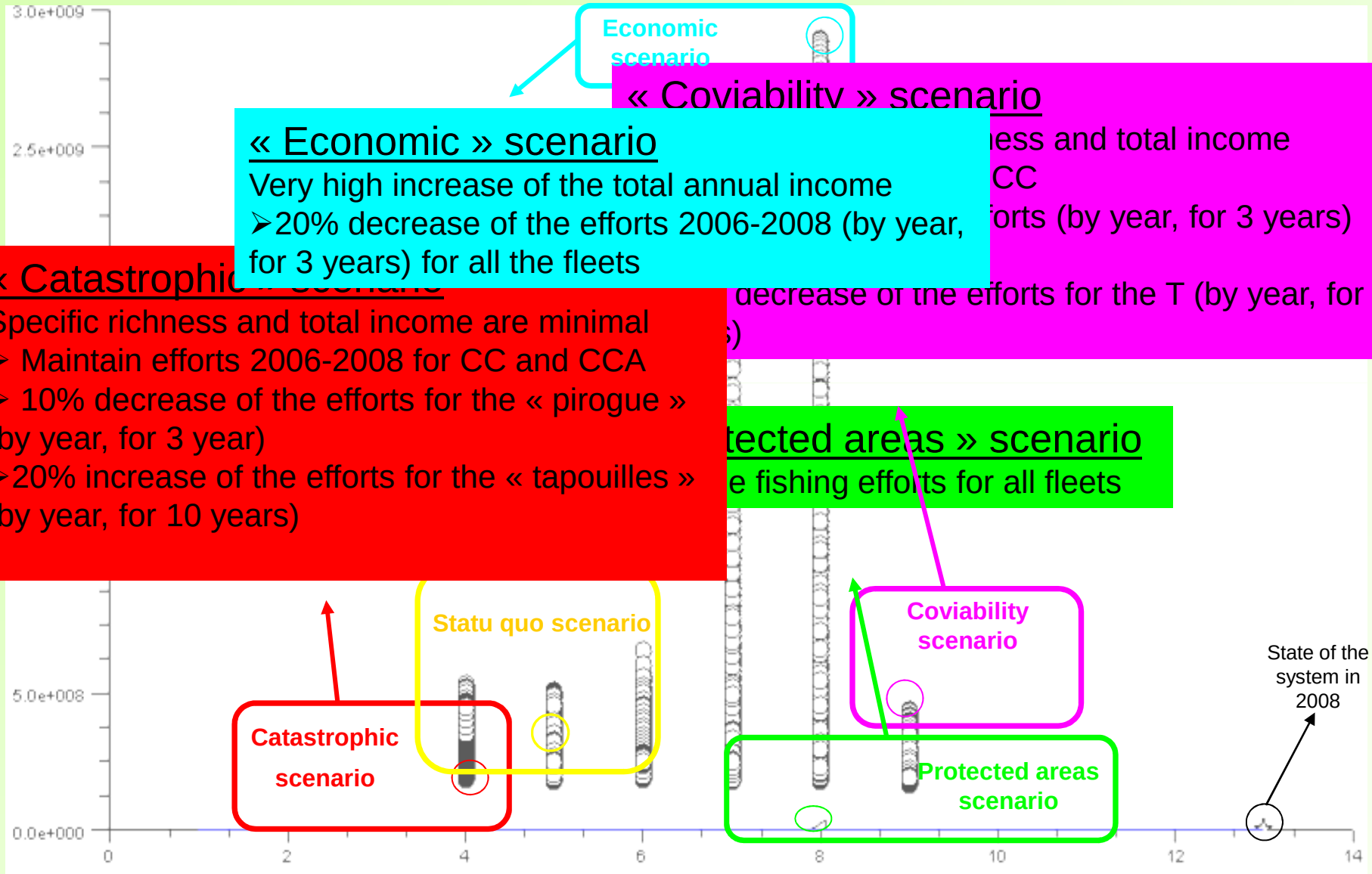


- Decrease, increase of the effort
- over 30 years

Ecological

Fishing scenarios

Economic



« Economic » scenario

Very high increase of the total annual income

➢20% decrease of the efforts 2006-2008 (by year, for 3 years) for all the fleets

« Coviability » scenario

ness and total income

CC

forts (by year, for 3 years)

decrease of the efforts for the T (by year, for

s)

« Catastrophic » scenario

Specific richness and total income are minimal

➢ Maintain efforts 2006-2008 for CC and CCA

➢ 10% decrease of the efforts for the « pirogue » (by year, for 3 year)

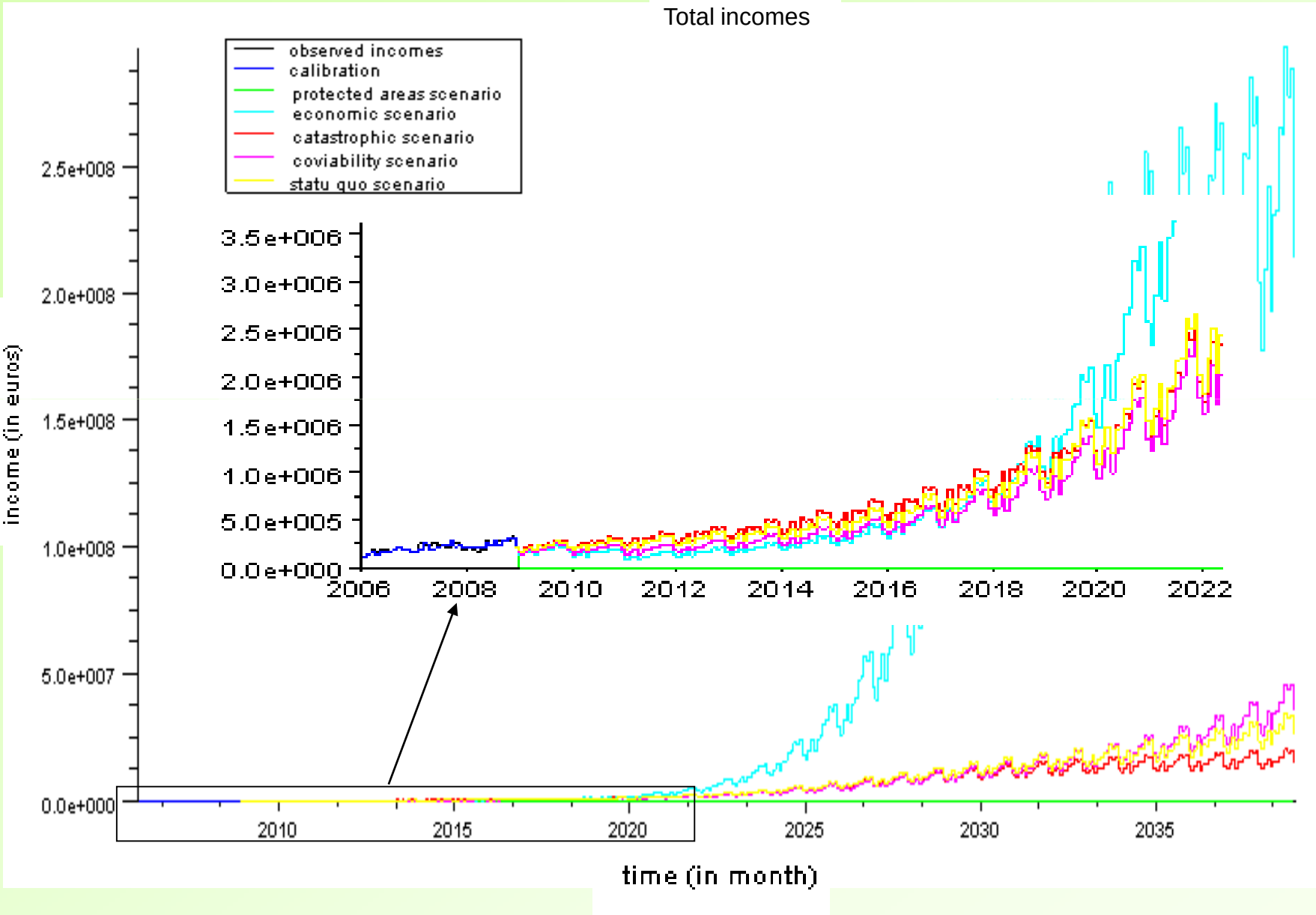
➢20% increase of the efforts for the « tapouilles » (by year, for 10 years)

tected areas » scenario

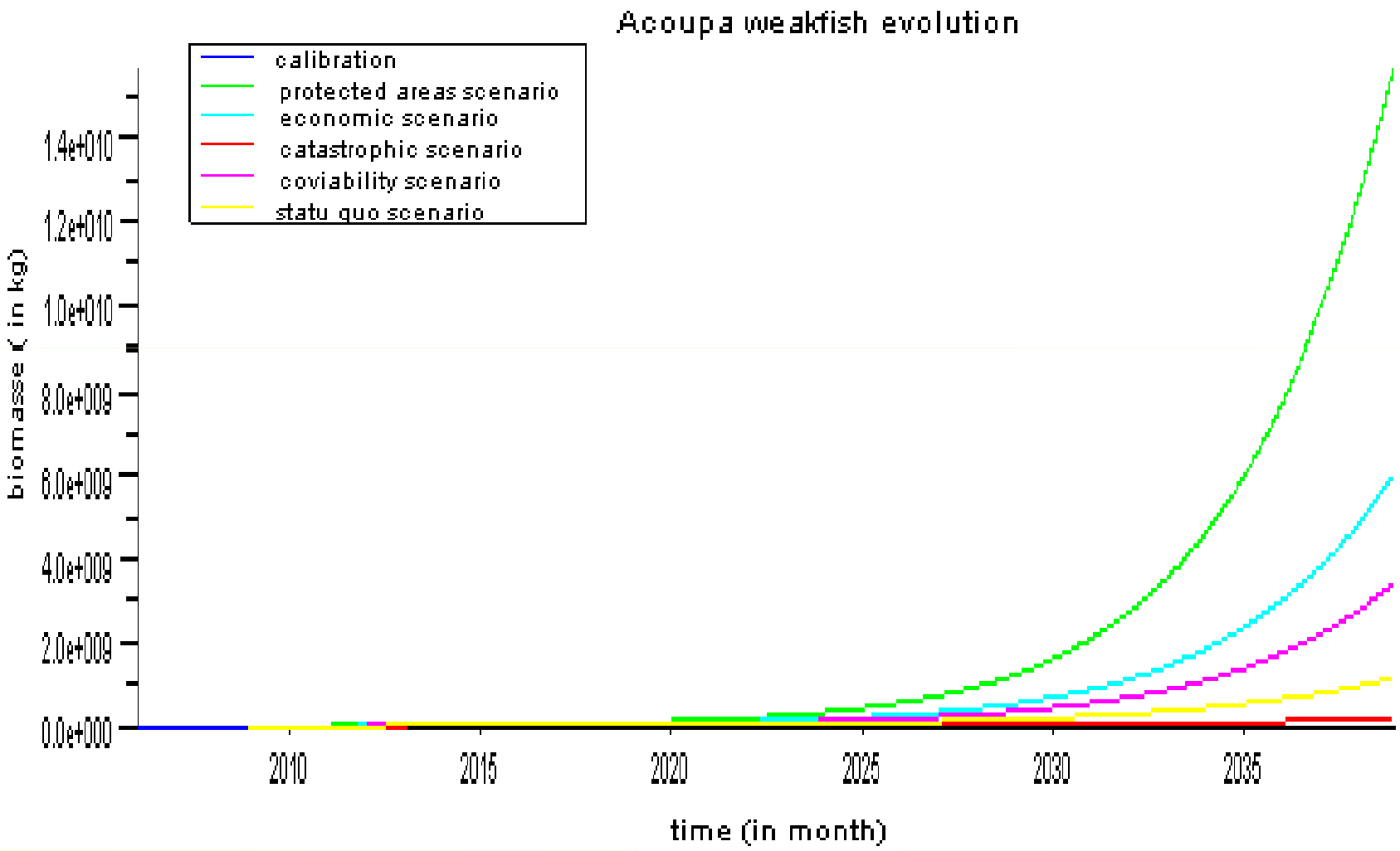
e fishing efforts for all fleets

Ecological

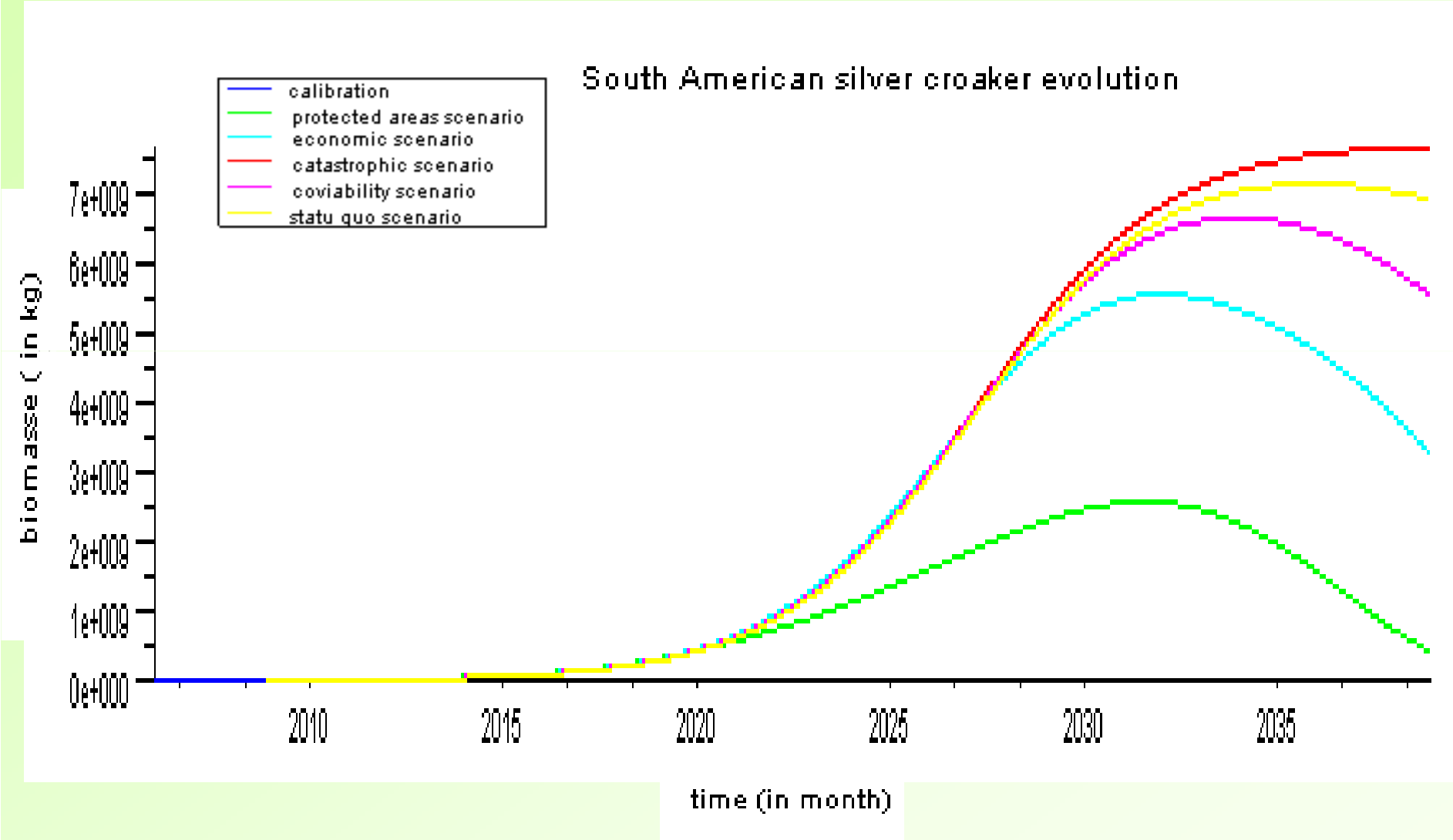
Scenarios & economic indicator



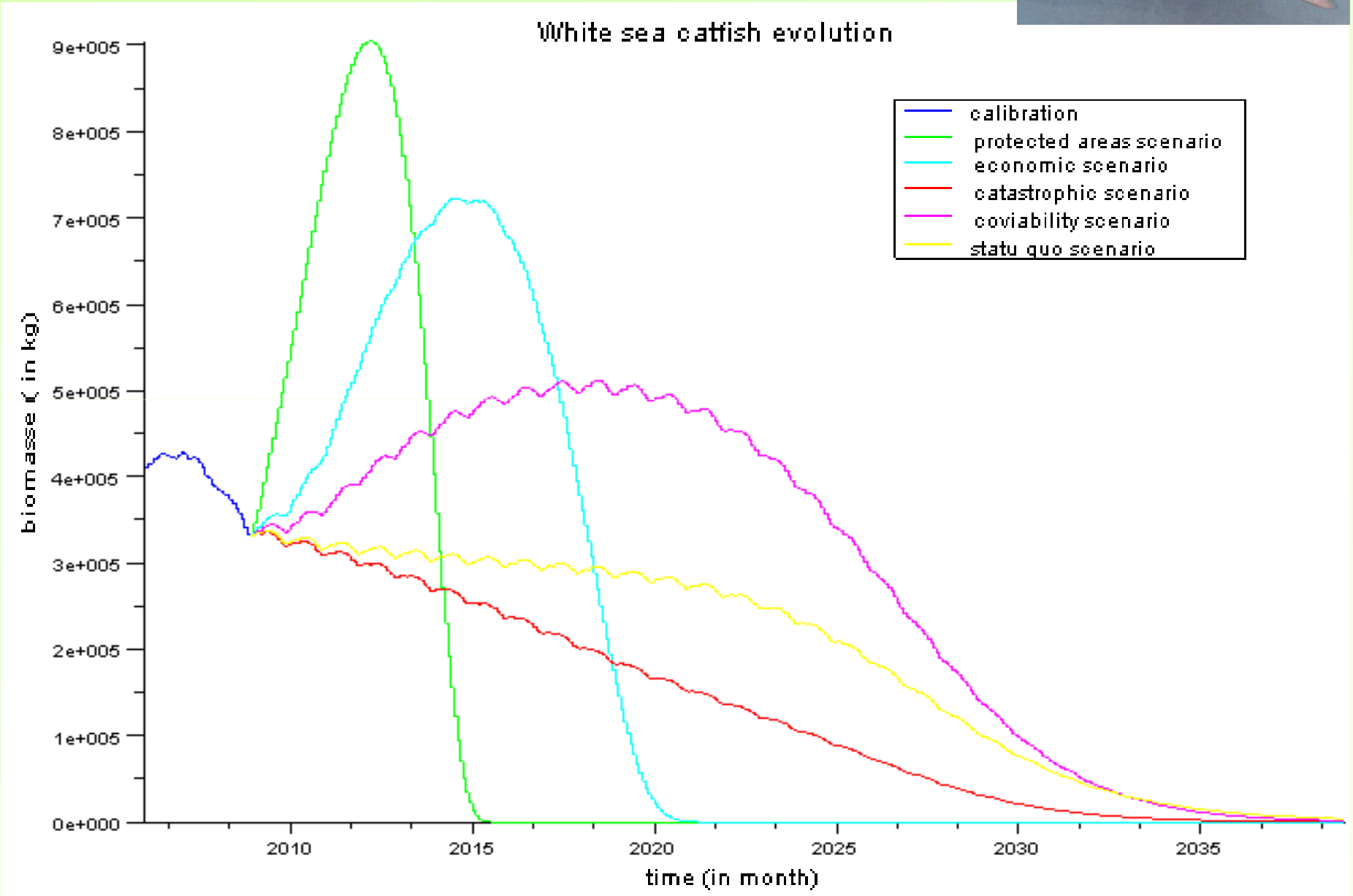
stock – Acoupa weakfish



stock – South American silver croaker



stock – White sea catfish



Perspectives

- To integrate the costs, investment dynamics
- To integrate : uncertainties, other species, spatial dimensions, etc.…
- To refine the calibration methods
- To expand the coviability and multicriteria methods

Research projects (GECO, ANR ADHOC, …)

- General implementation of the model in other Ecosytems

Thank you for your attention

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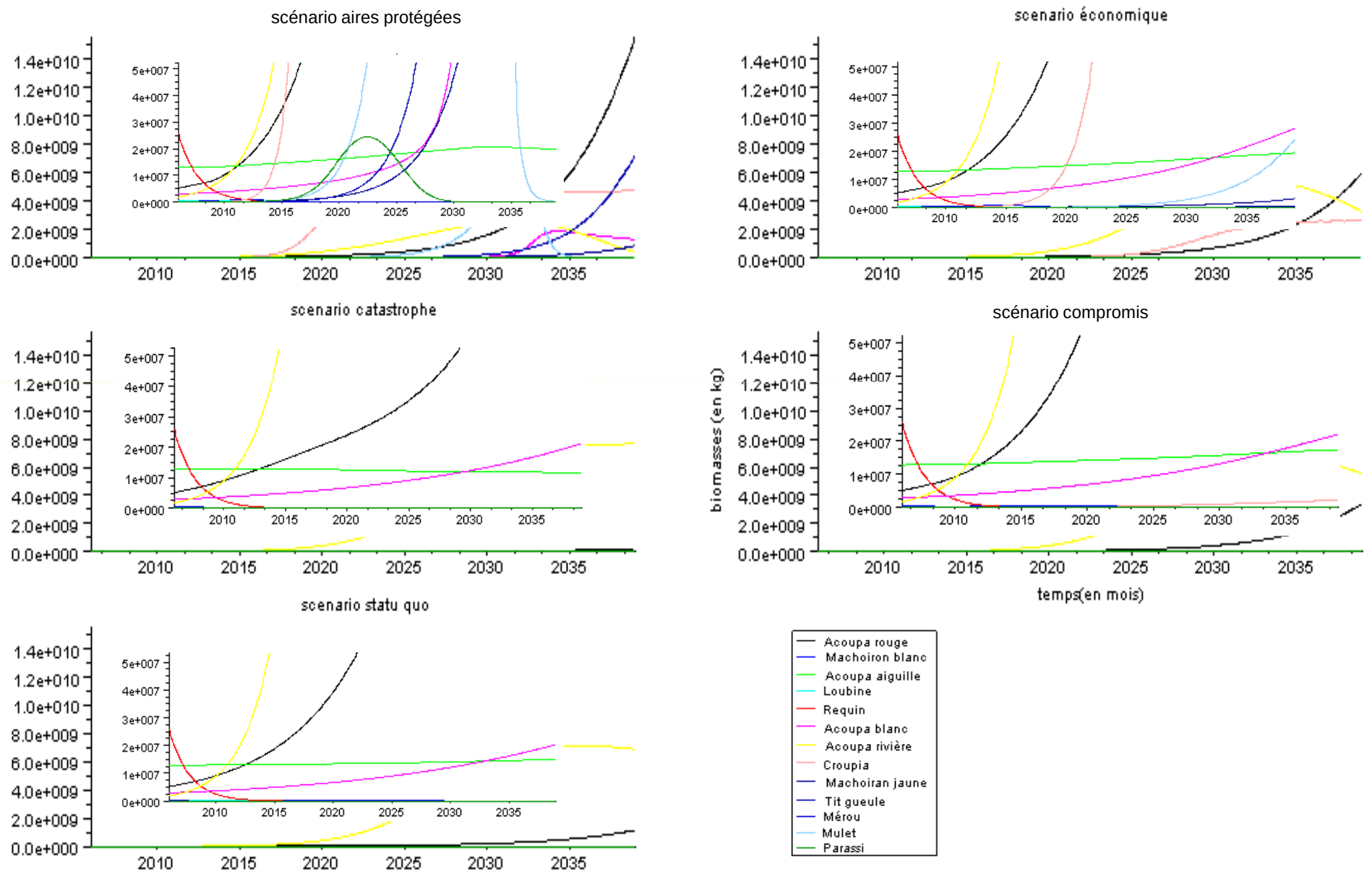
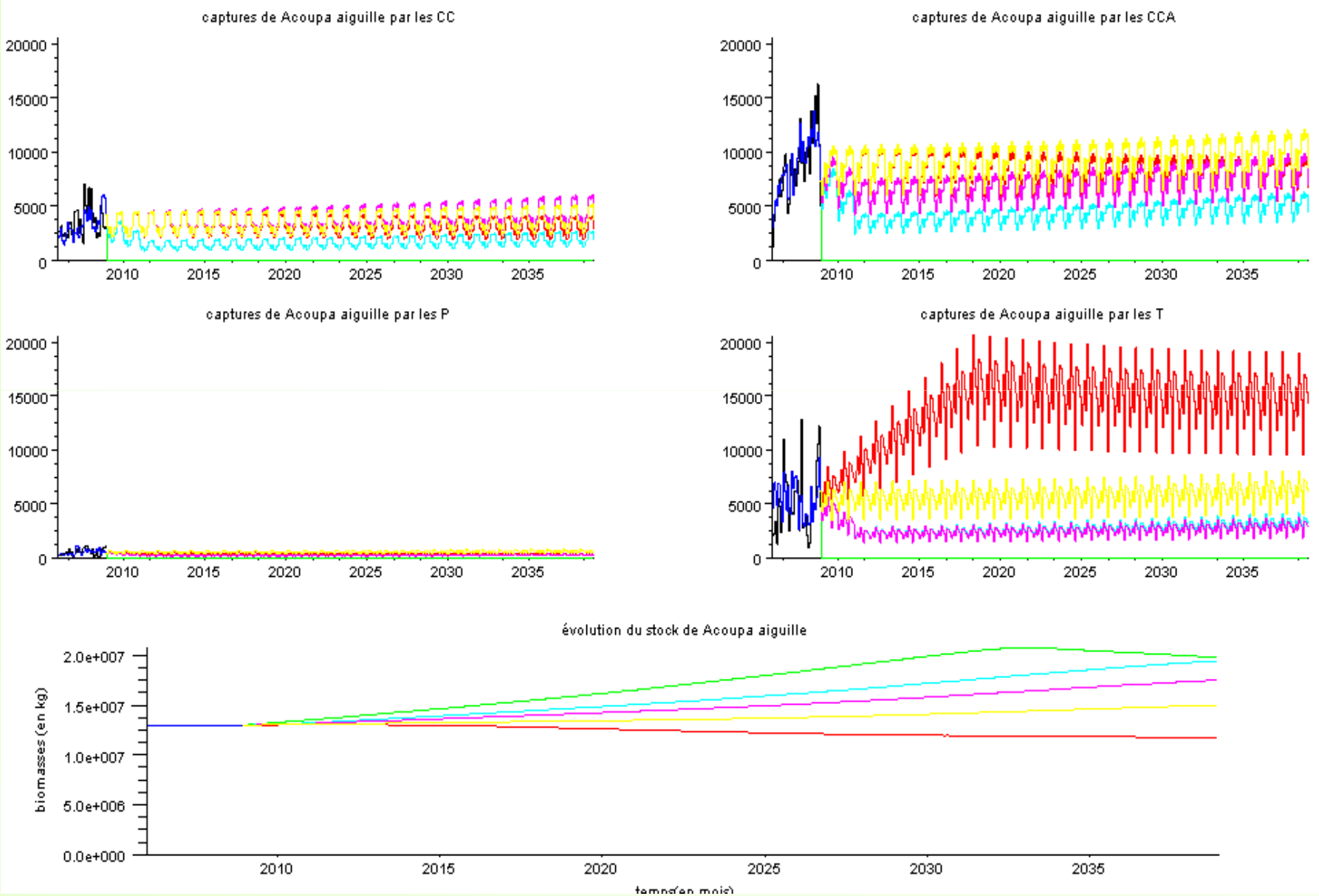
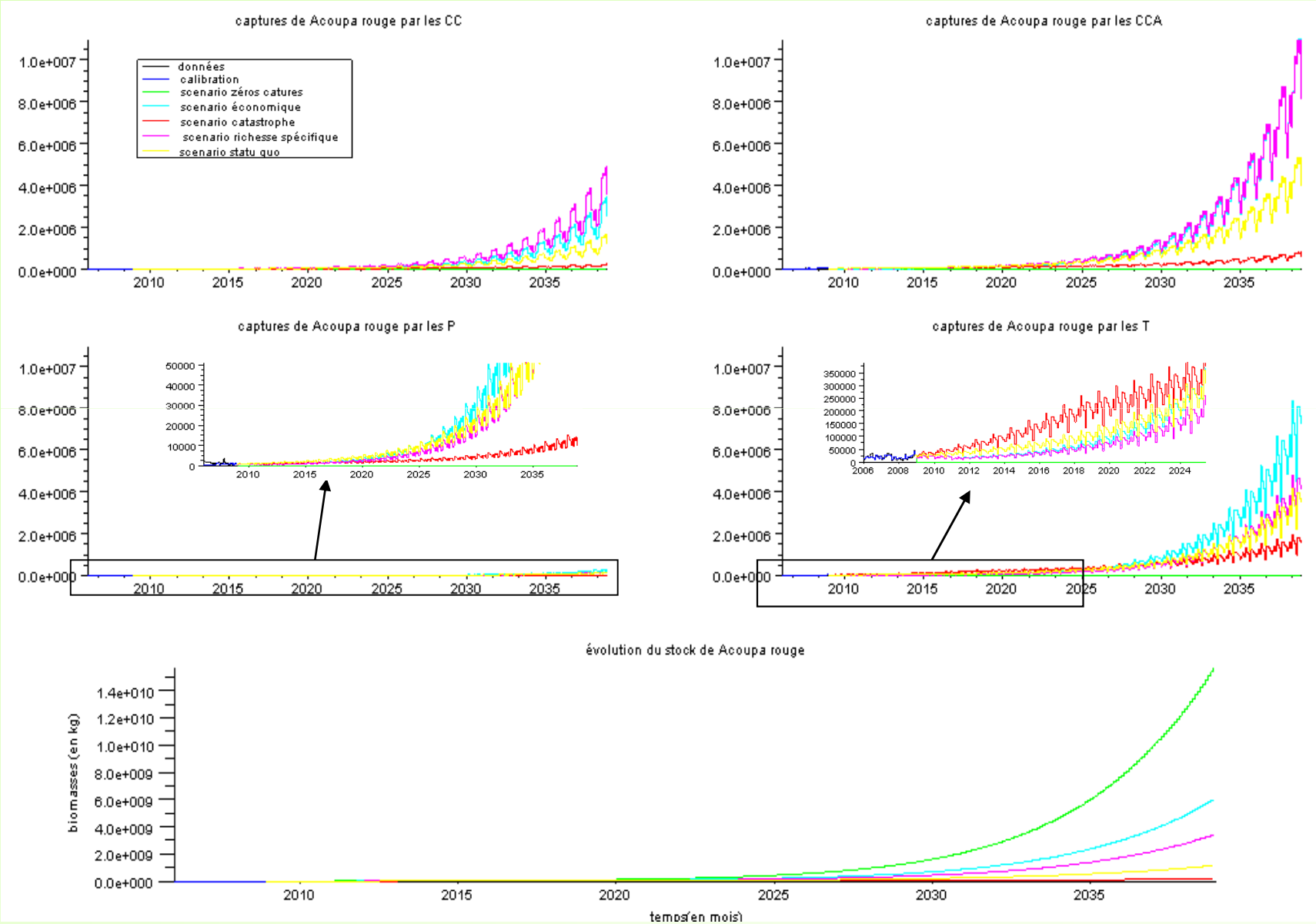
Scénarios & évolution des stocks



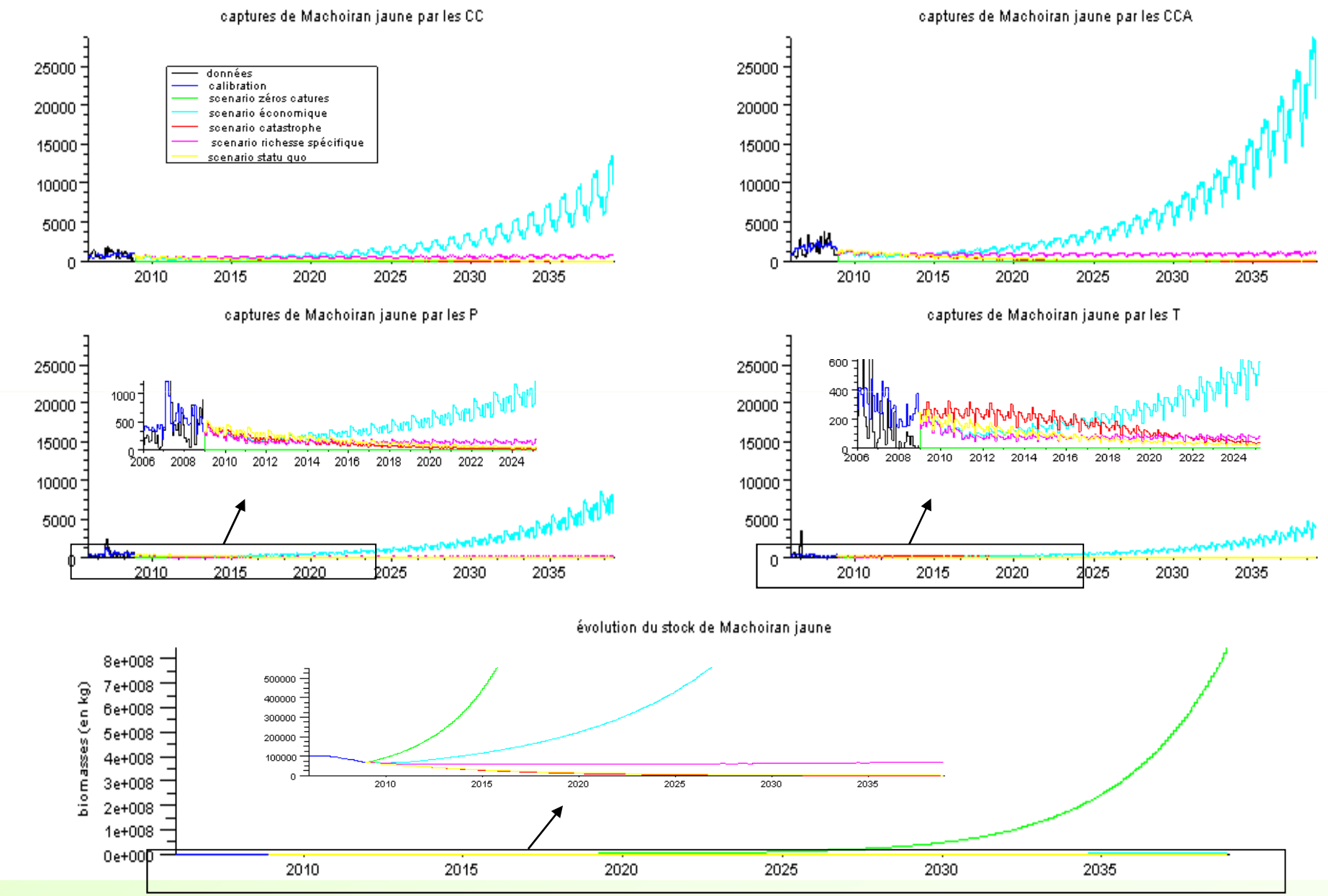
Les autres espèces



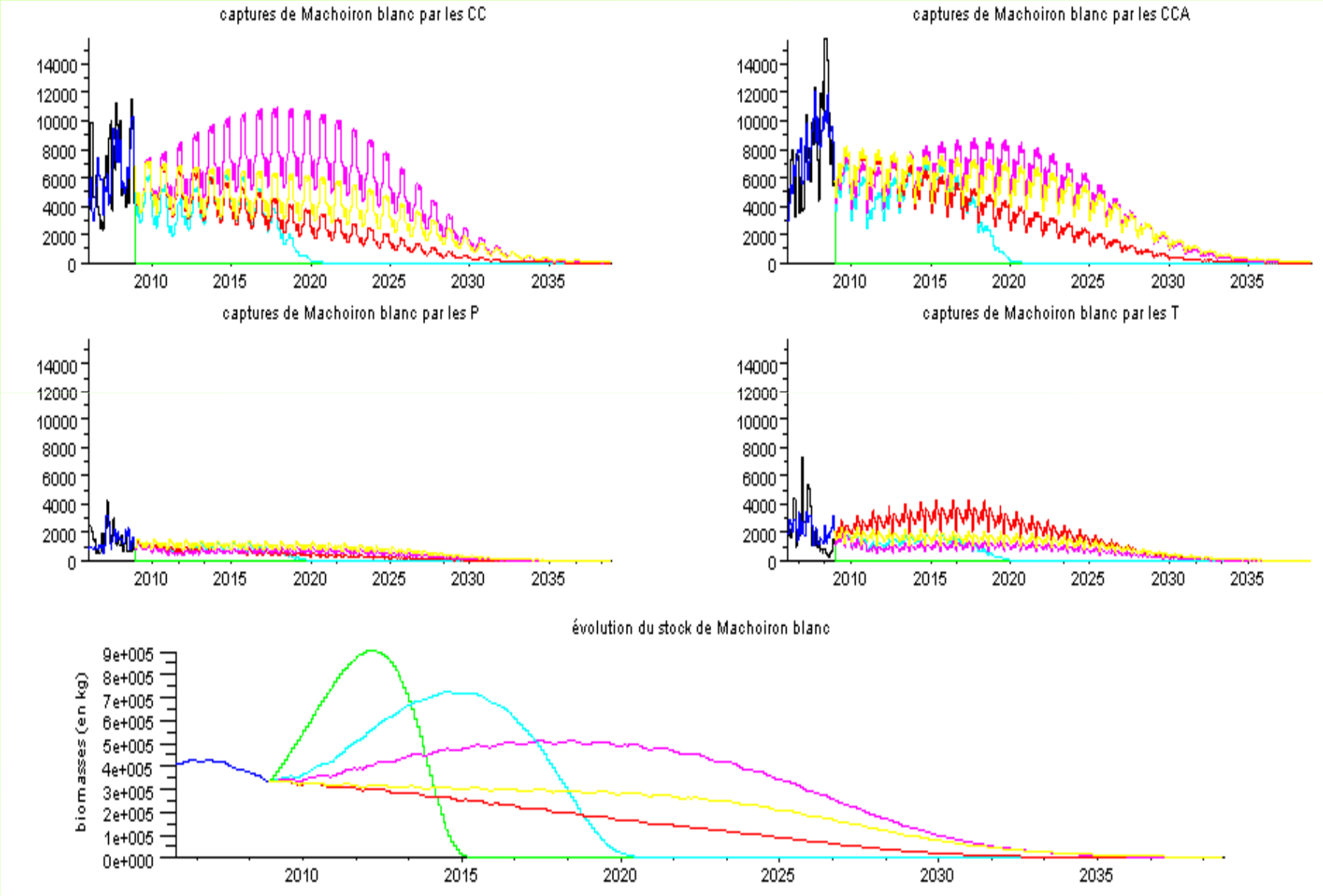
Captures et stocks – acoupa rouge



Captures et stocks – machoiran jaune



Machoiran blanc



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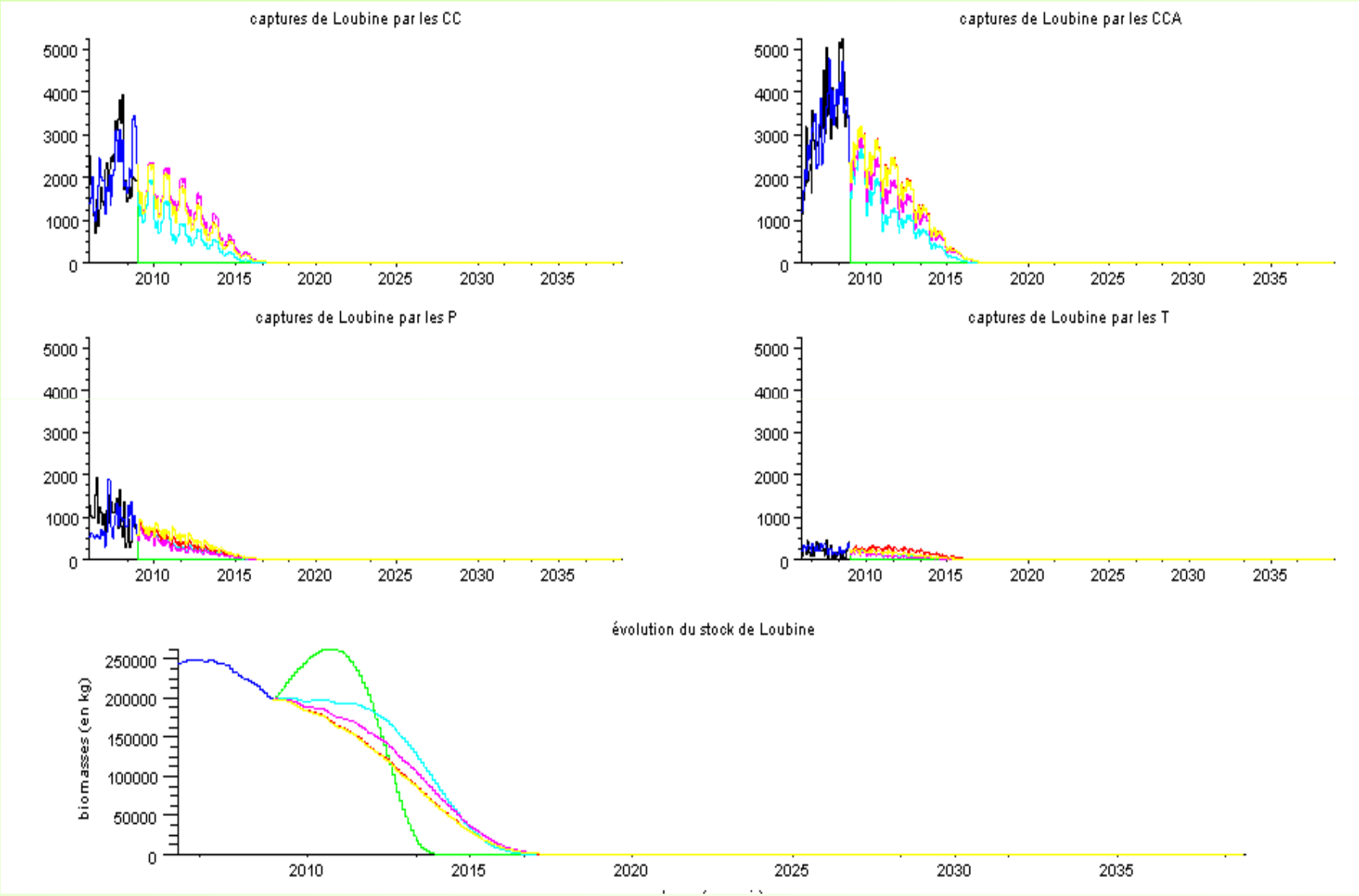
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captures de Loubine par les P
captures de Loubine par les T
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4000
5000
50000
100000
150000
200000
250000
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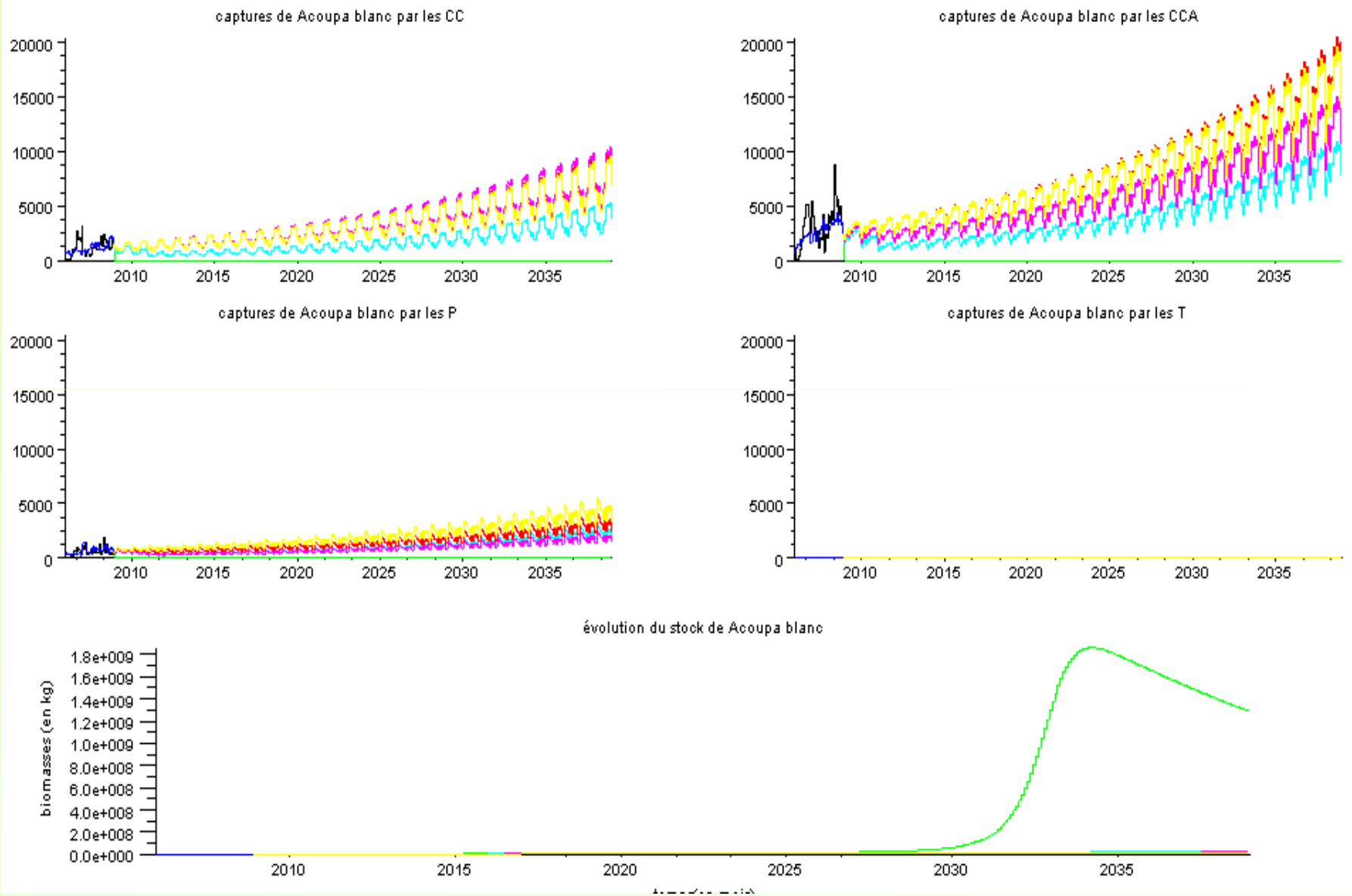
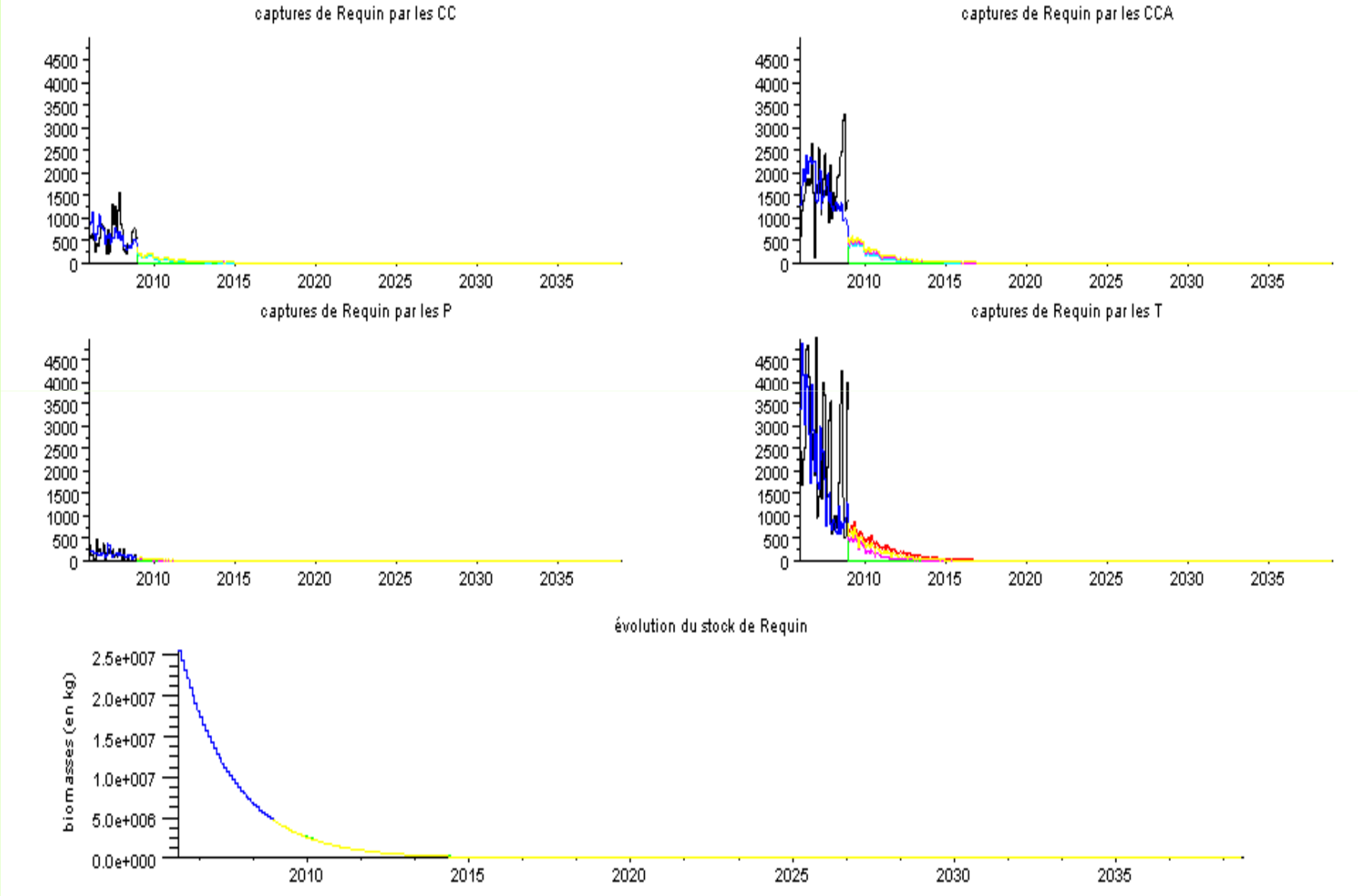
2015
2020
2025
2030
2035

Acoupa blanc



Requin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captures de Requin par les T
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1.5e+007
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5.0e+006
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3000
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500
0
2010
2015
2020
2025
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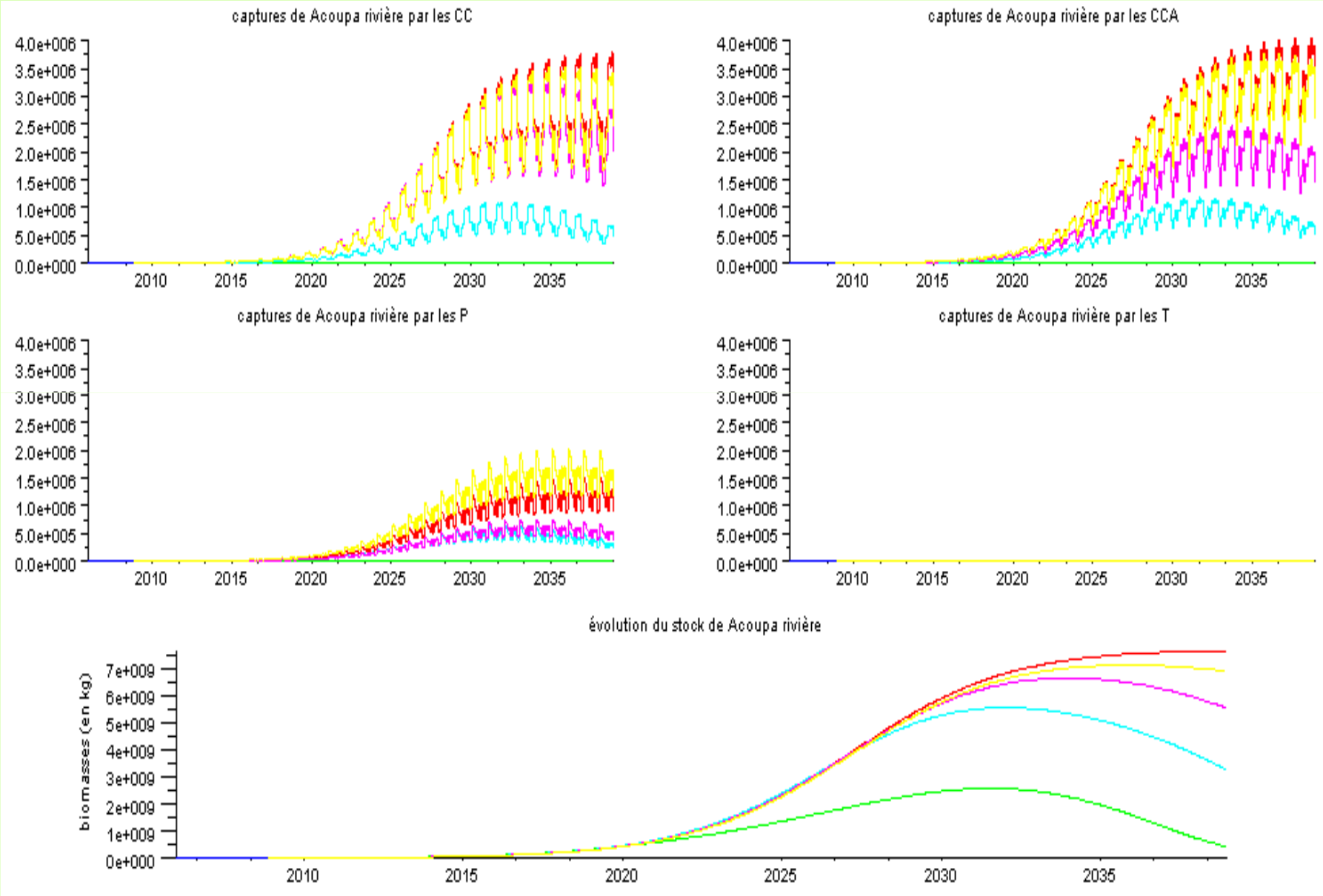
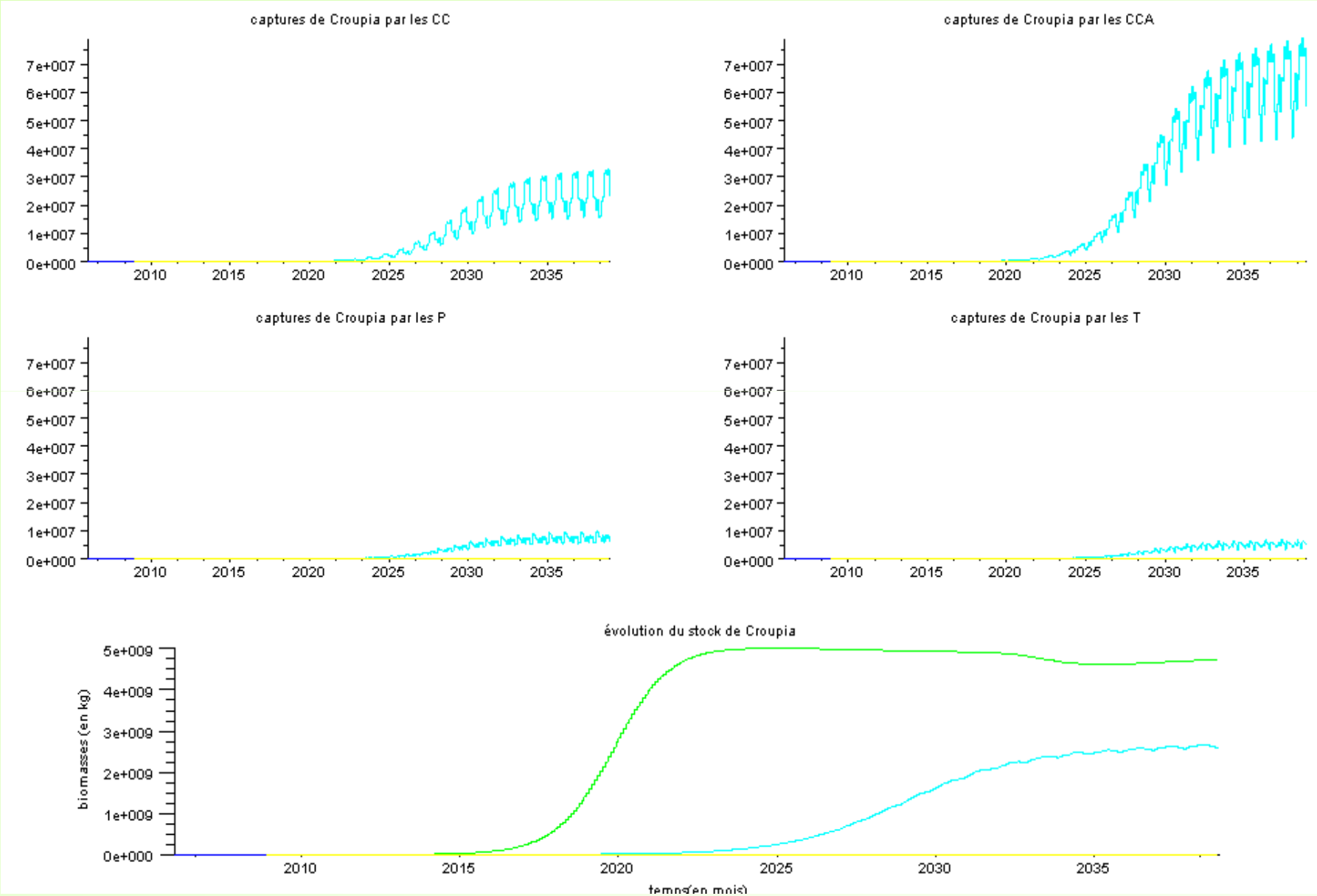
Acoupa rivière



Croupia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2015
2020
2025
2030
2035
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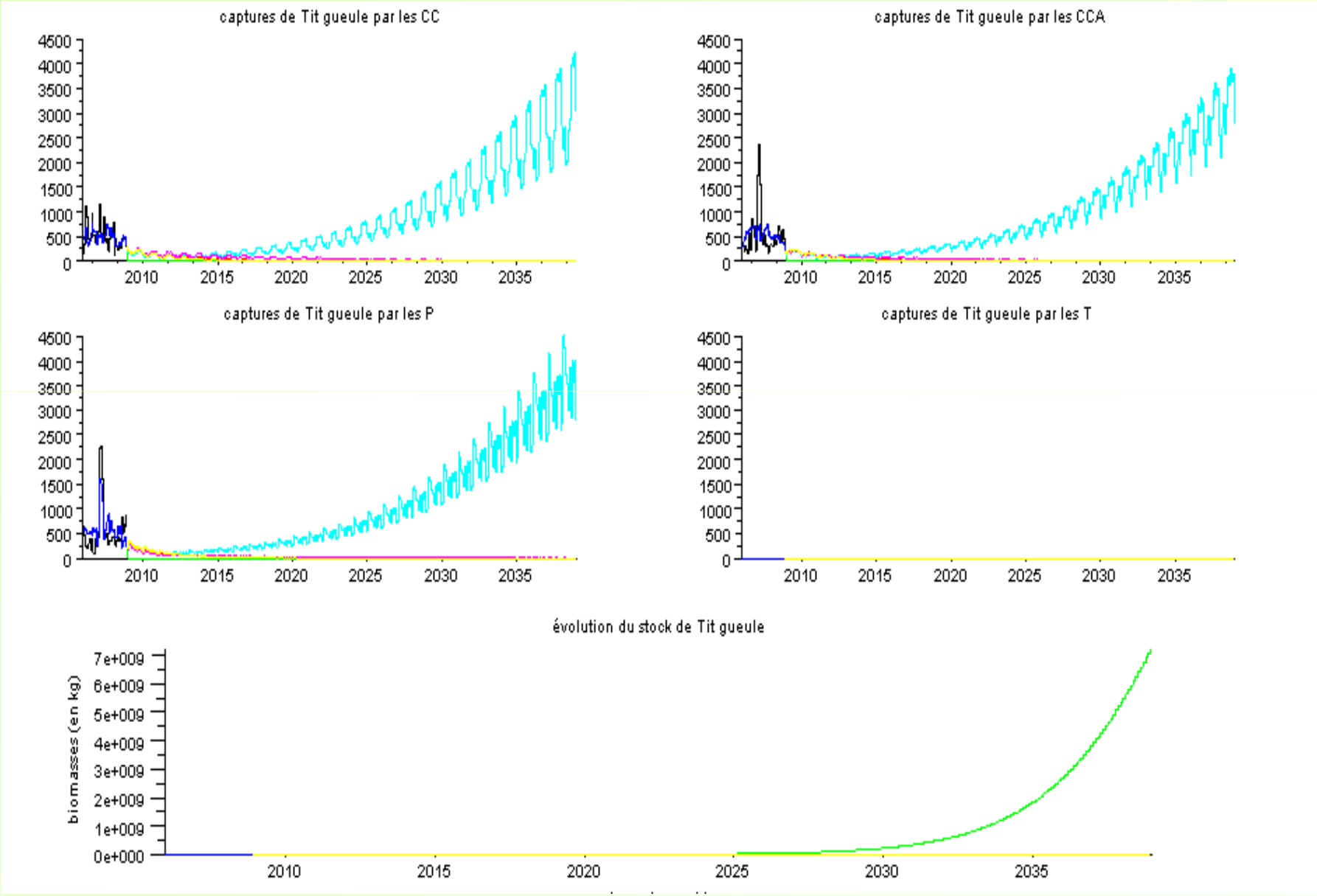
temps(en mois)

Tit gueule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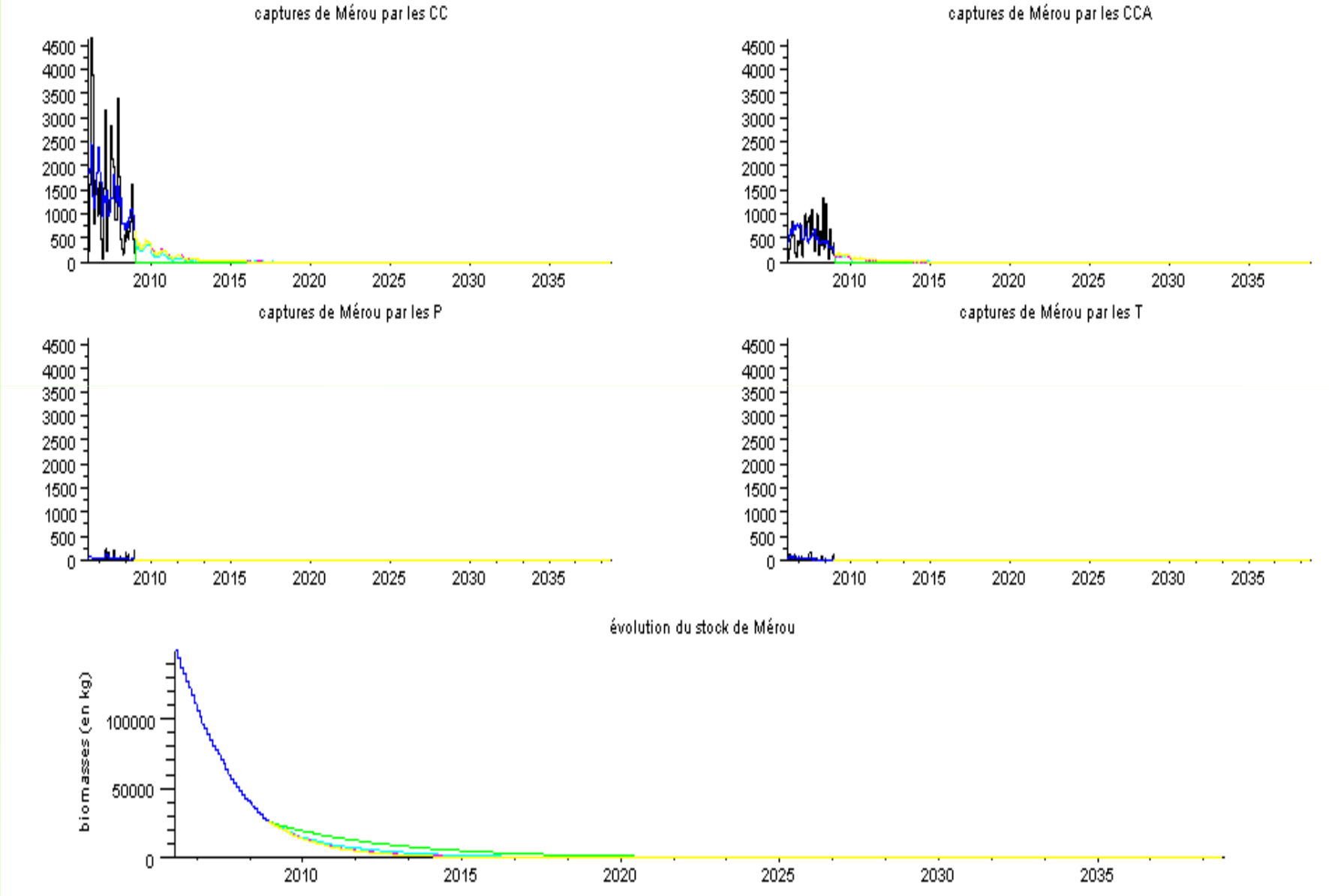
Mérou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2010
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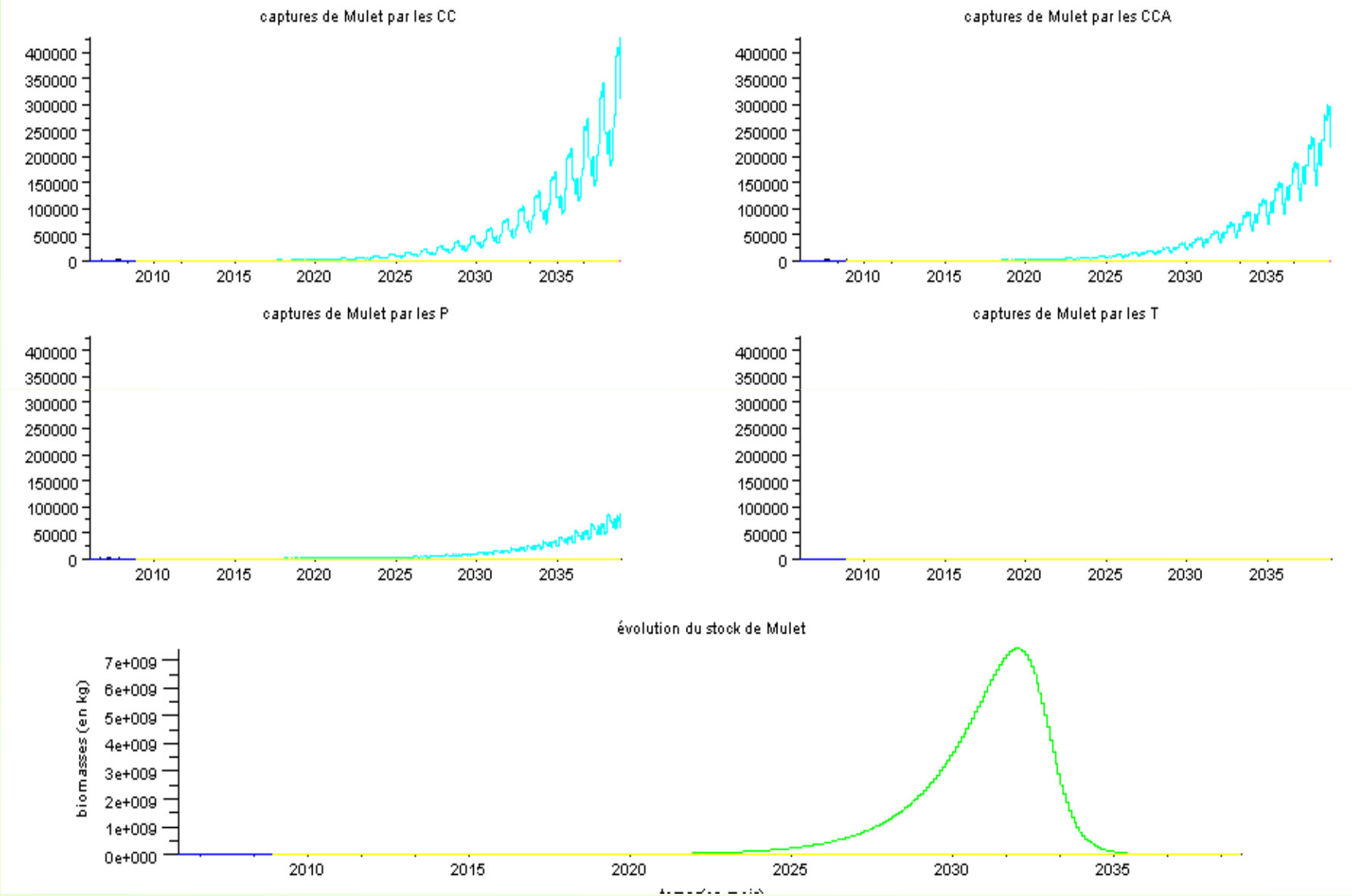
Mulet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2020
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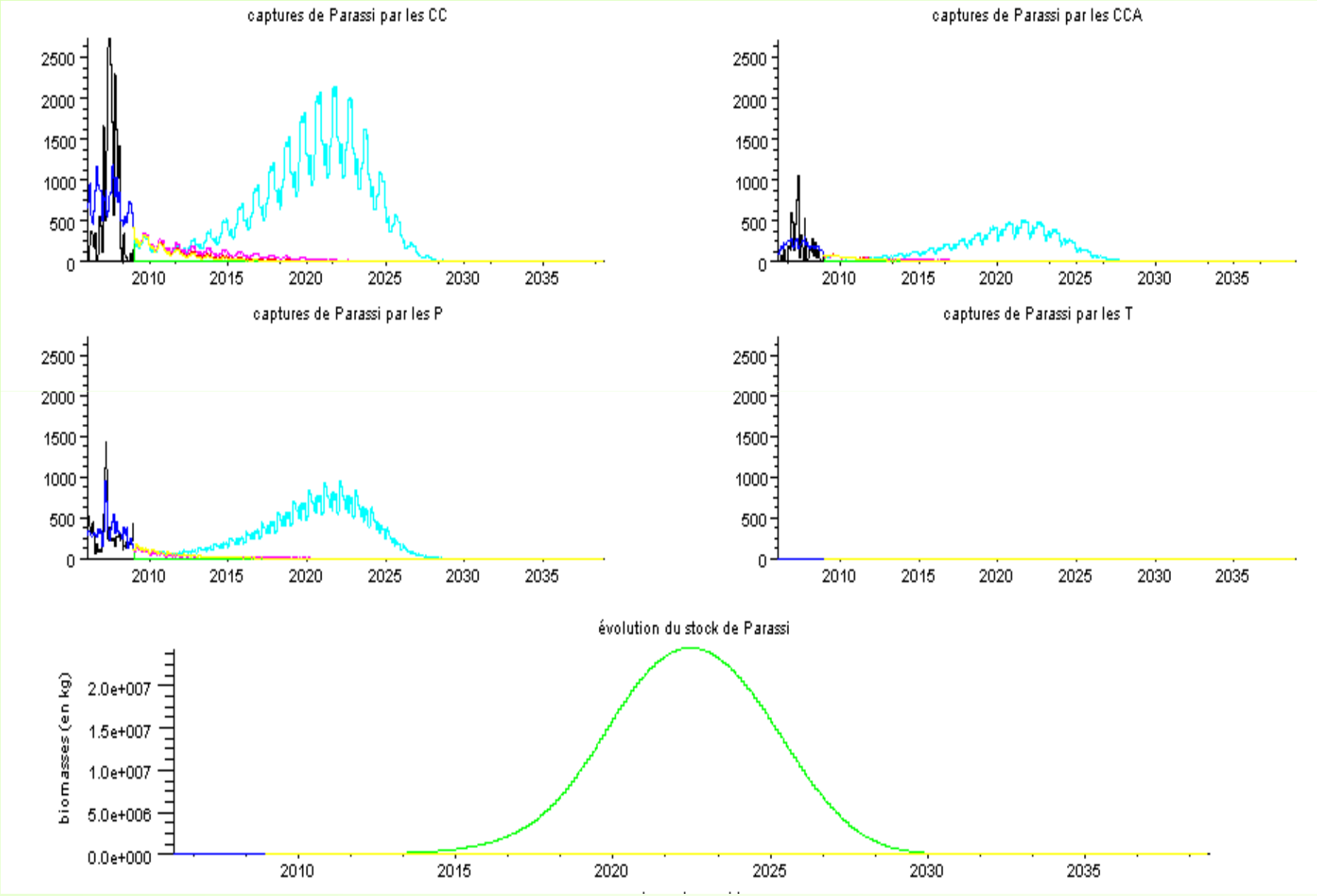
Parassi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2030
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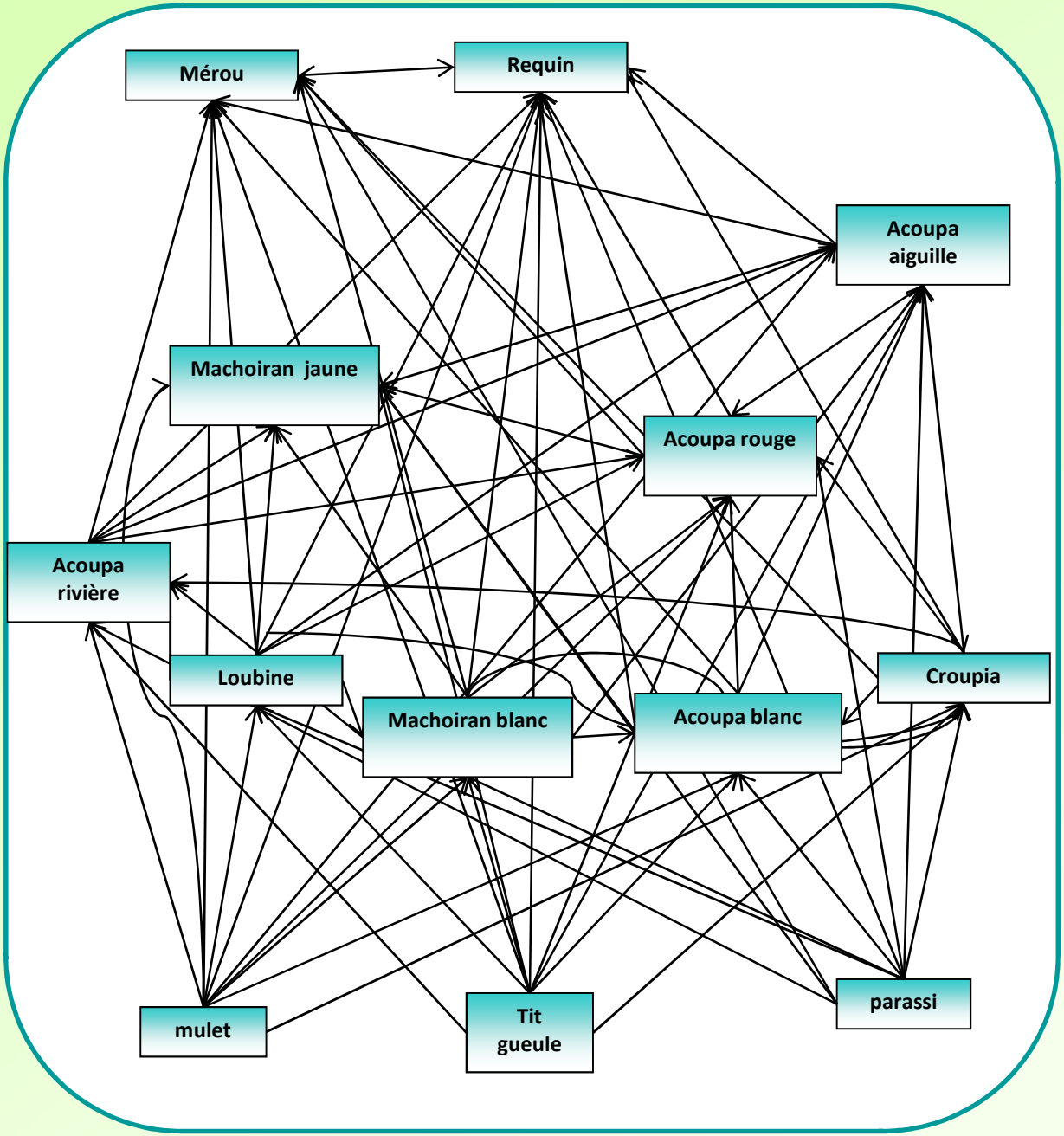
Mérou
Requin
Acoupa aiguille
Machoiran jaune
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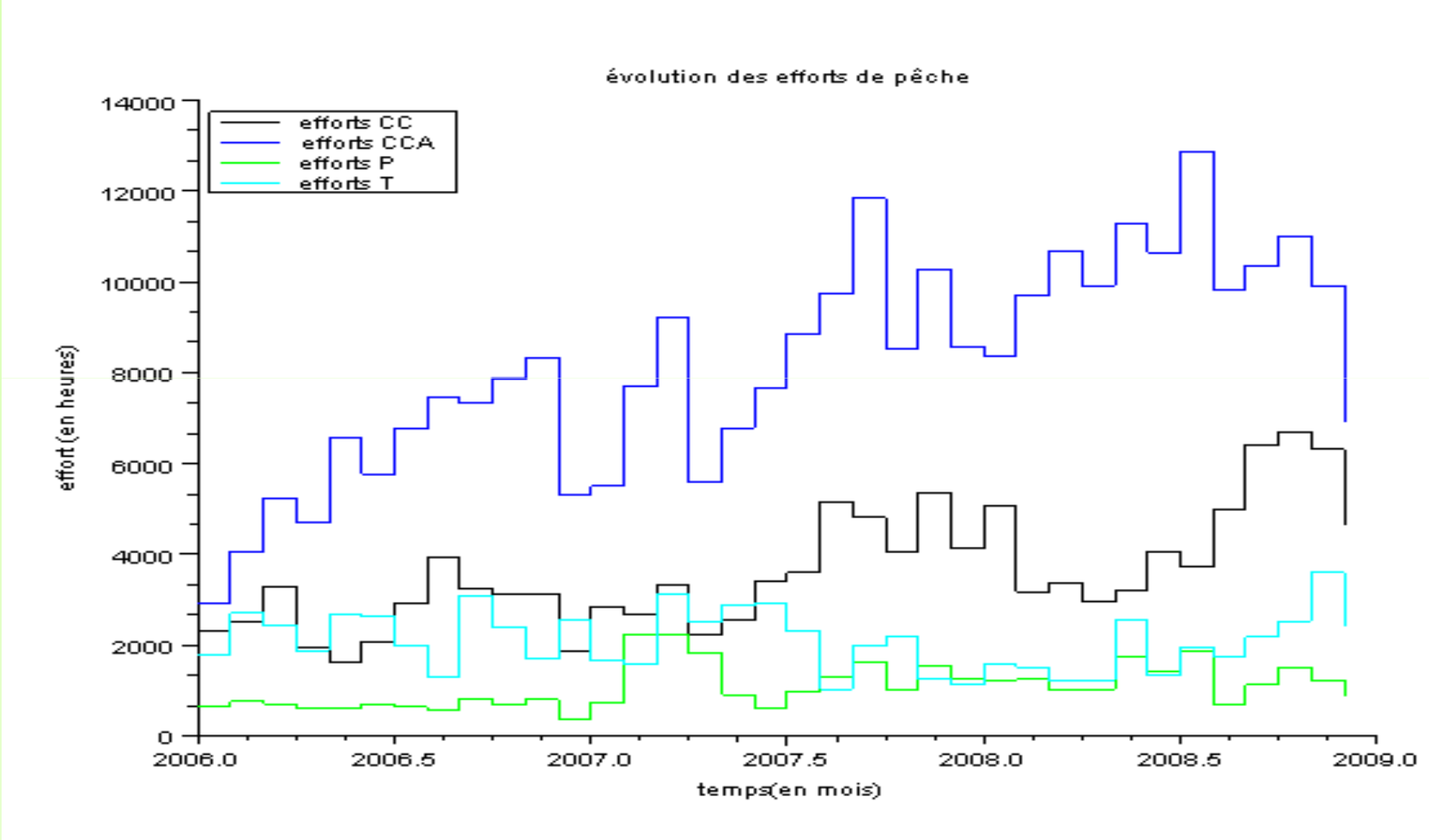
mulet
Tit gueule
parassi

Évolution des efforts de pêche



Effectifs initiaux (en kg)

Acoupa rouge	5135494.8
Machoiran blanc	403706.52
Acoupa aiguille	12870698.
Loubine	242037.34
Requin	26851078.
Acoupa blanc	2899416.6
Acoupa rivière	1826561.8
Croupia	56026.14
Machoiran jaune	101667.22
Tit gueule	33699.064
Mérou	154826.17
Mulet	30216.519
Parassi	18709.279

Matrice de capturabilités

	k			
s	CC	CCA	P	T
Acoupa rouge	0.0000003	0.0000005	1.000D-07	0.0000015
Machoiran blanc	0.0000044	0.0000025	0.0000033	0.0000026
Acoupa aiguille	7.026D-08	8.250D-08	3.917D-08	0.0000002
Loubine	0.0000025	0.0000017	0.0000034	0.0000005
Requin	1.406D-08	1.639D-08	1.175D-08	7.024D-08
Acoupa blanc	9.597D-08	1.000D-07	0.0000002	0.
Acoupa rivière	1.000D-07	5.376D-08	0.0000002	0.
Croupia	0.0000063	0.0000076	0.0000066	0.0000024
Machoiran jaune	0.0000022	0.0000024	0.0000055	0.0000015
Tit gueule	0.000006	0.0000028	0.0000237	0.
Mérou	0.0000052	0.0000009	0.0000006	0.0000002
Mulet	0.0000092	0.0000033	0.0000075	0.
Parassi	0.0000153	0.0000018	0.0000237	0.

Matrice stomachale

espèce j dans estomac de espèce i

espèce i	Acoupa rouge	mach. blanc	ac. Aiguille	loubine	requin	ac. Blanc	ac. rivière
Acoupa rouge	0.0254564	0.1213014	0.0869856	0.3158109	0.	0.4102415	4.9741572
Machoiran blanc	0.	47936.68	0.	1388.1738	0.	0.	0.0233614
Acoupa aiguille	0.0000192	0.064356	0.0258952	5.3148734	0.	0.4678999	0.4656661
Loubine	0.	0.0007028	0.	39666.669	0.	0.	0.
Requin	27.680911	0.0007275	0.0170867	0.0516908	0.0057111	0.7969365	0.1314366
Acoupa blanc	0.016645	0.1315807	1.193882	0.551302	0.	8.532051	0.0844883
Acoupa rivière	0.	5.8380467	0.	1388.4544	0.	0.	4.8587903
Croupia	0.	17061.34	0.	54099.086	0.	0.	2.55606
Machoiran jaune	2.8885215	302.26016	0.000638	17605.985	0.	0.2095426	0.9911735
Tit gueule	0.	0.	0.	0.	0.	0.	0.
Mérou	0.2860634	7381.839	0.0347416	20615.15	4.8623131	18.080347	0.0181147
Mulet	0.	0.	0.	0.	0.	0.	0.
Parassi	0.	0.	0.	0.	0.	0.	0.

	croupia	mach. jaune	tit gueule	mérou	mulet	parassi
Acoupa rouge	0.1156809	0.	0.9301029	0.	0.1591199	59.347734
Machoiran blanc	0.0359384	0.	4.0499376	0.	1.5297834	2.1862915
Acoupa aiguille	0.011976	0.	0.2890905	0.	0.0136726	29.843048
Loubine	0.0035653	0.	251.66322	0.	1.356518	12.267111
Requin	46.499815	6.686545	0.1122893	26.247568	0.210991	5.7556984
Acoupa blanc	3.3264388	0.	0.2249866	0.	112.79879	0.3351819
Acoupa rivière	1.6655089	0.	0.0569149	0.	0.0430587	28.958494
Croupia	20.890661	0.	0.6201027	0.	0.5223949	6.8510136
Machoiran jaune	0.0000003	8.2036392	0.3087584	0.	2.2497755	7.081529
Tit gueule	0.	0.	0.	0.	0.	0.
Mérou	0.4633582	52.831797	3.1918825	0.0322986	25.341319	1.2764855
Mulet	0.	0.	0.	0.	0.	0.
Parassi	0.	0.	0.	0.	0.	0.

Matrice de relations trophiques

1.0D-13 7

	Acoupa rouge	mach. blanc	ac. Aiguille	loubine	requin	ac. Blanc	ac. rivière
Ac. rouge	- 0.2227435	0.1516268	0.10854	0.3947636	- 276.80911	0.3463519	6.2176965
Mach. blanc	- 1.213014	- 919445.95	- 0.64356	1735.2102	- 0.007275	- 1.315807	- 58.351265
Ac. aiguille	- 0.869832	0.080945	- 0.226583	6.6435917	- 0.170867	- 11.353945	0.5820826
Loubine	- 3.158109	- 13881.737	- 53.148734	- 347083.35	- 0.516908	- 5.51302	- 13884.544
Requin	34.601139	0.0009094	0.0213584	0.0646135	- 0.0499721	0.9961706	0.1642957
Ac. blanc	- 4.0816088	0.1644759	- 3.1866465	0.6891275	- 7.969365	- 74.655446	0.1056104
Ac. rivière	- 49.741572	7.0639444	- 4.656661	1735.568	- 1.314366	- 0.844883	- 42.514415
Croupia	- 1.156809	21326.316	- 0.11976	67623.822	- 464.99815	- 33.264388	- 13.460014
Mach. jaune	3.6106519	377.8252	0.0007975	22007.481	- 66.86545	0.2619282	1.2389669
Tit gueule	- 9.301029	- 40.499376	- 2.890905	- 2516.6322	- 1.122893	- 2.249866	- 0.569149
Mérou	0.3575793	9227.2987	0.043427	25768.938	- 256.39779	22.600434	0.0226434
Mulet	- 1.591199	- 15.297834	- 0.136726	- 13.56518	- 2.10991	- 1127.9879	- 0.430587
Parassi	- 593.47734	- 21.862915	- 298.43048	- 122.67111	- 57.556984	- 3.351819	- 289.58494

	croupia	mach. jaune	tit gueule	mérou	mulet	parassi
Ac. rouge	0.1446011	- 28.885215	1.1626286	- 2.860634	0.1988999	74.184668
Mach. blanc	- 170613.36	- 3022.6016	5.062422	- 73818.39	1.9122292	2.7328644
Ac. aiguille	0.01497	- 0.00638	0.3613631	- 0.347416	0.0170908	37.30381
Loubine	- 540990.86	- 176059.85	314.57903	- 206151.5	1.6956475	15.333889
Requin	58.124769	8.3581812	0.1403616	- 15.813671	0.2637388	7.194623
Ac. blanc	4.1580485	- 2.095426	0.2812333	- 180.80347	140.99849	0.4189774
Ac. rivière	- 23.478714	- 9.911735	0.0711436	- 0.181147	0.0538234	36.198118
Croupia	- 182.79328	- 0.000003	0.7751284	- 4.633582	0.6529936	8.563767
Mach. jaune	0.0000004	- 71.781843	0.385948	- 528.31797	2.8122194	8.8519112
Tit gueule	- 6.201027	- 3.087584	0.	- 31.918825	0.	0.
Mérou	0.5791978	66.039746	3.9898531	- 0.2826127	31.676649	1.5956069
Mulet	- 5.223949	- 22.497755	0.	- 253.41319	0.	0.
Parassi	- 68.510136	- 70.81529	0.	- 12.764855	0.	0.