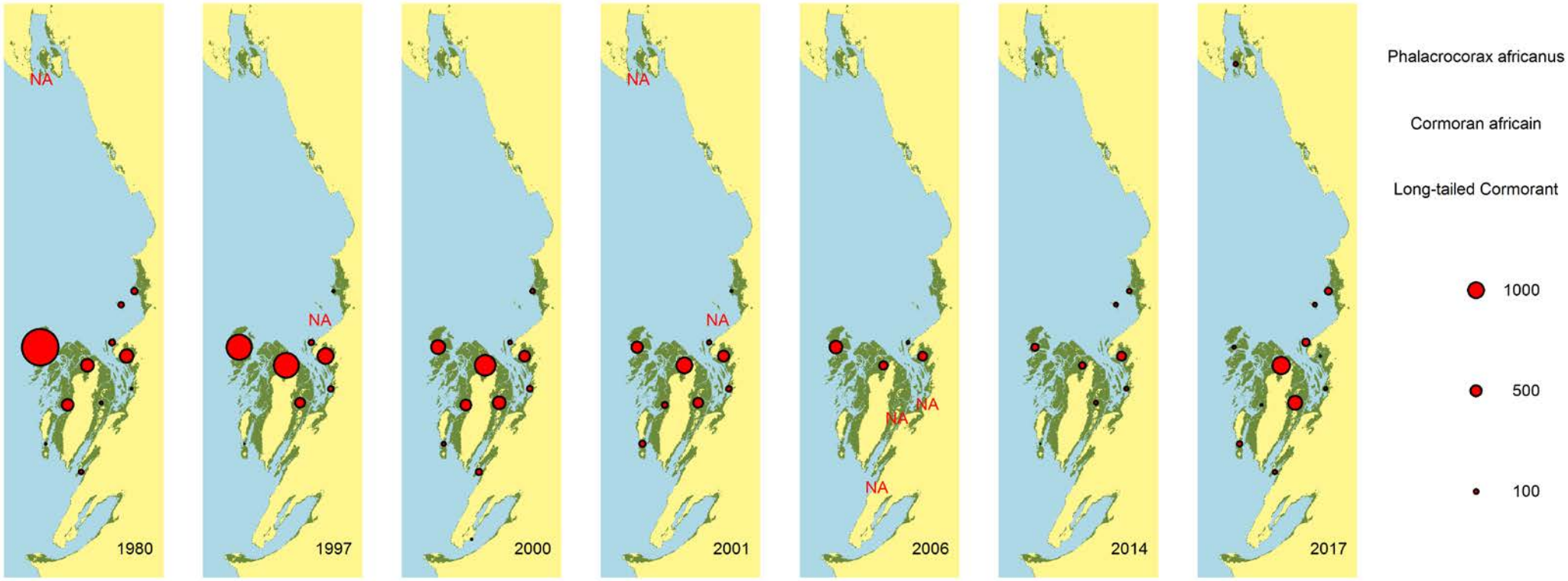
The waterbirds of Parc National du Banc d'Arguin

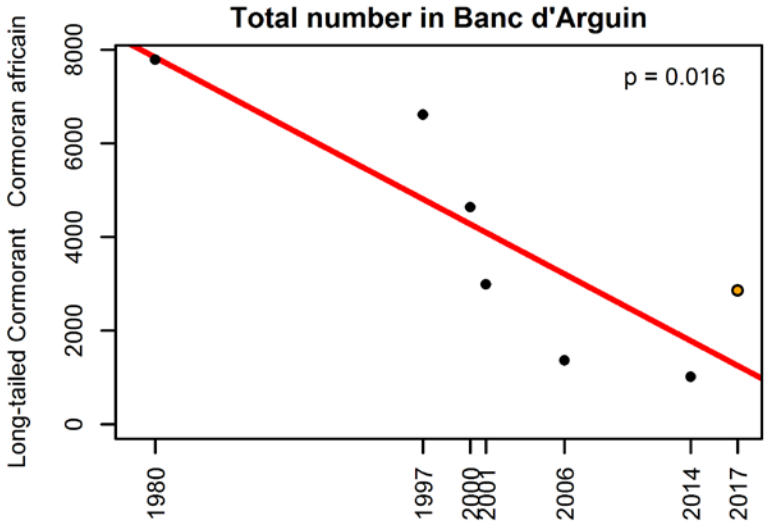
Oudman, Thomas; Schekkerman, Hans; Kidee, Ahmadou; Roomen, Marc van; Tentij, Manon; Piersma, Theunis

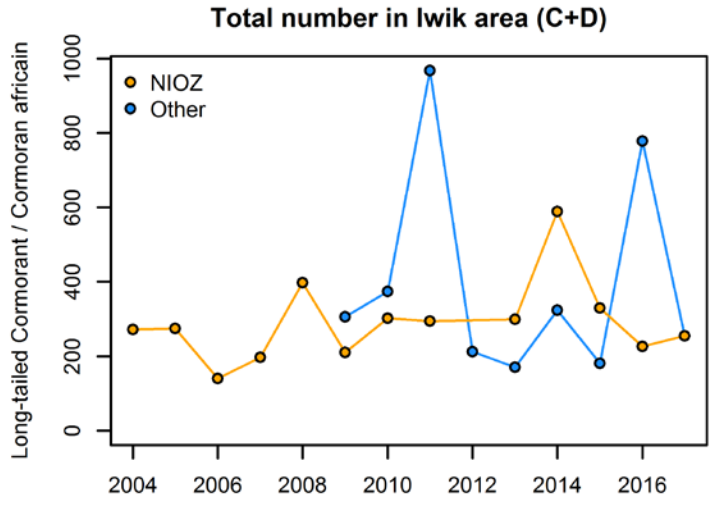
APPENDIX I: PROGRAM WORKSHOP
IWIK, 23 JANUARY 2017

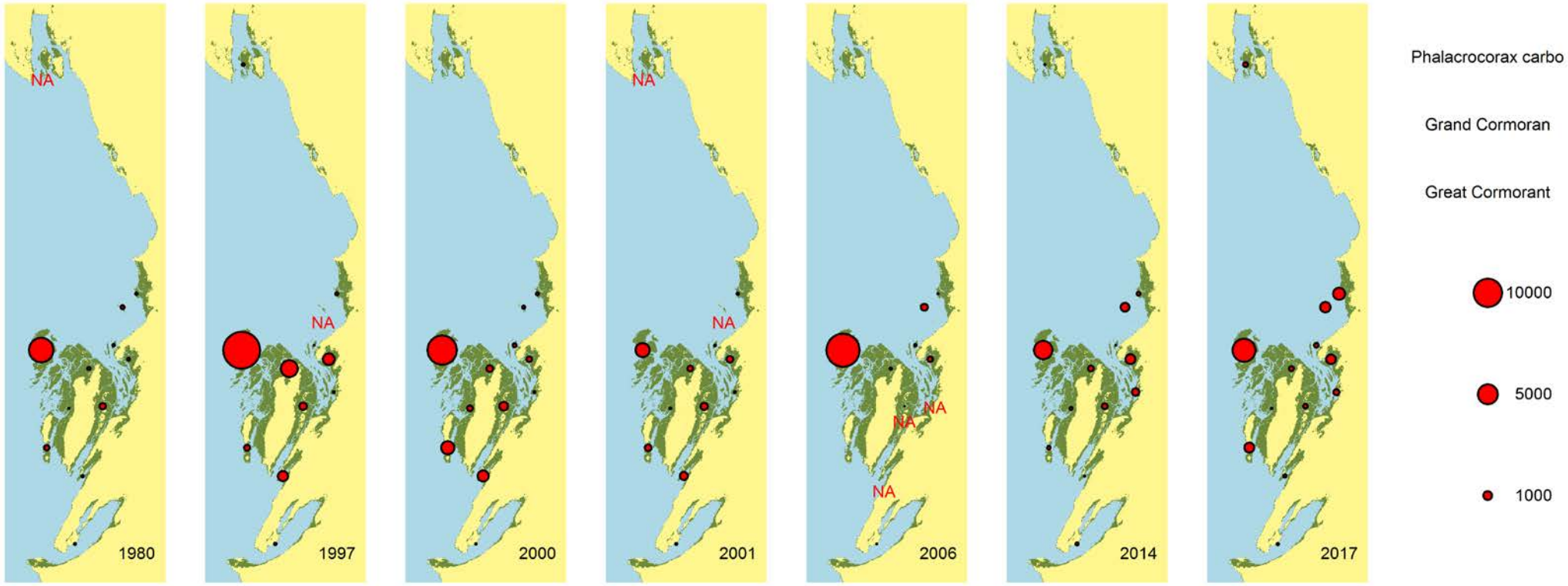
PRESENTATIONS 9:00 – 13:00		
Manon Tentij	Introduction	9:00 – 9:15
Han Olff	Landscape ecology of Banc d'Arguin	9:15 – 9:45
Sidi Cheikh	Long term and large scale seagrass dynamics	9:45 – 10:00
Break		
Hacen M. el Hacen	The importance of birds for the functioning of Banc d'Arguin	10:30 – 10:45
Mohamed Vall A. Salem	Seasonal benthos dynamics	10:45 – 11:00
Thomas Oudman	Behavioural responses to the environmental heterogeneity	11:00 – 11:15
Sidi Yahya Lemrabott	The role of rays and sharks in the ecosystem	11:15 – 11:30
Break		
Hans Schekkerman	History and methods of bird counting in Banc d'Arguin	12:00 – 12:15
Thomas Oudman	Bird community dynamics at Banc d'Arguin	12:15 – 12:30
Theunis Piersma	The nature of the changes since 1980	12:30 – 13:00
LUNCH 13:00 – 14:00		
BRAINSTORM SESSION 14:00 – 16:30		
- Determining and understanding population trends		14:00 – 15:00
Break		
- From local trends to global mechanisms and back		15:15 – 15:45
- Future bird monitoring in BdA		15:45 – 16:15
- Rounding-up and farewell		16:15 – 16:30

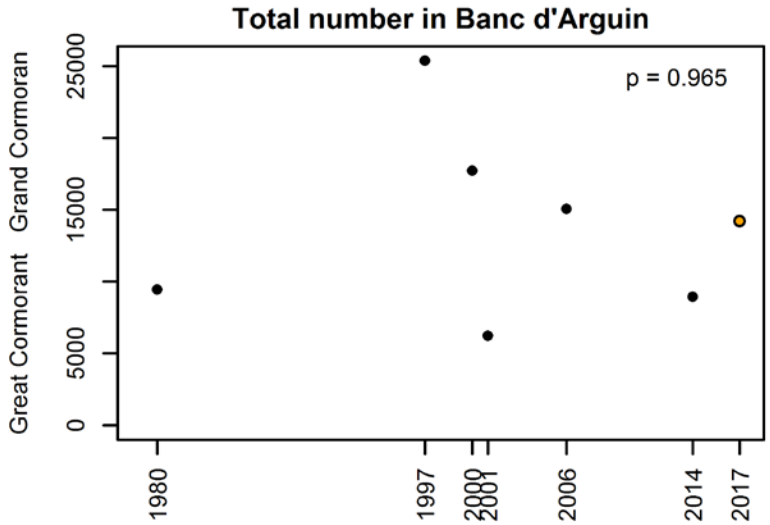
APPENDIX II

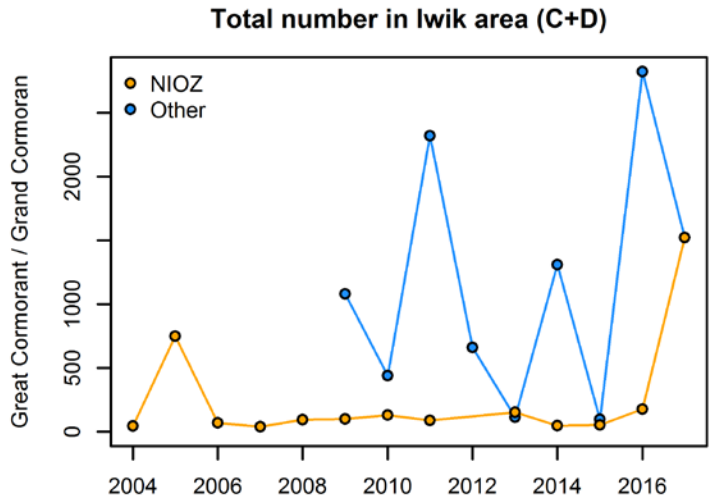

NA
1980
1997
2000
2001
2006
2014
2017
Phalacrocorax africanus
Cormoran africain
Long-tailed Cormorant
1000
500
100

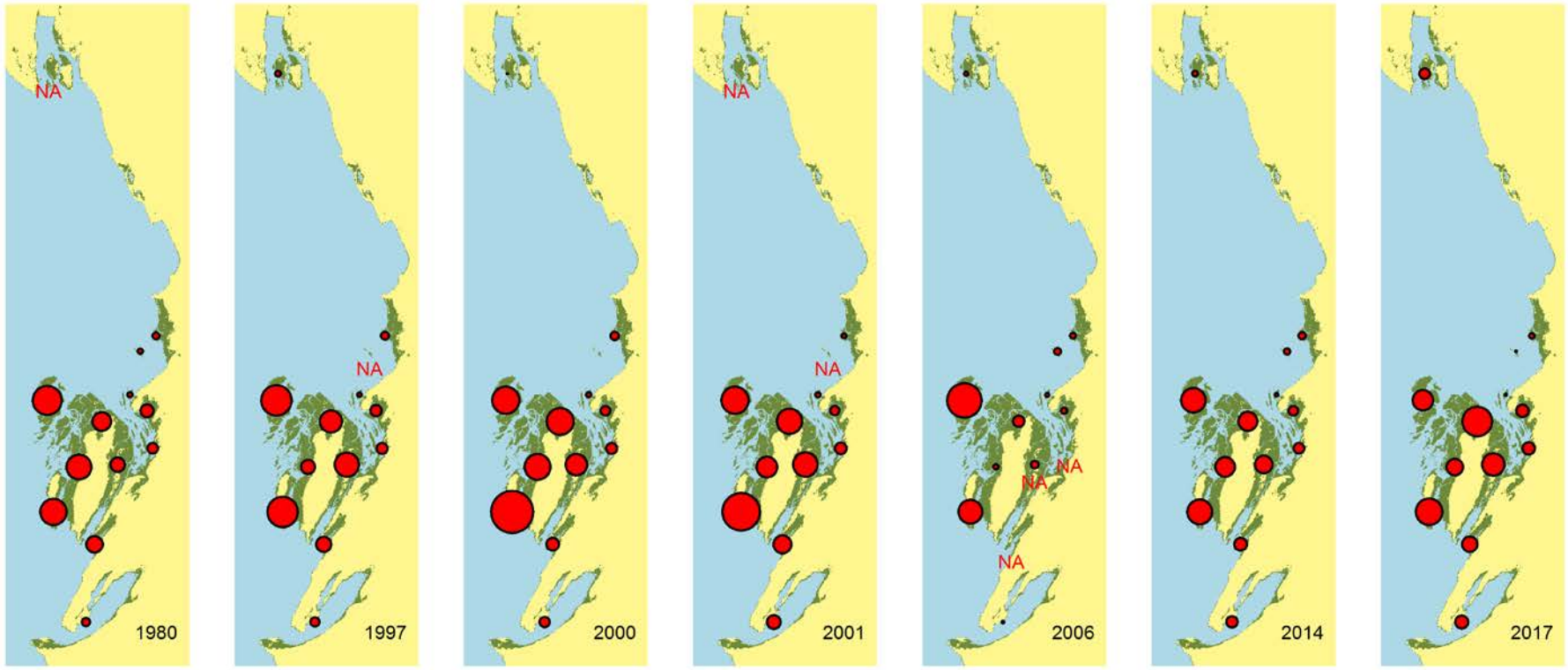

Total number in Banc d'Arguin
p = 0.016
Long-tailed Cormorant Cormoran africain
0
2000
4000
6000
8000
1980
1997
2000
2001
2006
2014
2017

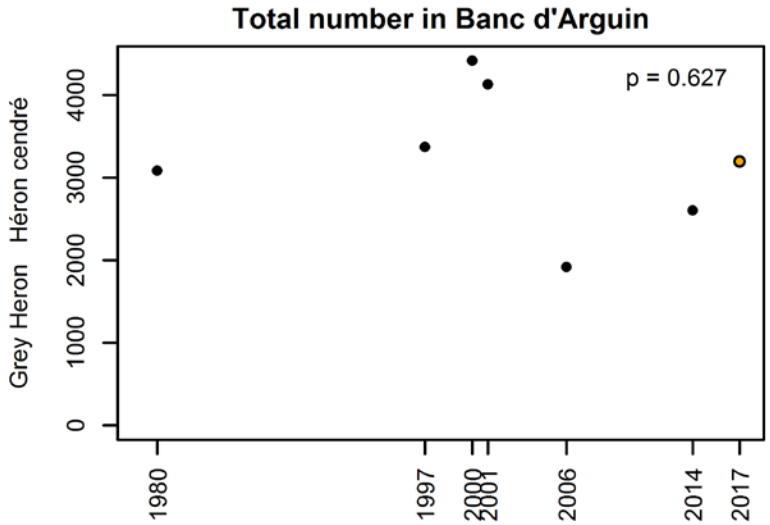

Total number in Iwik area (C+D)
NIOZ
Other
Long-tailed Cormorant / Cormoran africain
0
200
400
600
800
1000
2004
2006
2008
2010
2012
2014
2016

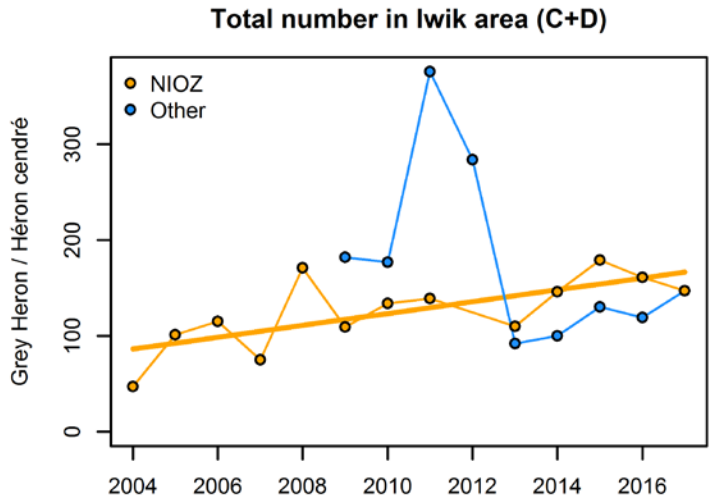

NA
1980
1997
2000
2001
2006
2014
2017
Phalacrocorax carbo
Grand Cormoran
Great Cormorant
10000
5000
1000

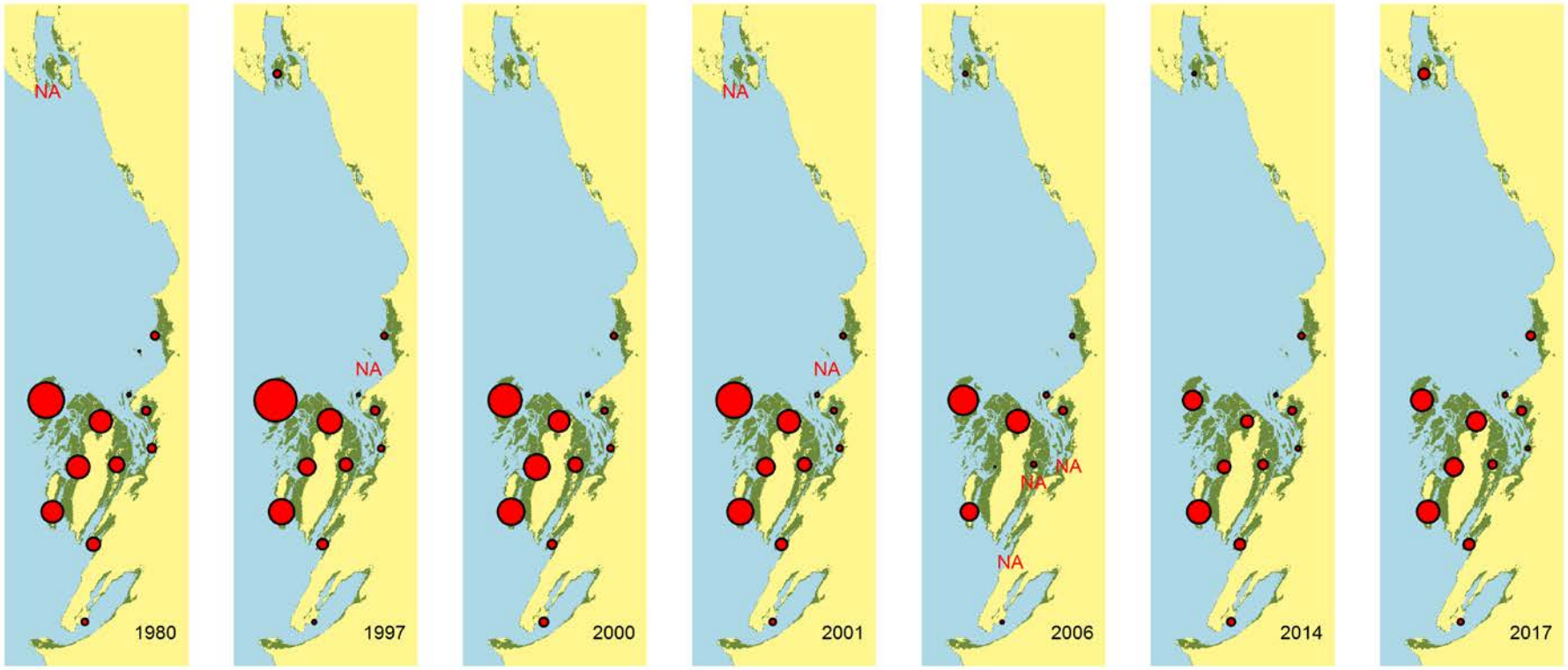

Total number in Banc d'Arguin
Great Cormorant Grand Cormoran
0
5000
15000
25000
p = 0.965
1980
1997
2000
2001
2006
2014
2017

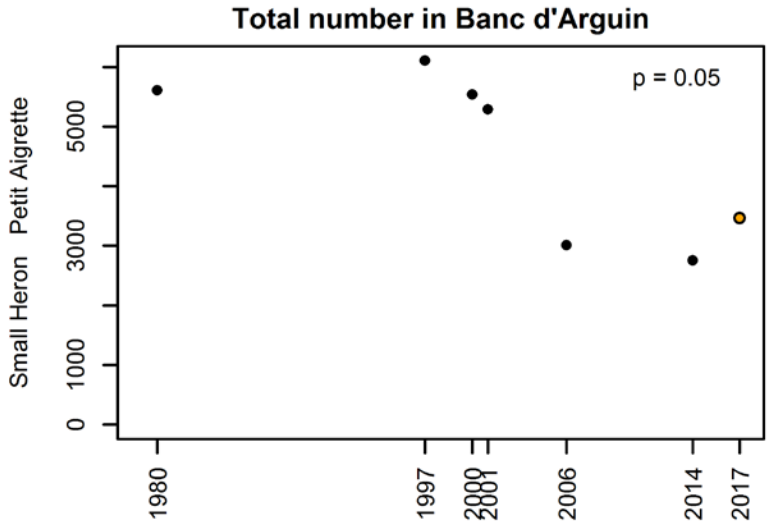

Total number in Iwik area (C+D)
Great Cormorant / Grand Cormoran
0
500
1000
2000
NIOZ
Other
2004
2006
2008
2010
2012
2014
2016

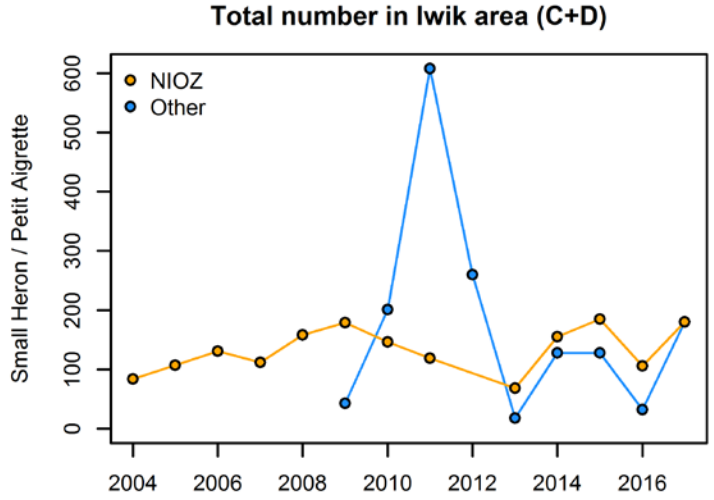

NA
1980
1997
2000
2001
2006
2014
2017
Ardea cinerea
Héron cendré
Grey Heron
1000
500
100

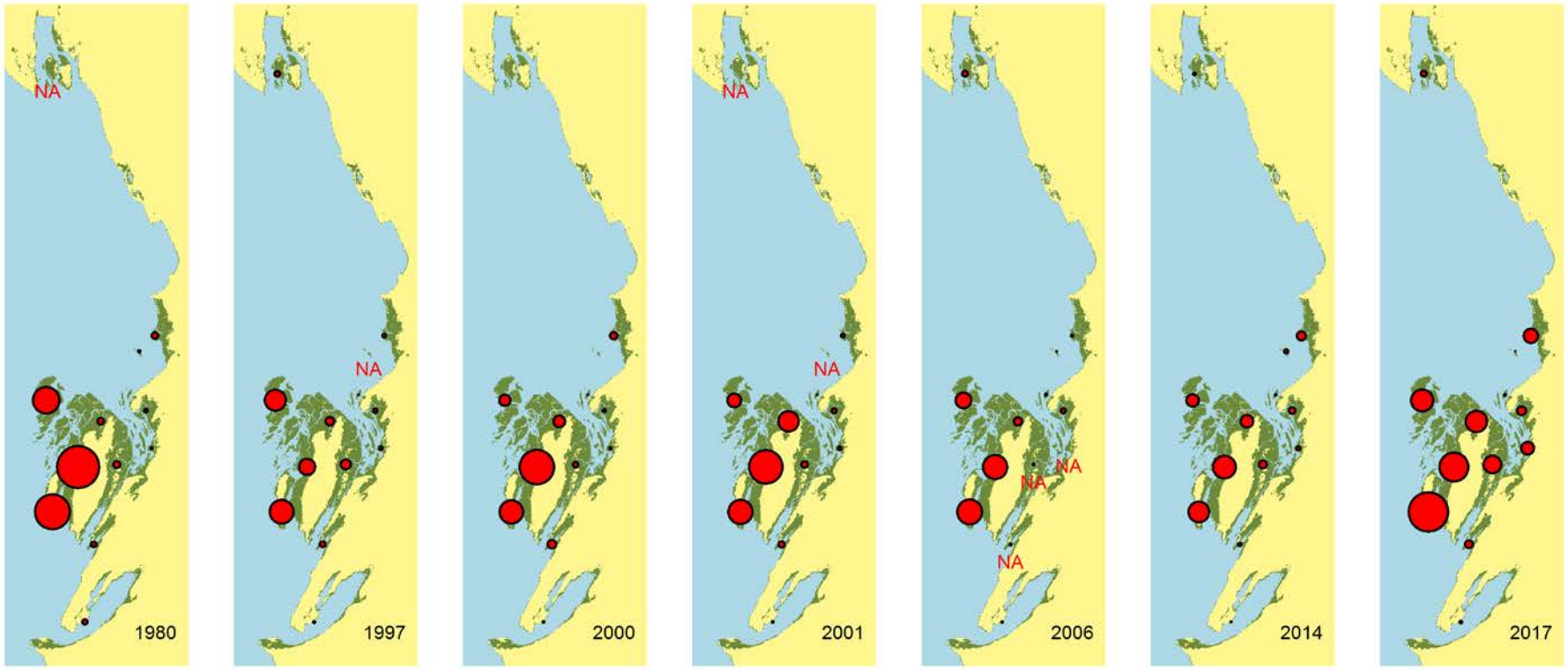

Total number in Banc d'Arguin
Grey Heron Héron cendré
p = 0.627
0
1000
2000
3000
4000
1980
1997
2000
2001
2006
2014
2017

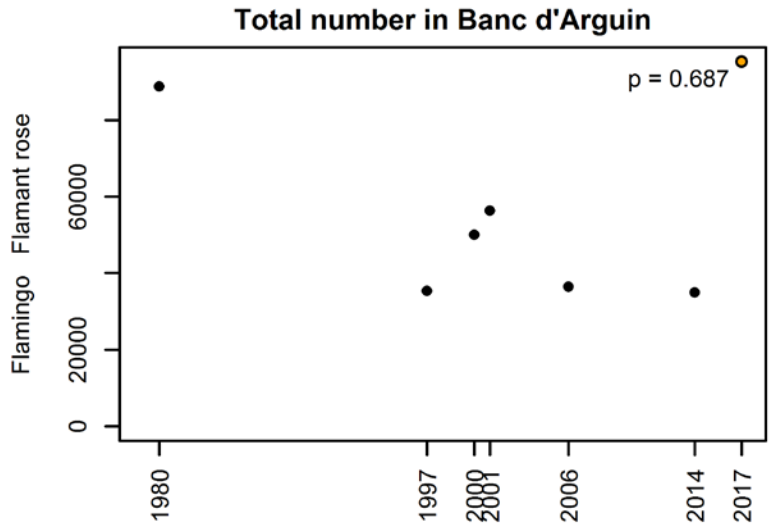

Total number in Iwik area (C+D)
Grey Heron / Héron cendré
NIOZ
Other
0
100
200
300
2004
2006
2008
2010
2012
2014
2016

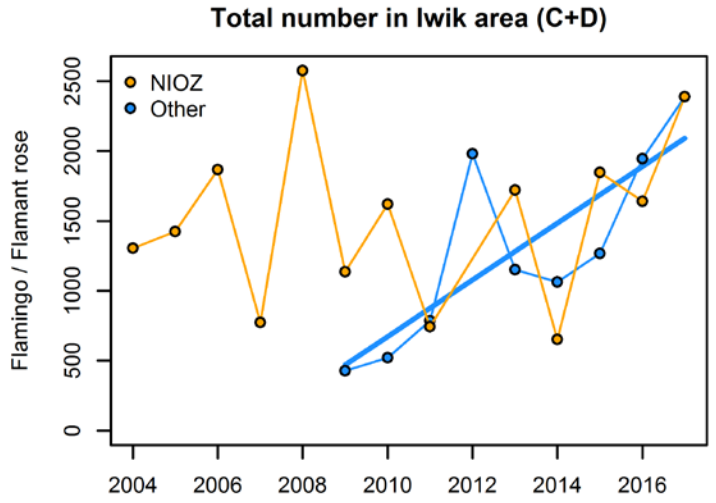

NA
1980
1997
2000
2001
2006
2014
2017
Egretta spec
Petit Aigrette
Small Heron
1000
500
100

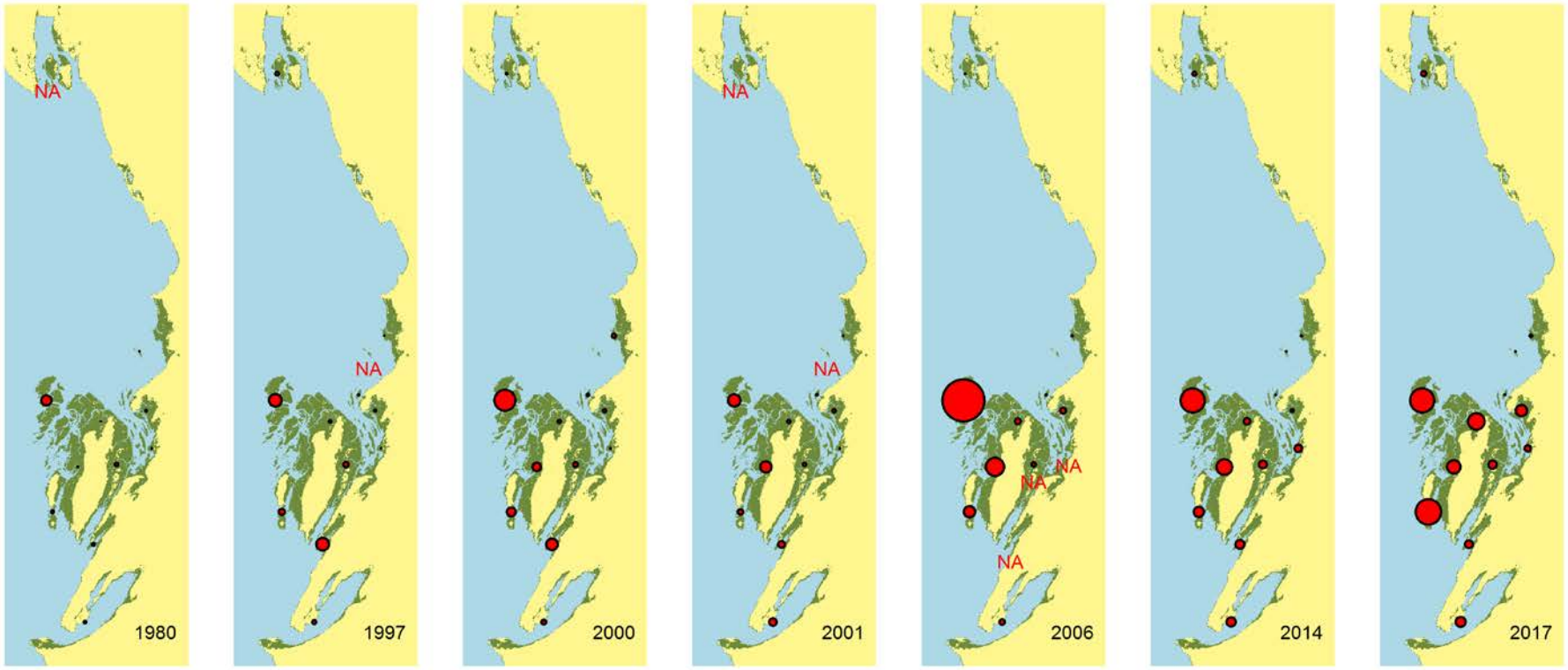

Total number in Banc d'Arguin
Small Heron Petit Aigrette
p = 0.05
0
1000
3000
5000
1980
1997
2000
2001
2006
2014
2017

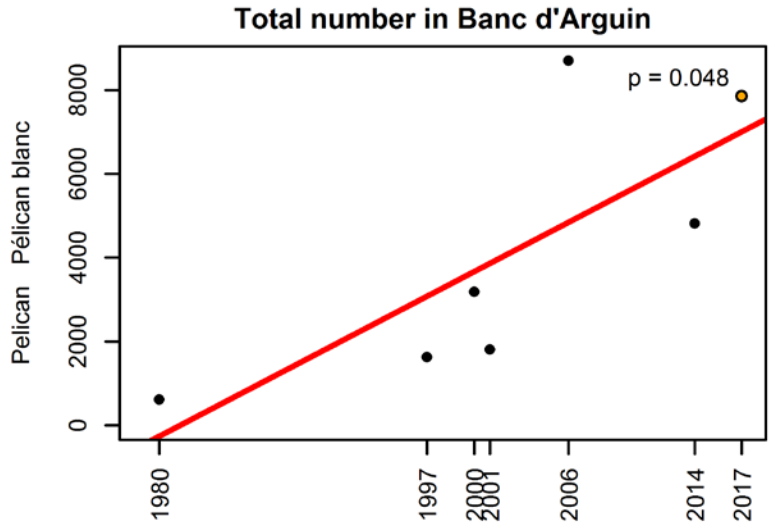

Total number in Iwik area (C+D)
Small Heron / Petit Aigrette
NIOZ
Other
0
100
200
300
400
500
600
2004
2006
2008
2010
2012
2014
2016

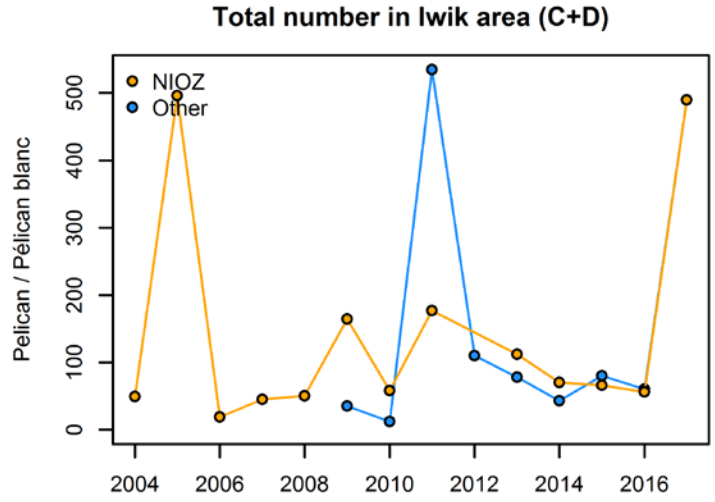

NA
1980
1997
2000
2001
2006
2014
2017
Phoenicopterus ruber roseu
Flamant rose
Flamingo
10000
5000
1000

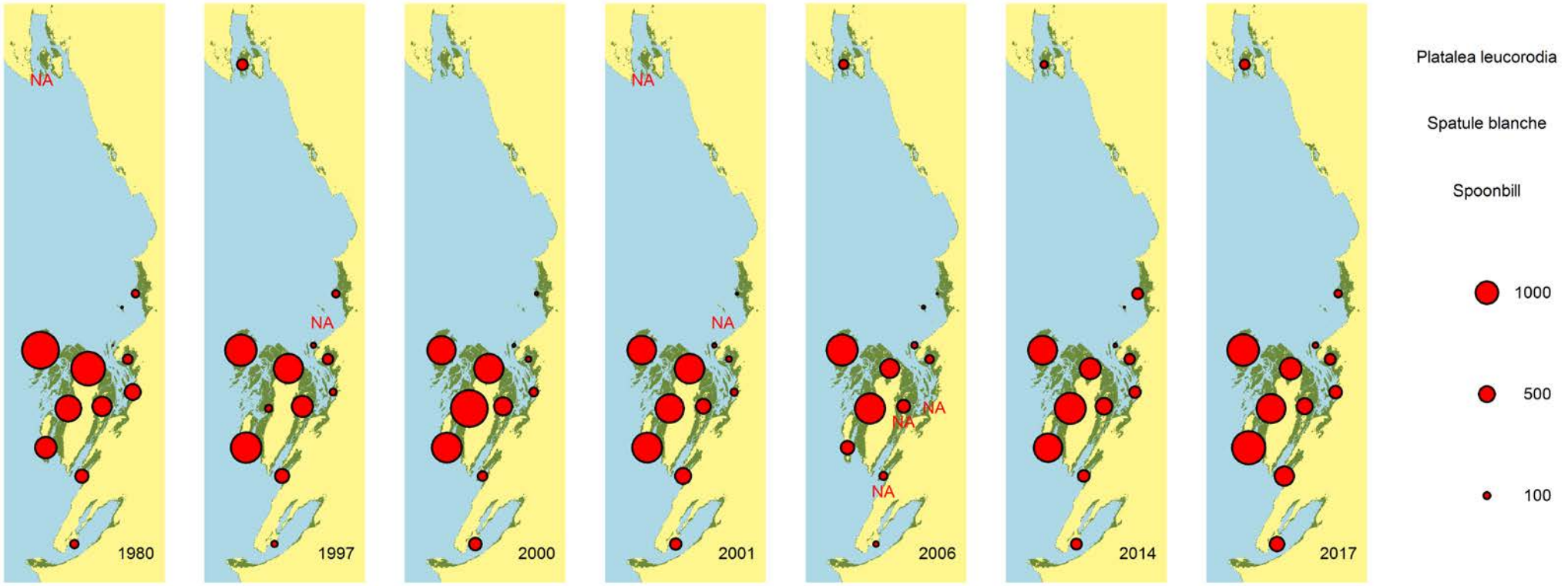

Total number in Banc d'Arguin
p = 0.687
Flamingo Flamant rose
0
20000
60000
1980
1997
2000
2001
2006
2014
2017

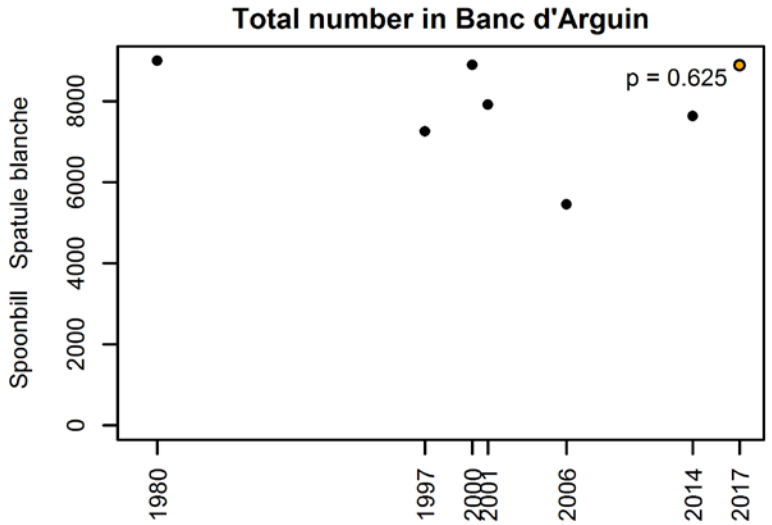

Total number in Iwik area (C+D)
NIOZ
Other
Flamingo / Flamant rose
0
500
1000
1500
2000
2500
2004
2006
2008
2010
2012
2014
2016

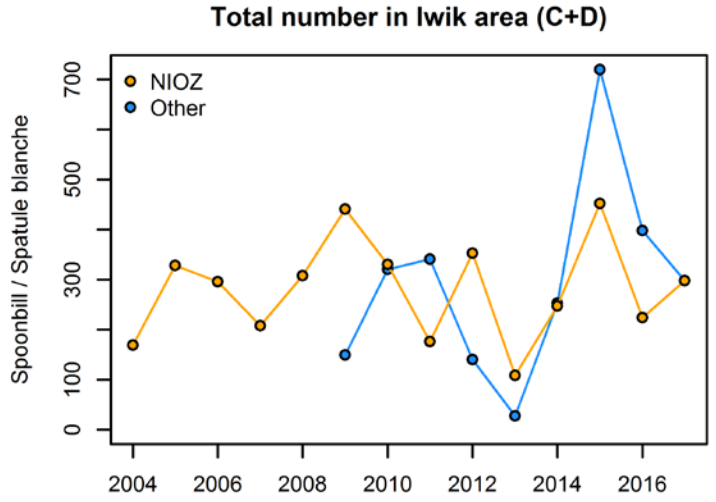

NA
1980
1997
2000
2001
2006
2014
2017
Pelecanus onocrotalus
Pélican blanc
Pelican
1000
500
100

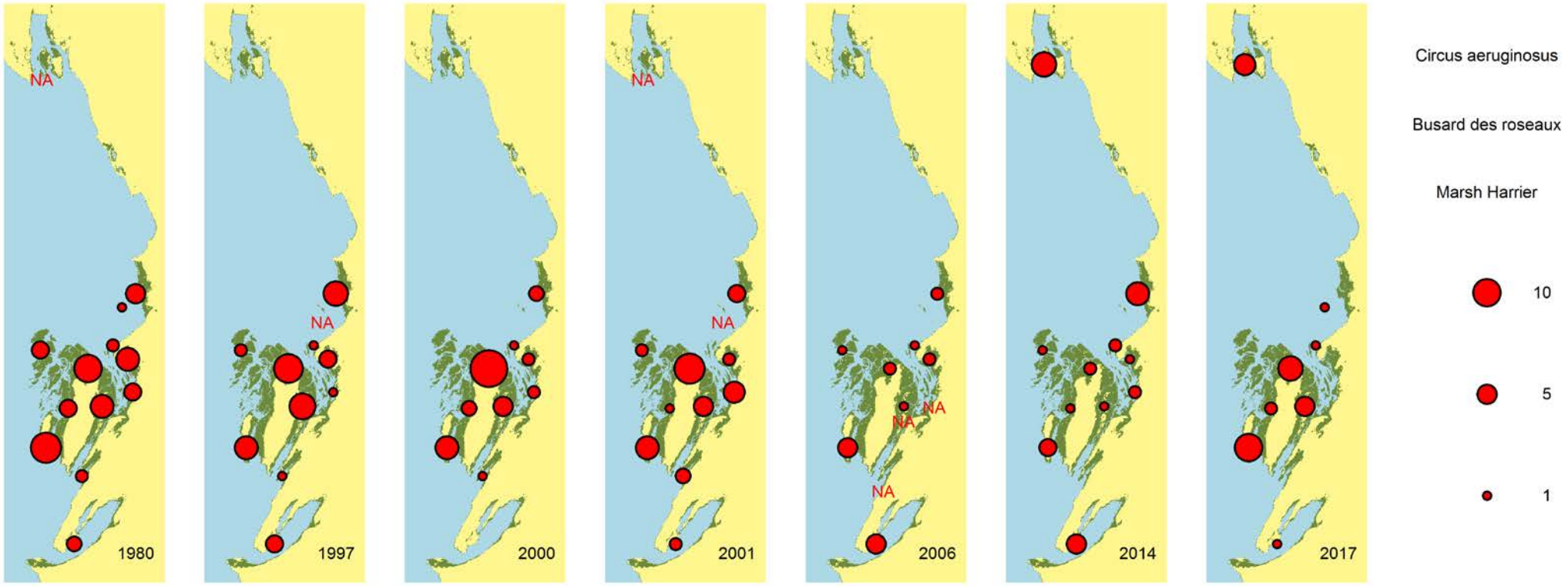

Total number in Banc d'Arguin
p = 0.048
Pelican Pélican blanc
0
2000
4000
6000
8000
1980
1997
2000
2001
2006
2014
2017

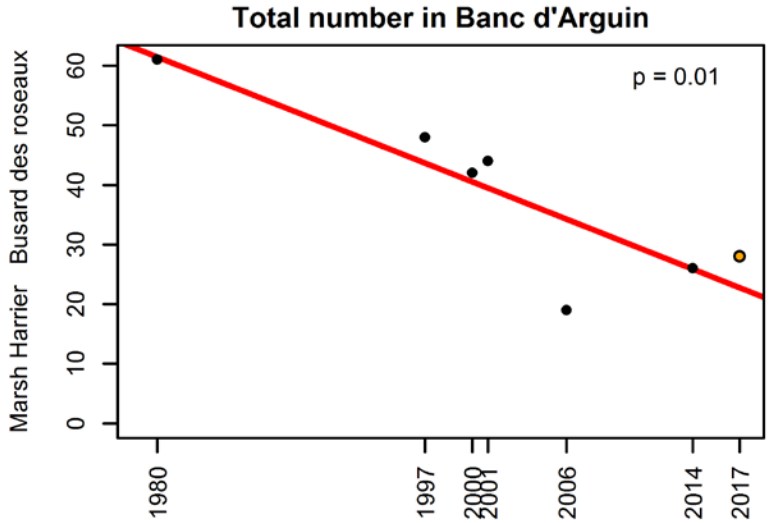

Total number in Iwik area (C+D)
NIOZ
Other
Pelican / Pélican blanc
0
100
200
300
400
500
2004
2006
2008
2010
2012
2014
2016

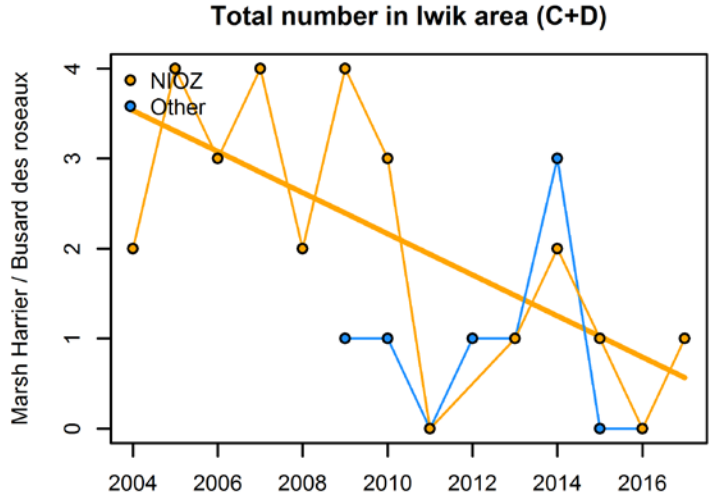

NA
1980
1997
2000
2001
2006
2014
2017
Platalea leucorodia
Spatule blanche
Spoonbill
1000
500
100

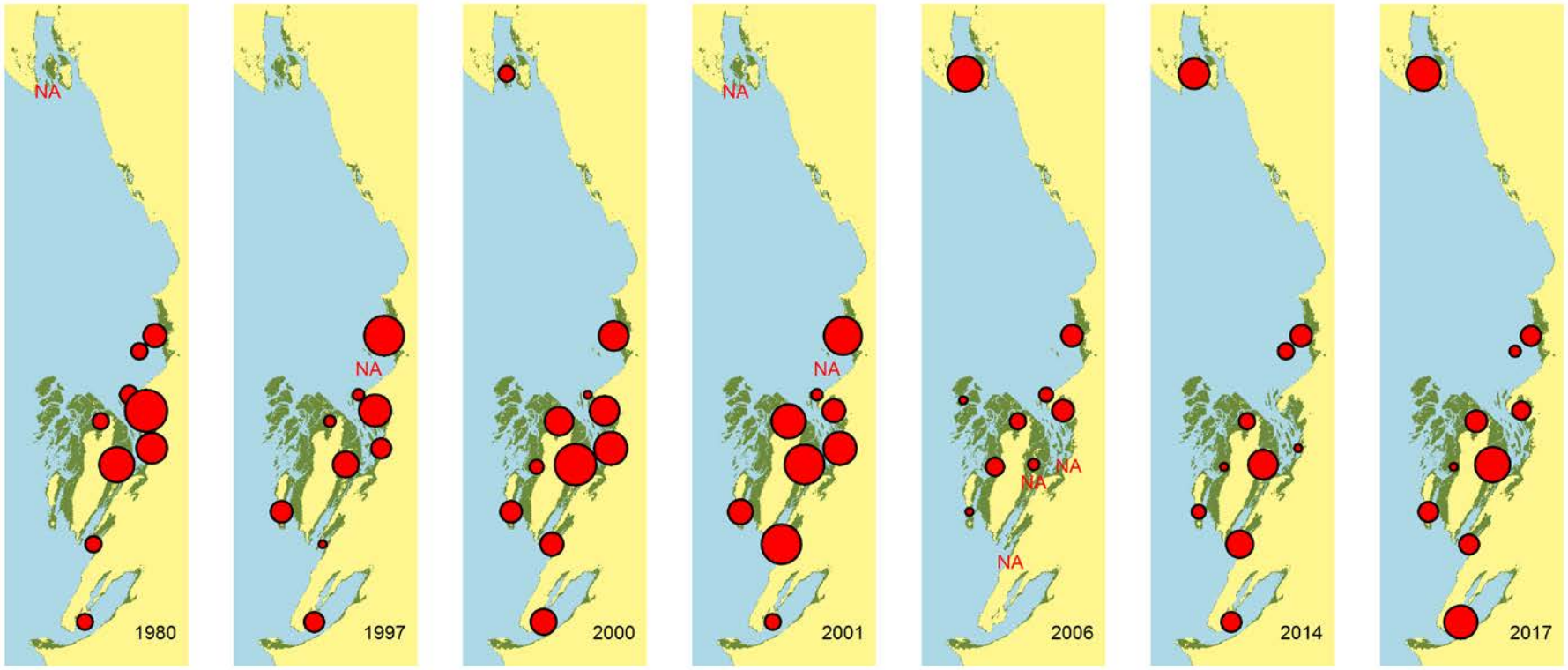

Total number in Banc d'Arguin
Spoonbill Spatule blanche
p = 0.625
0
2000
4000
6000
8000
1980
1997
2000
2001
2006
2014
2017

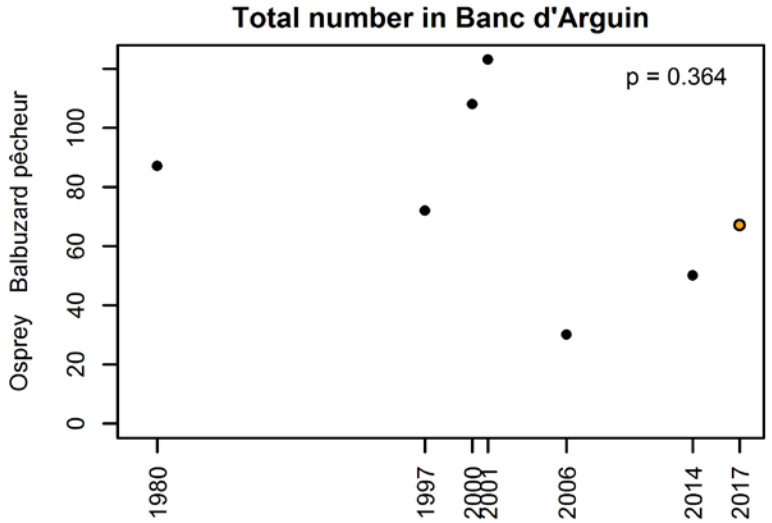

Total number in Iwik area (C+D)
Spoonbill / Spatule blanche
NIOZ
Other
0
100
300
500
700
2004
2006
2008
2010
2012
2014
2016

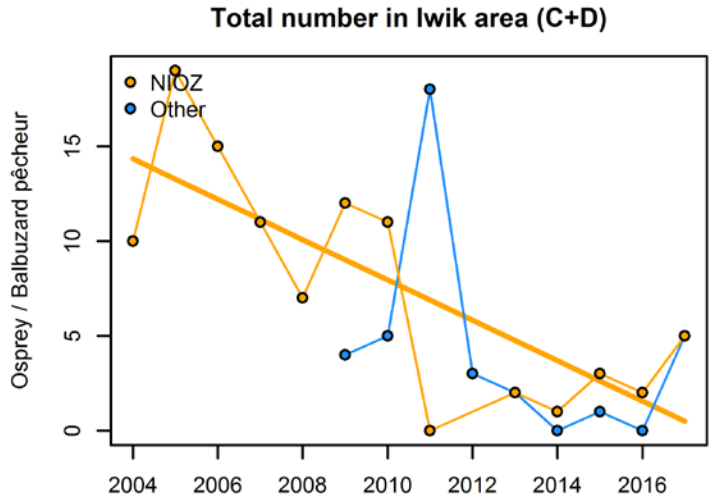

NA
1980
1997
2000
2001
2006
2014
2017
Circus aeruginosus
Busard des roseaux
Marsh Harrier
10
5
1

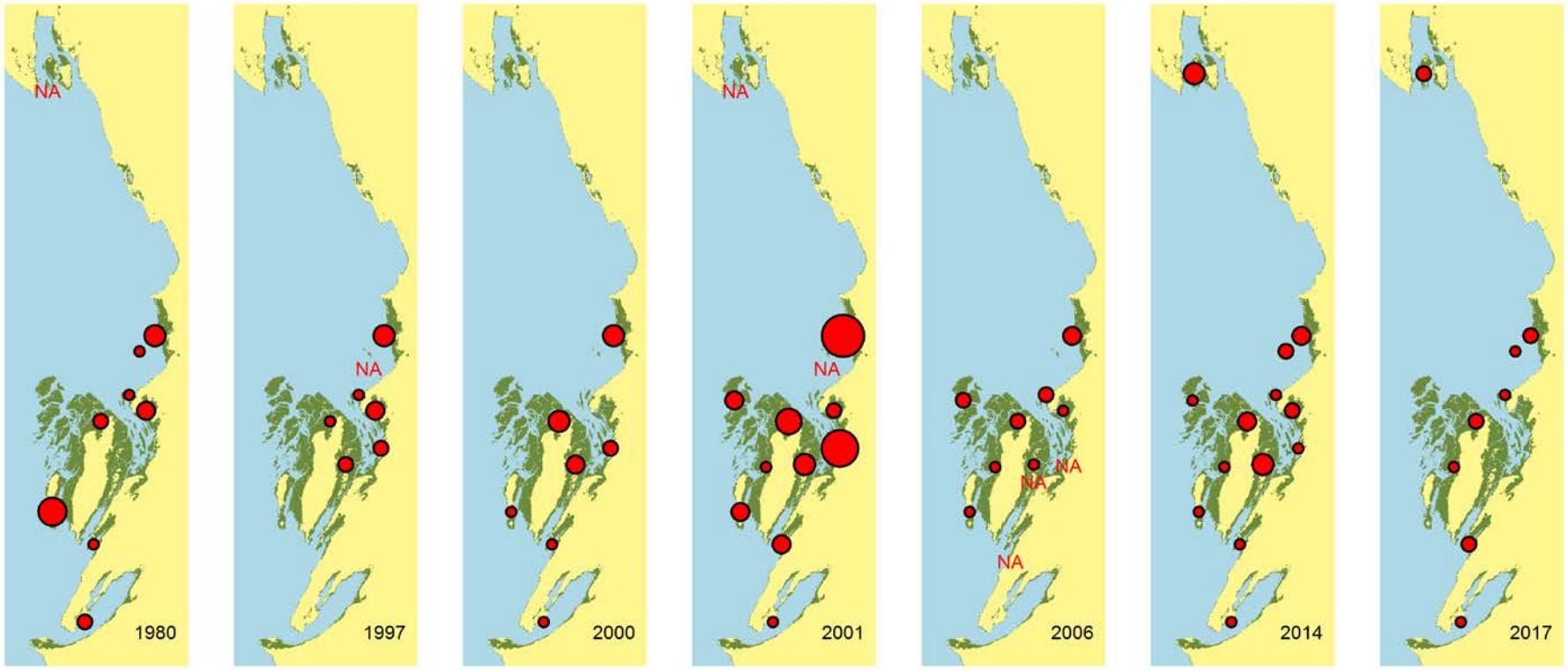

Total number in Banc d'Arguin
p = 0.01
Marsh Harrier Busard des roseaux
0
10
20
30
40
50
60
1980
1997
2000
2001
2006
2014
2017

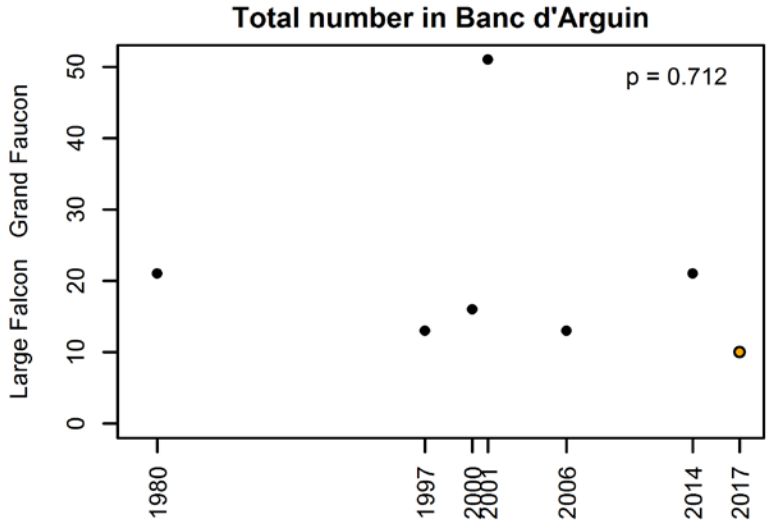

Total number in Iwik area (C+D)
NIOZ
Other
Marsh Harrier / Busard des roseaux
0
1
2
3
4
2004
2006
2008
2010
2012
2014
2016


NA
1980
1997
2000
2001
2006
2014
2017
Pandion haliaetus
Balbuzard pêcheur
Osprey
10
5
1


Total number in Banc d'Arguin
p = 0.364
Osprey Balbuzard pêcheur
0
20
40
60
80
100
1980
1997
2000
2001
2006
2014
2017


Total number in Iwik area (C+D)
NIOZ
Other
Osprey / Balbuzard pêcheur
0
5
10
15
2004
2006
2008
2010
2012
2014
2016


NA
1980
1997
2000
2001
2006
2014
2017
Falco spec
Grand Faucon
Large Falcon
10
5
1


Total number in Banc d'Arguin
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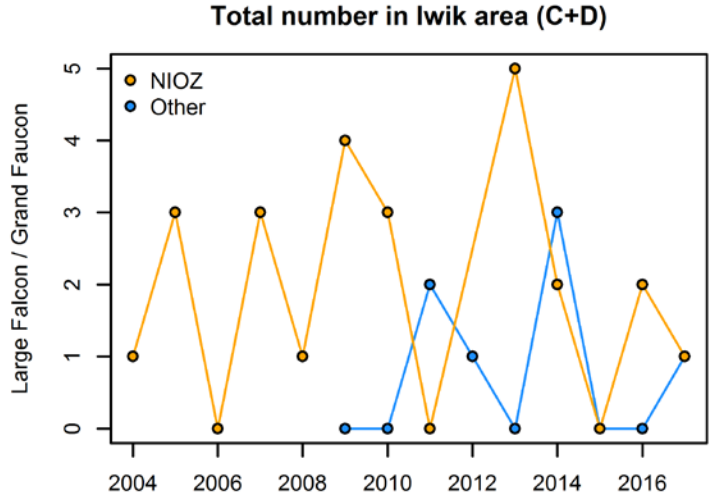
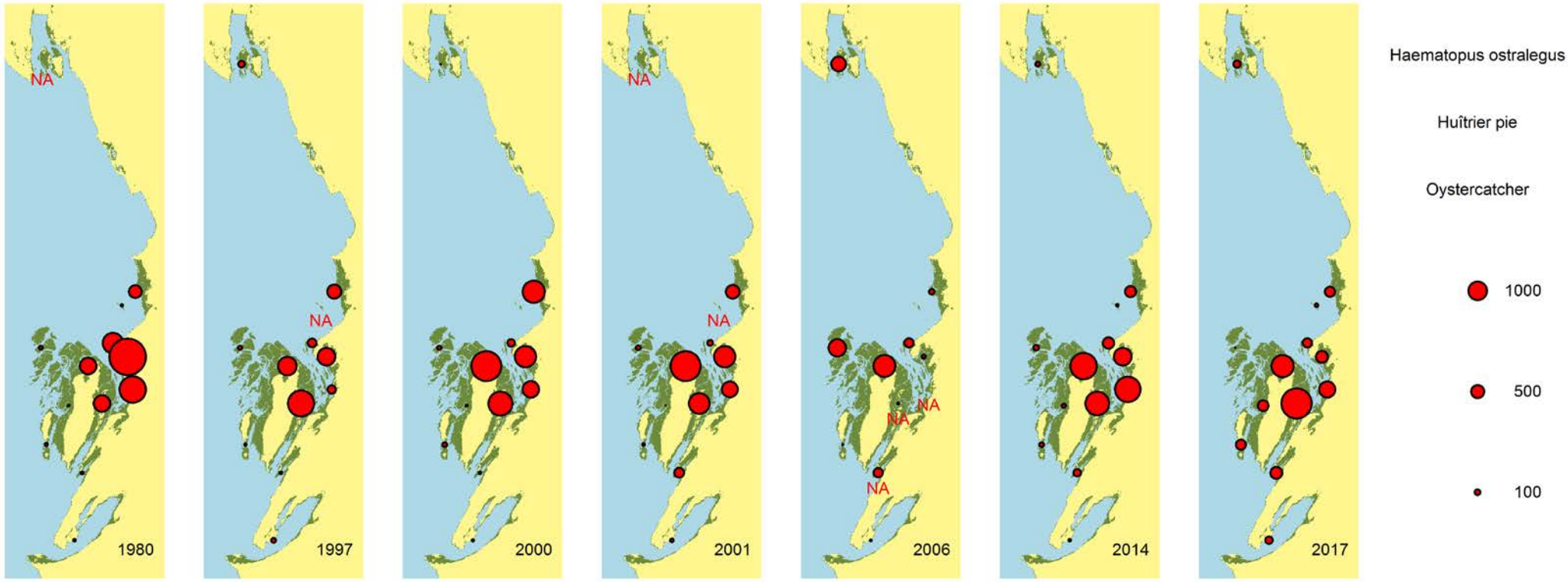
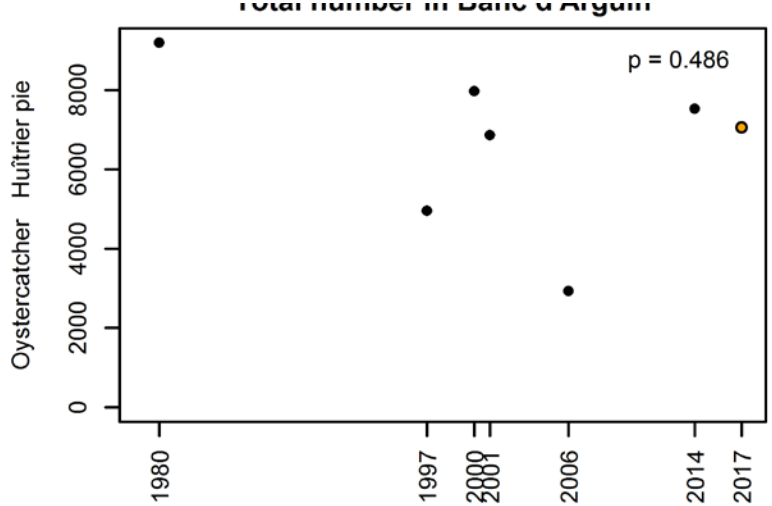
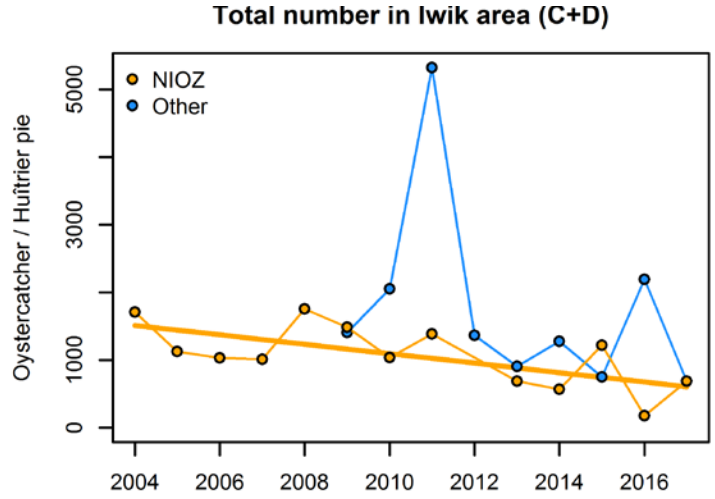
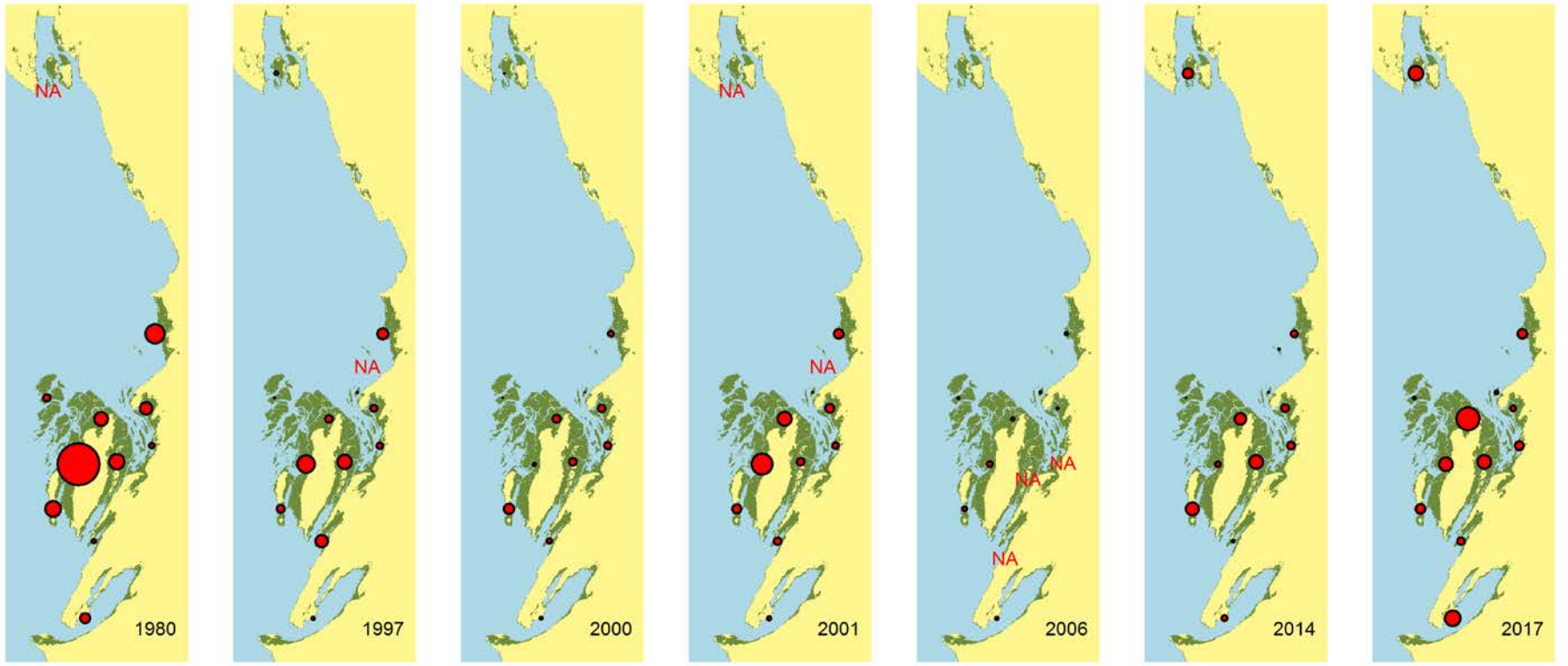
Large Falcon Grand Faucon
0
10
20
30
40
50
1980
1997
2000
2001
2006
2014
2017

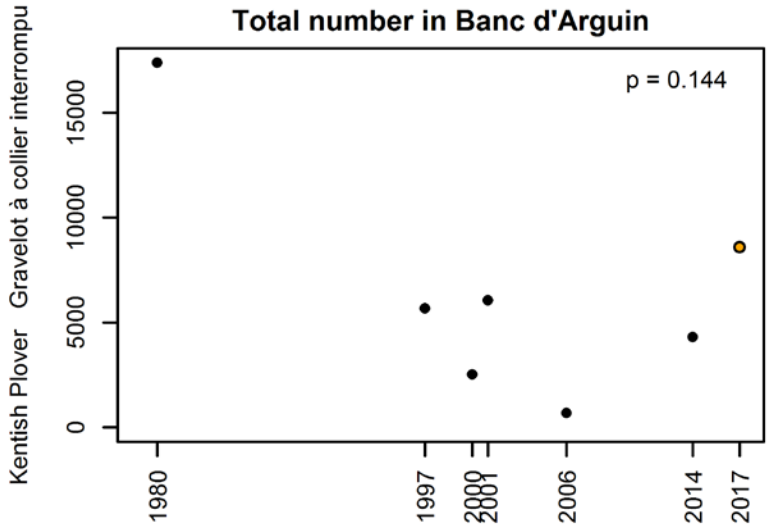

Total number in Iwik area (C+D)
NIOZ
Other
Large Falcon / Grand Faucon
0
1
2
3
4
5
2004
2006
2008
2010
2012
2014
2016

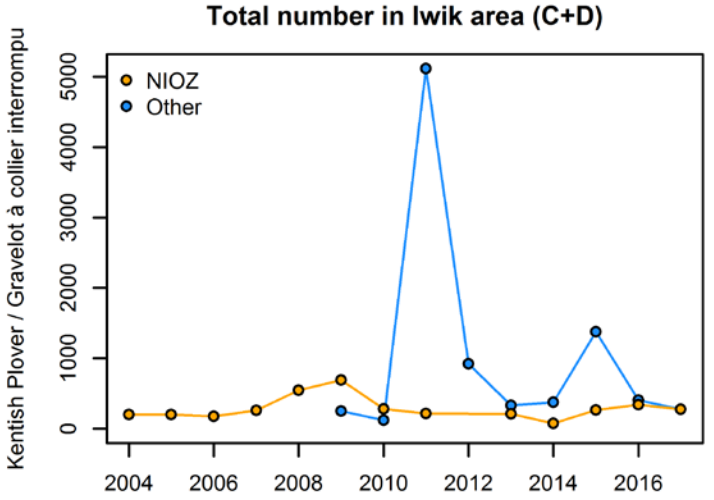

NA
1980
1997
2000
2001
2006
2014
2017
Haematopus ostralegus
Huîtrier pie
Oystercatcher
1000
500
100

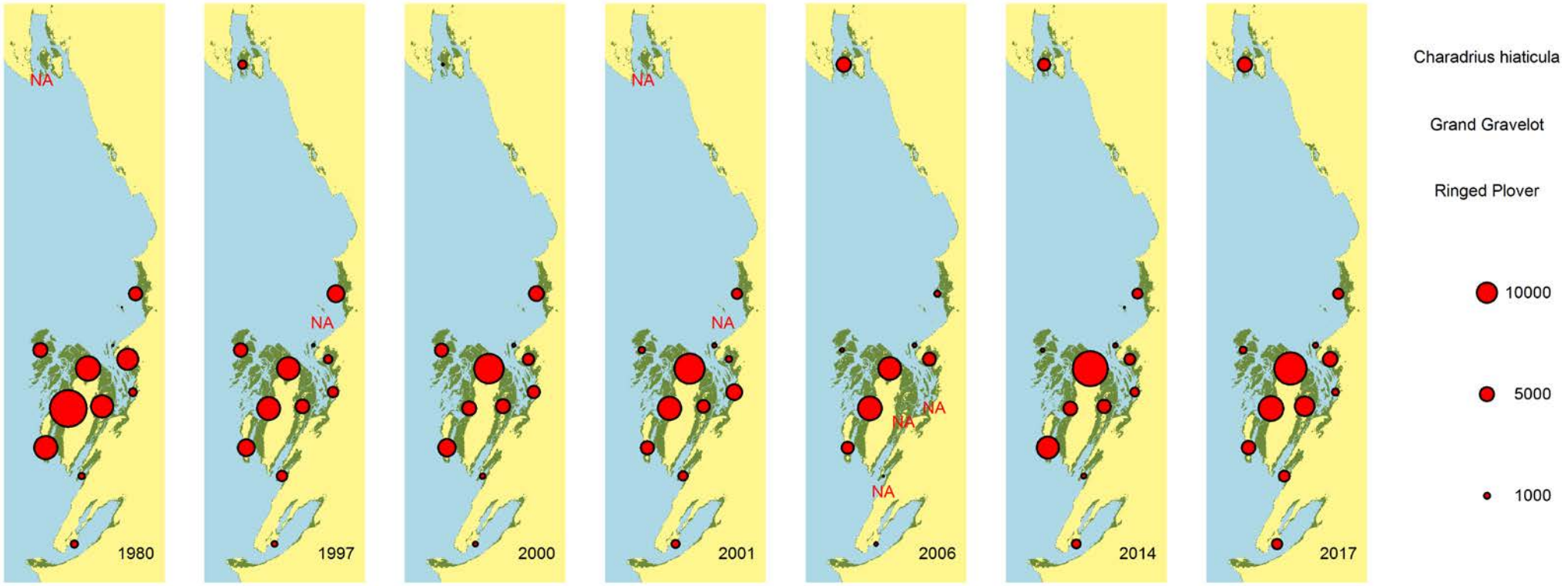

p = 0.486
Oystercatcher Huîtrier pie
0
2000
4000
6000
8000
1980
1997
2000
2001
2006
2014
2017

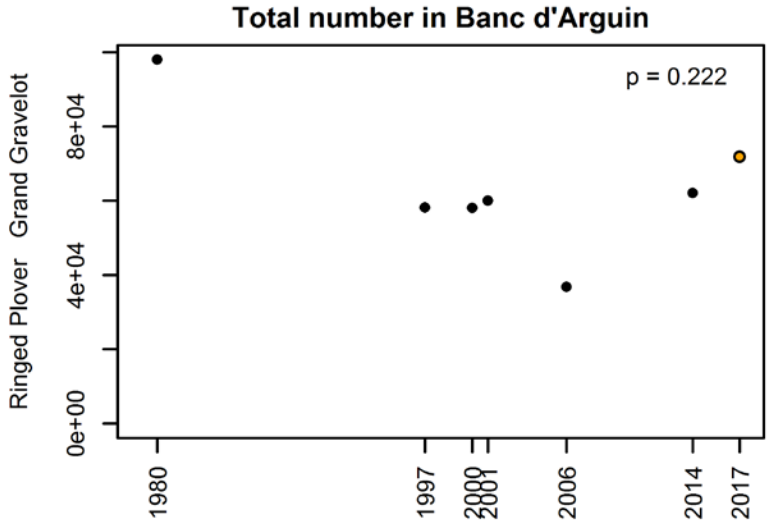

Total number in Iwik area (C+D)
NIOZ
Other
Oystercatcher / Huîtrier pie
0
1000
3000
5000
2004
2006
2008
2010
2012
2014
2016

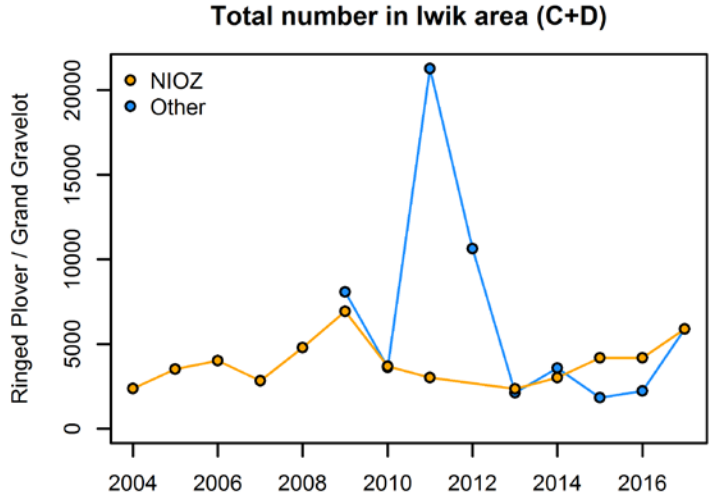

NA
1980
1997
2000
2001
2006
2014
2017
Charadrius alexandrinus
Gravelot à collier interrompu
Kentish Plover
1000
500
100

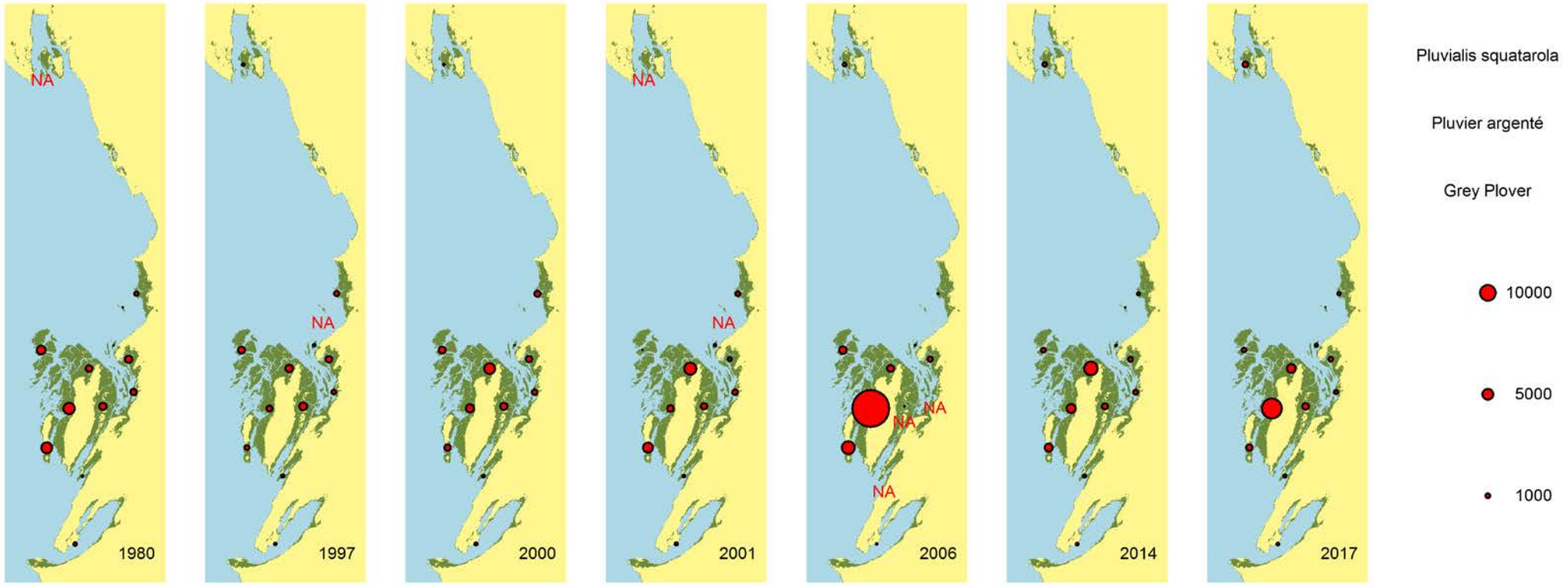

Total number in Banc d'Arguin
p = 0.144
Kentish Plover Gravelot à collier interrompu
0
5000
10000
15000
1980
1997
2000
2001
2006
2014
2017

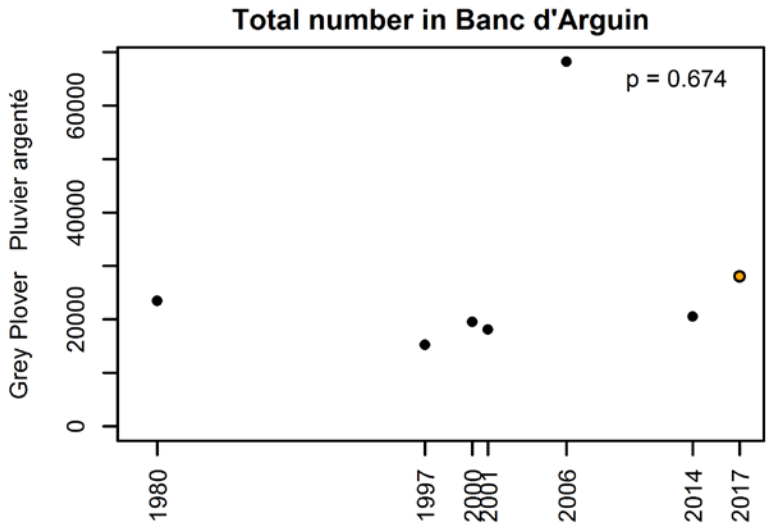

Total number in Iwik area (C+D)
NIOZ
Other
Kentish Plover / Gravelot à collier interrompu
0
1000
2000
3000
4000
5000
2004
2006
2008
2010
2012
2014
2016

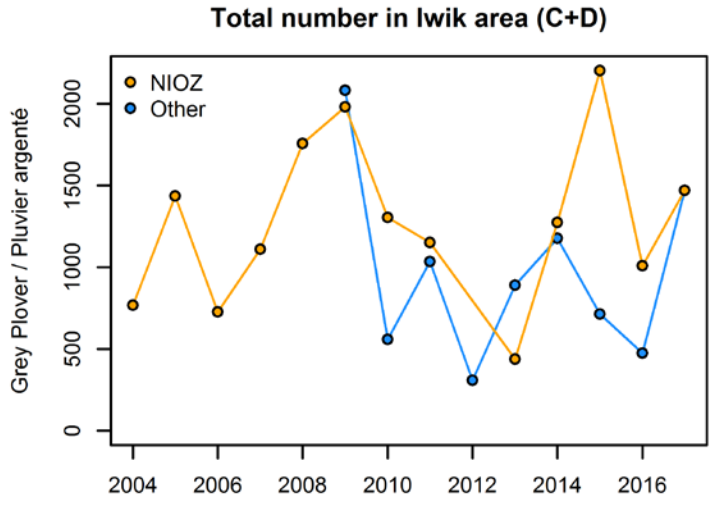

NA
1980
1997
2000
2001
2006
2014
2017
Charadrius hiaticula
Grand Gravelot
Ringed Plover
10000
5000
1000

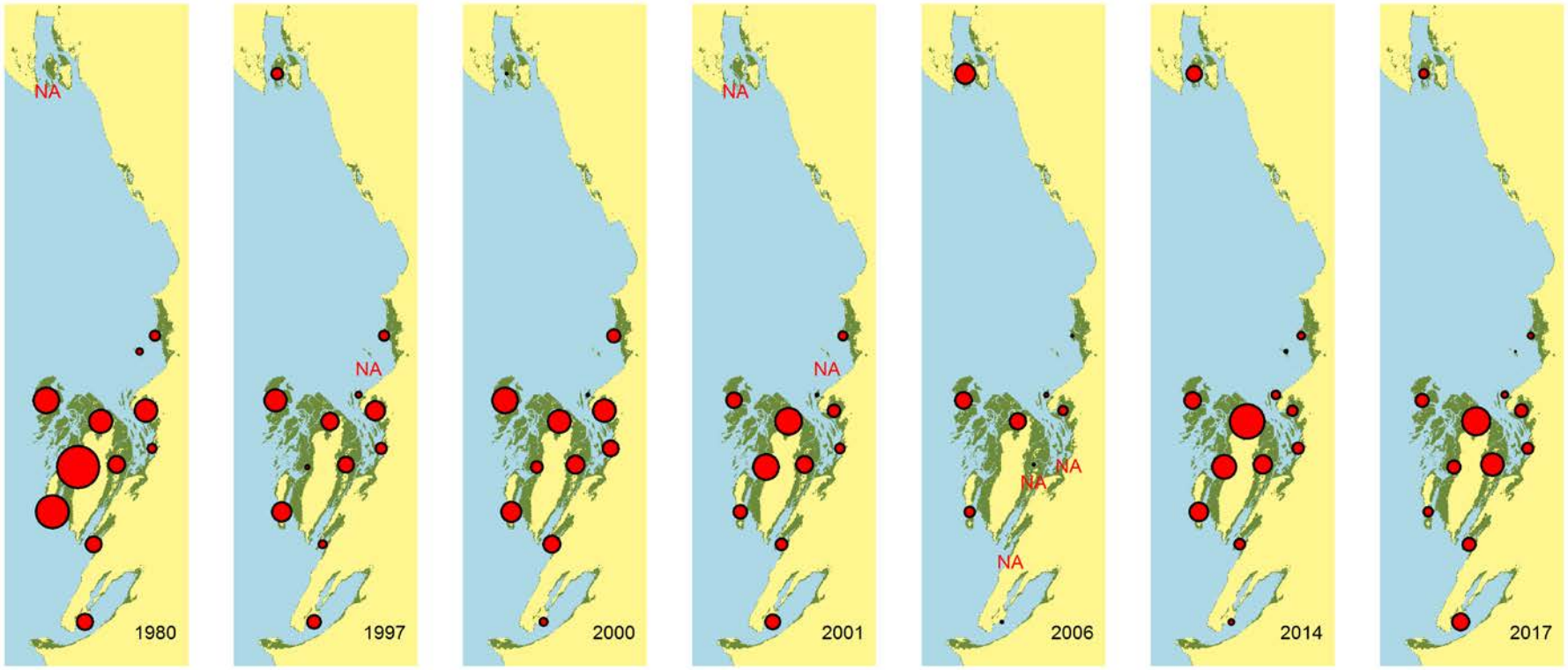

Total number in Banc d'Arguin
p = 0.222
Ringed Plover Grand Gravelot
0e+00
4e+04
8e+04
1980
1997
2000
2001
2006
2014
2017

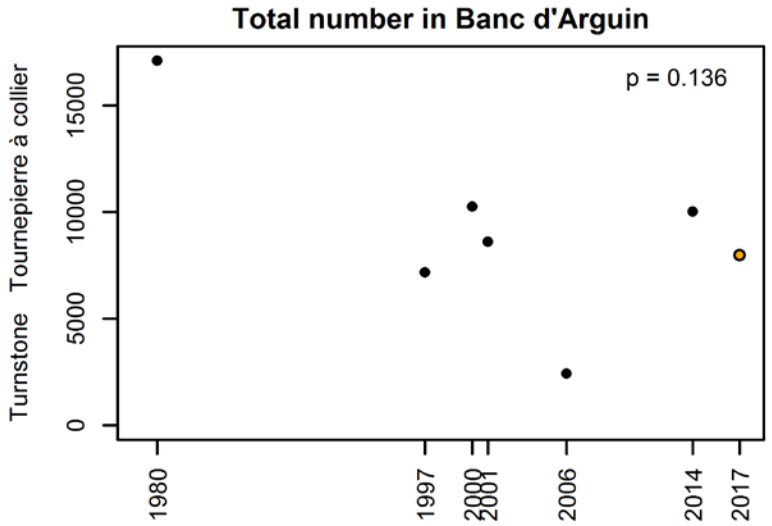

Total number in Iwik area (C+D)
NIOZ
Other
Ringed Plover / Grand Gravelot
0
5000
10000
15000
20000
2004
2006
2008
2010
2012
2014
2016

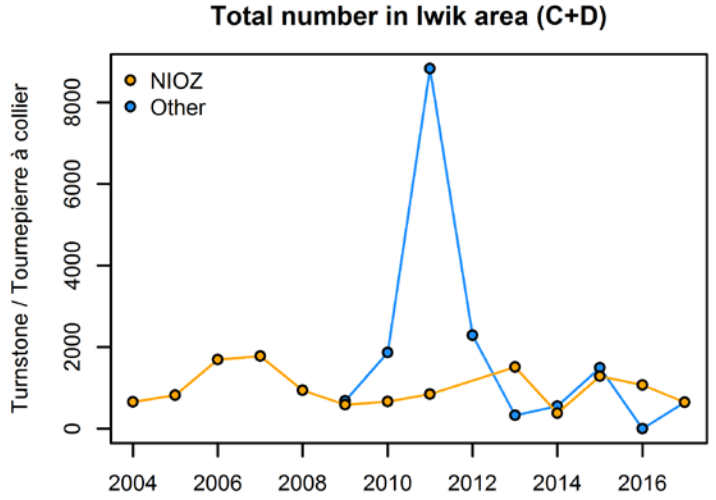

NA
1980
1997
2000
2001
2006
2014
2017
Pluvialis squatarola
Pluvier argenté
Grey Plover
10000
5000
1000

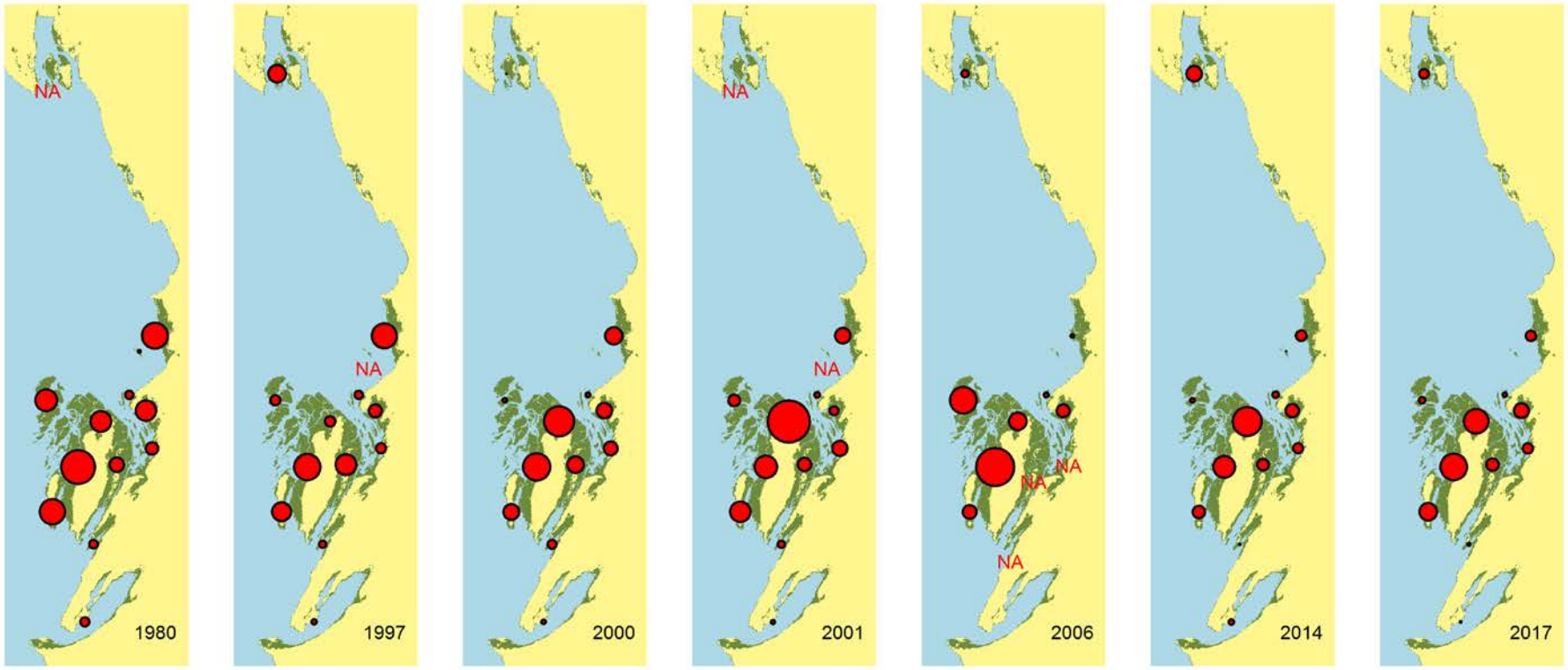

Total number in Banc d'Arguin
Grey Plover Pluvier argenté
p = 0.674
0
20000
40000
60000
1980
1997
2000
2001
2006
2014
2017

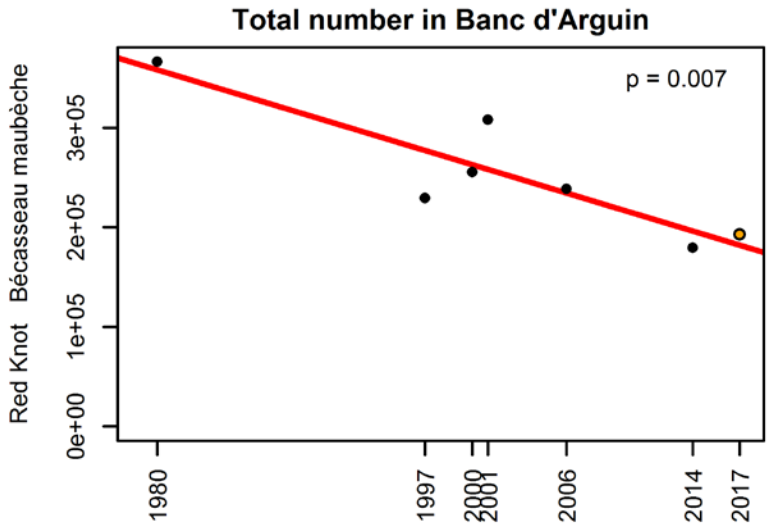

Total number in Iwik area (C+D)
Grey Plover / Pluvier argenté
NIOZ
Other
0
500
1000
1500
2000
2004
2006
2008
2010
2012
2014
2016

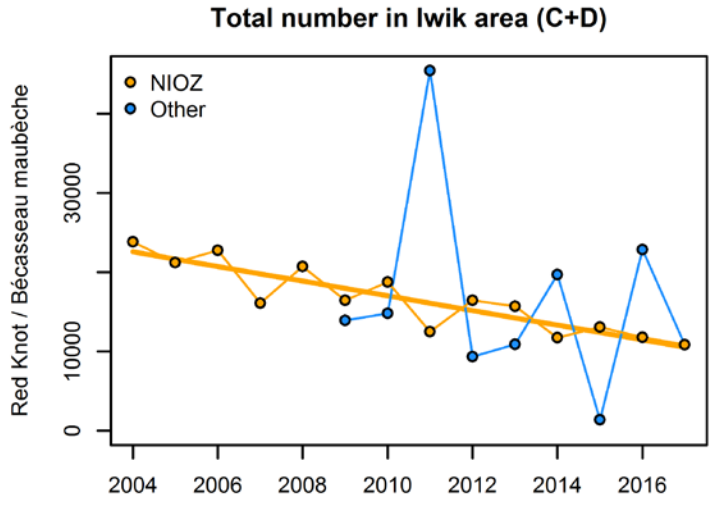

NA
1980
1997
2000
2001
2006
2014
2017
Arenaria interpres
Tournepierre à collier
Turnstone
1000
500
100

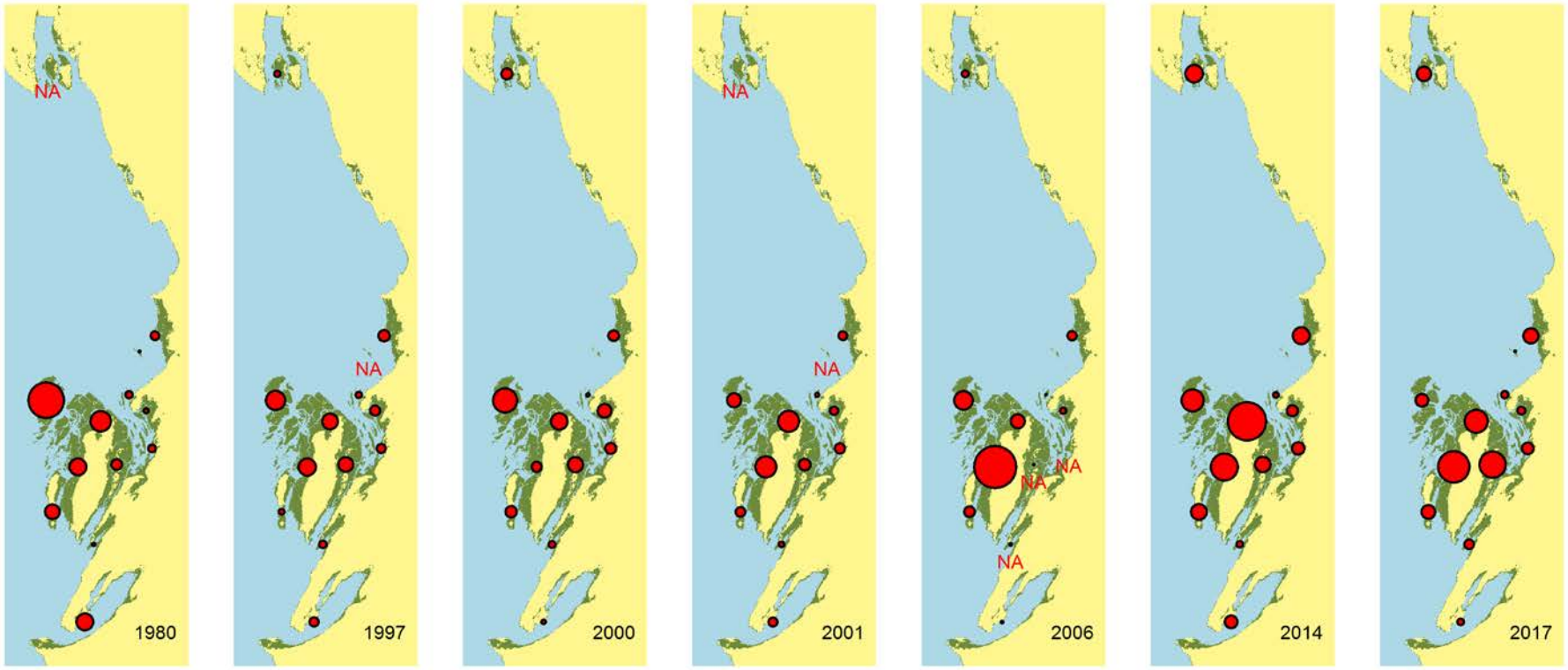

Total number in Banc d'Arguin
p = 0.136
Turnstone Tournepierre à collier
0
5000
10000
15000
1980
1997
2000
2001
2006
2014
2017

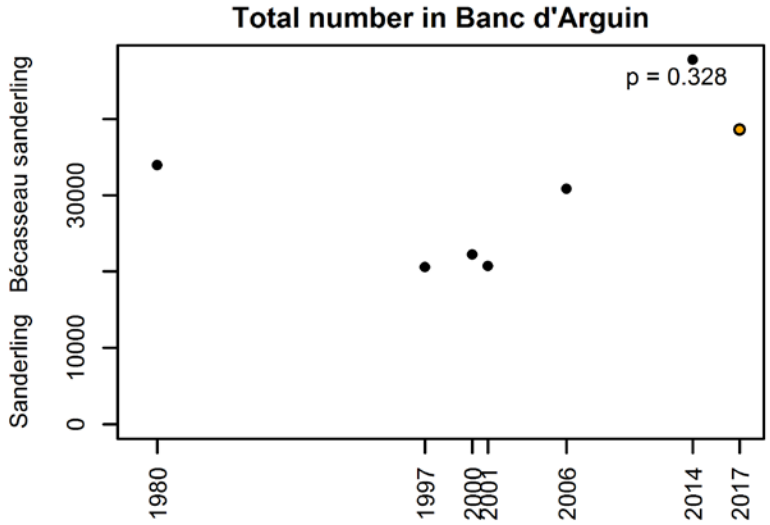

Total number in Iwik area (C+D)
NIOZ
Other
Turnstone / Tournepierre à collier
0
2000
4000
6000
8000
2004
2006
2008
2010
2012
2014
2016

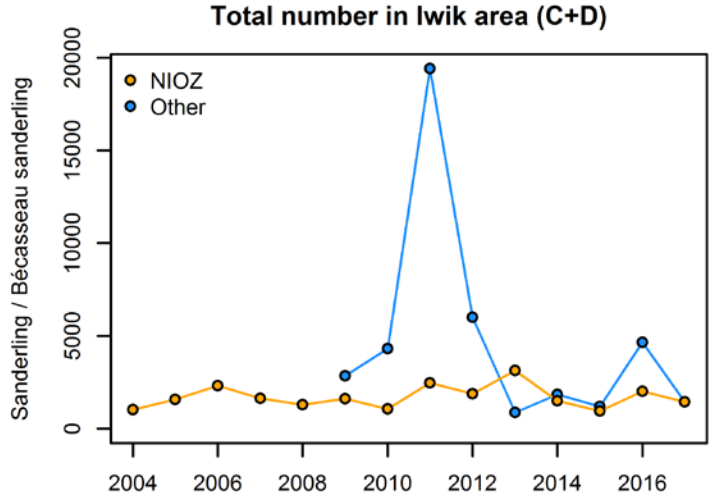

NA
1980
1997
2000
2001
2006
2014
2017
Calidris canutus
Bécasseau maubèche
Red Knot
1e+05
50000
10000

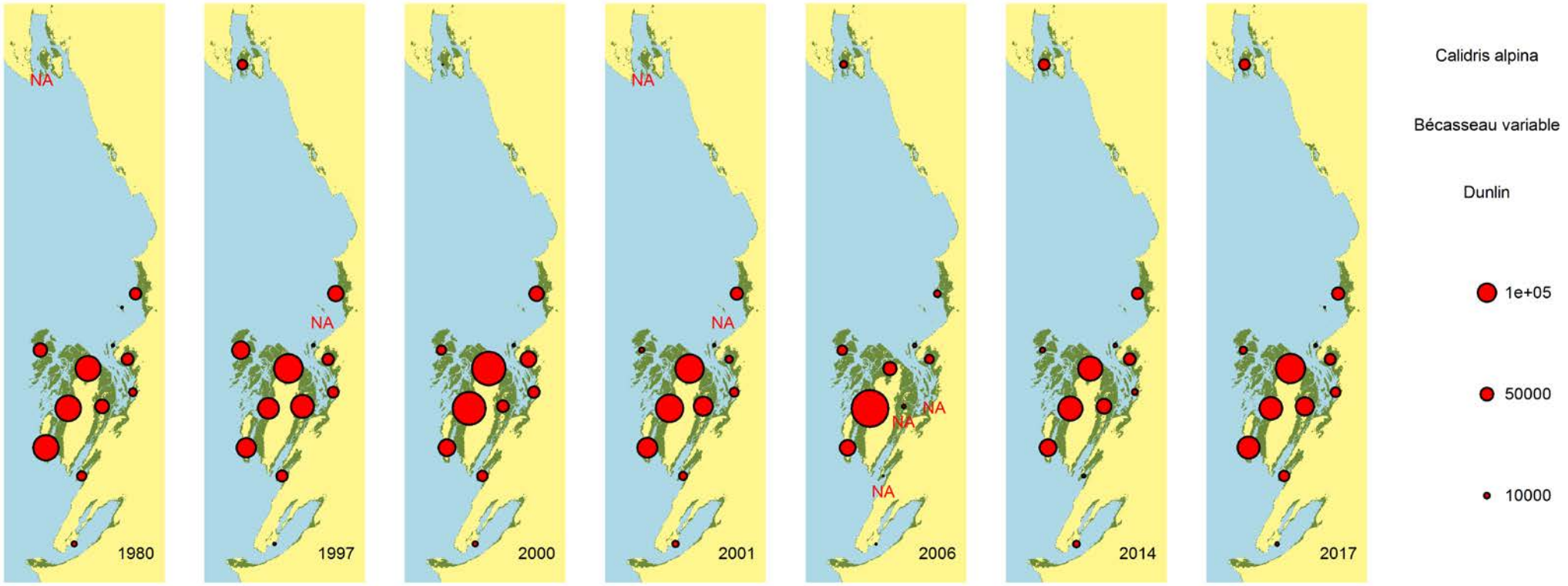

Total number in Banc d'Arguin
p = 0.007
Red Knot Bécasseau maubèche
0e+00
1e+05
2e+05
3e+05
1980
1997
2000
2001
2006
2014
2017

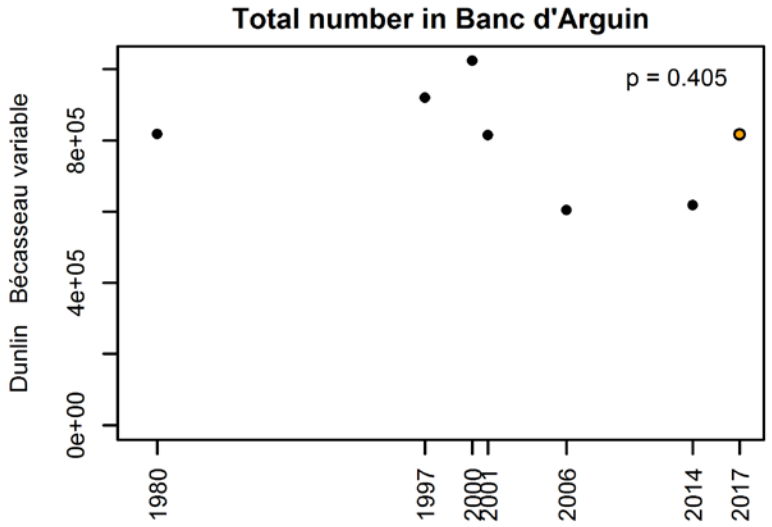

Total number in Iwik area (C+D)
NIOZ
Other
Red Knot / Bécasseau maubèche
0
10000
30000
2004
2006
2008
2010
2012
2014
2016

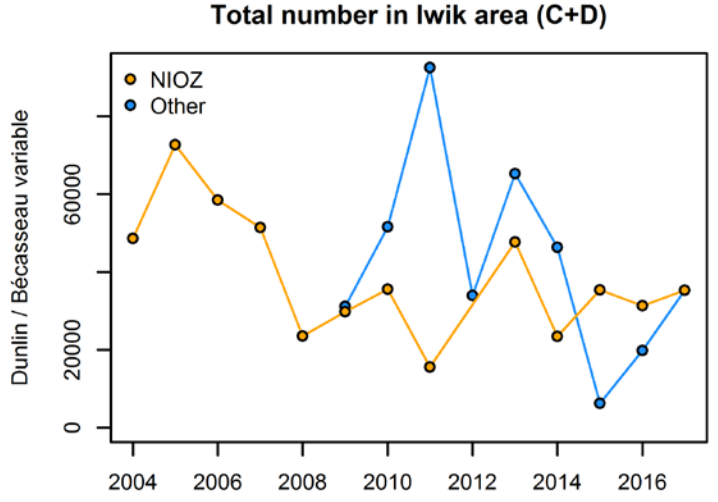

NA
1980
1997
2000
2001
2006
2014
2017
Calidris alba
Bécasseau sanderling
Sanderling
10000
5000
1000

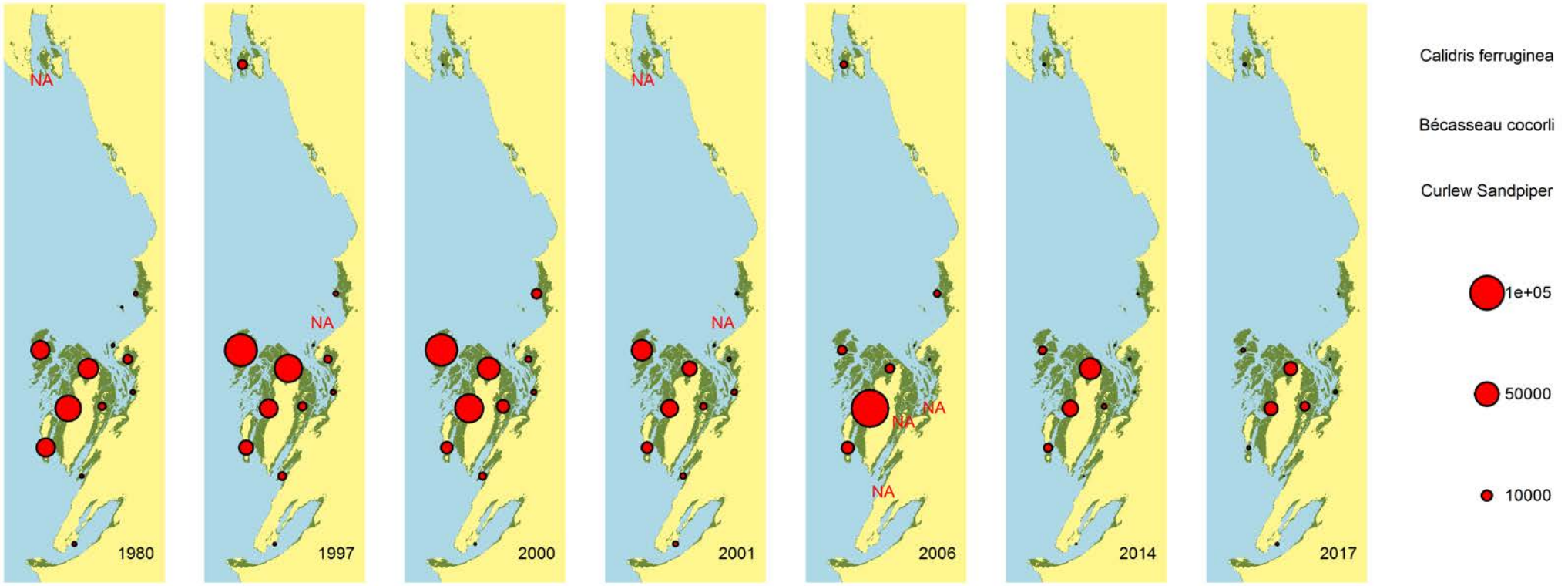

Total number in Banc d'Arguin
p = 0.328
Sanderling Bécasseau sanderling
0
10000
30000
1980
1997
2000
2001
2006
2014
2017

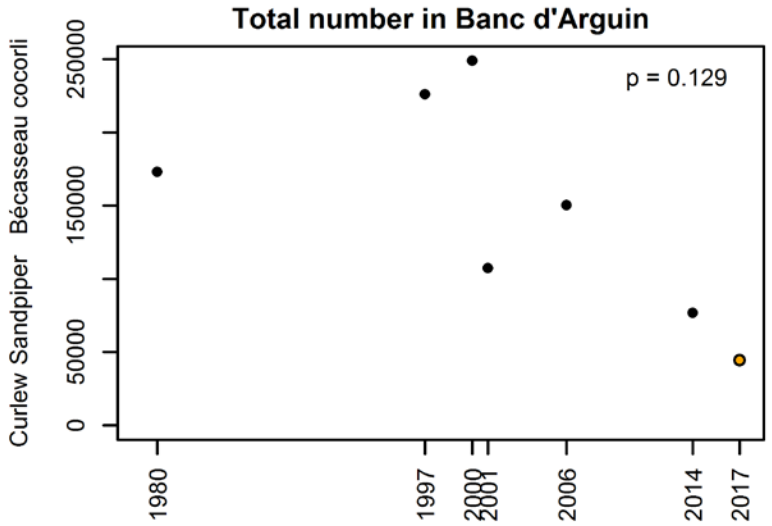

Total number in Iwik area (C+D)
NIOZ
Other
Sanderling / Bécasseau sanderling
0
5000
10000
15000
20000
2004
2006
2008
2010
2012
2014
2016

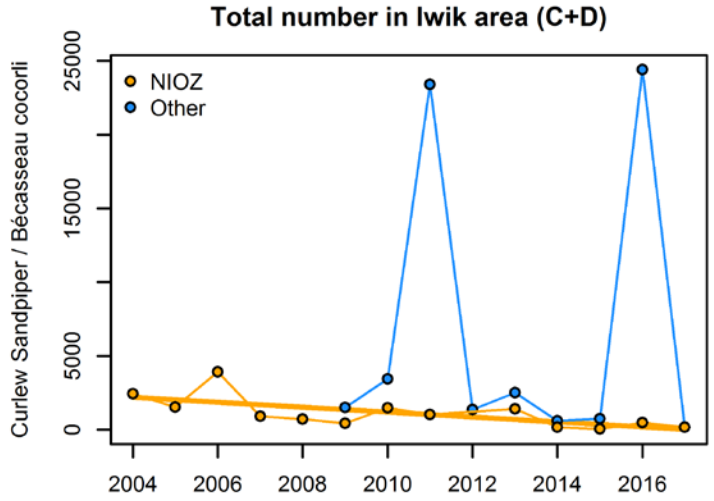

NA
1980
1997
2000
2001
2006
2014
2017
Calidris alpina
Bécasseau variable
Dunlin
1e+05
50000
10000

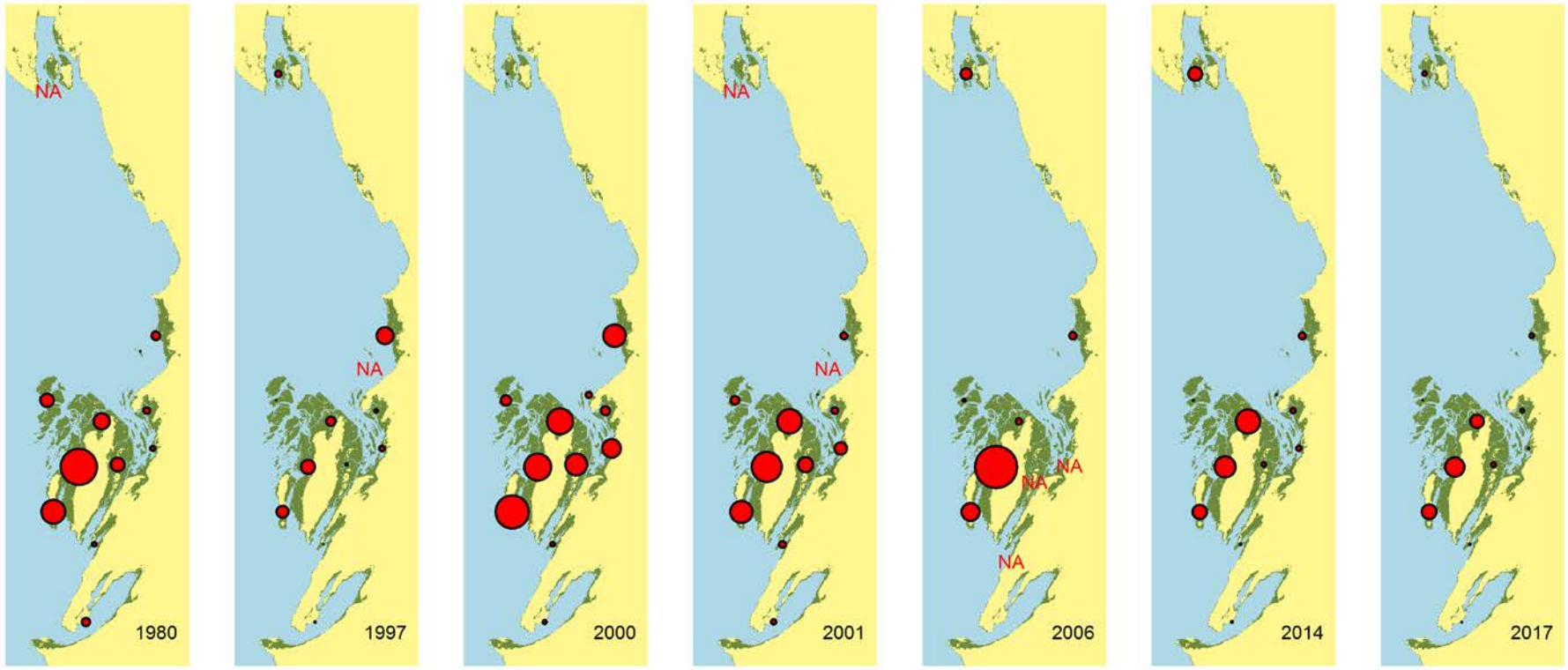

Total number in Banc d'Arguin
p = 0.405
Dunlin Bécasseau variable
0e+00
4e+05
8e+05
1980
1997
2000
2001
2006
2014
2017

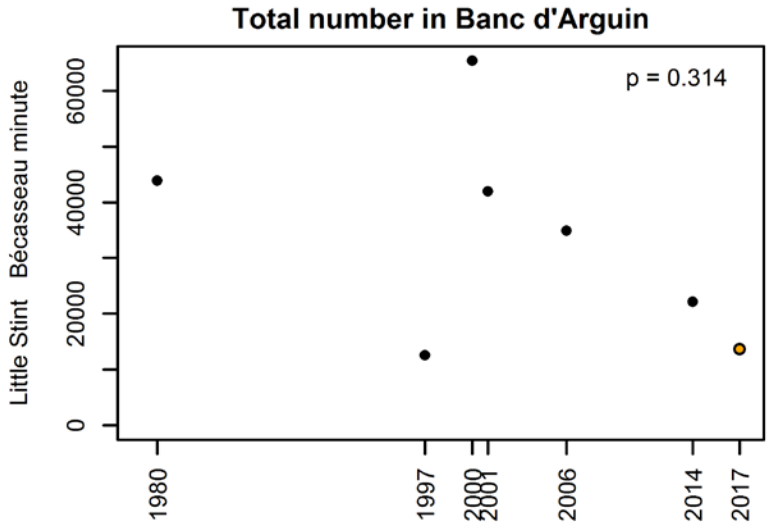

Total number in Iwik area (C+D)
NIOZ
Other
Dunlin / Bécasseau variable
0
20000
60000
2004
2006
2008
2010
2012
2014
2016

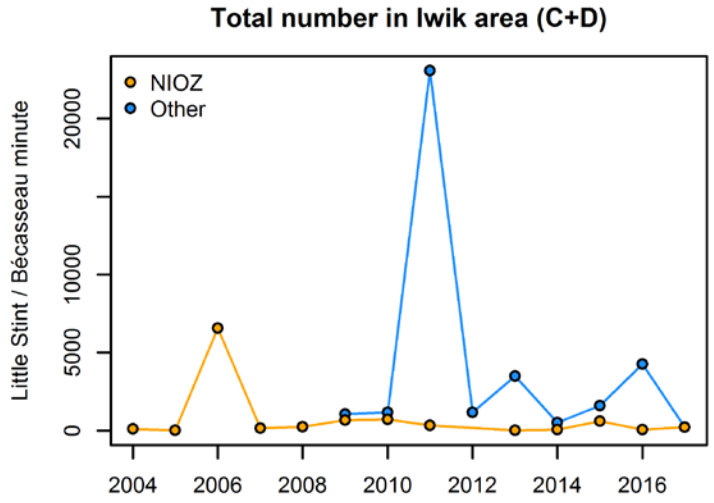

NA
1980
1997
2000
2001
2006
2014
2017
Calidris ferruginea
Bécasseau cocorli
Curlew Sandpiper
1e+05
50000
10000

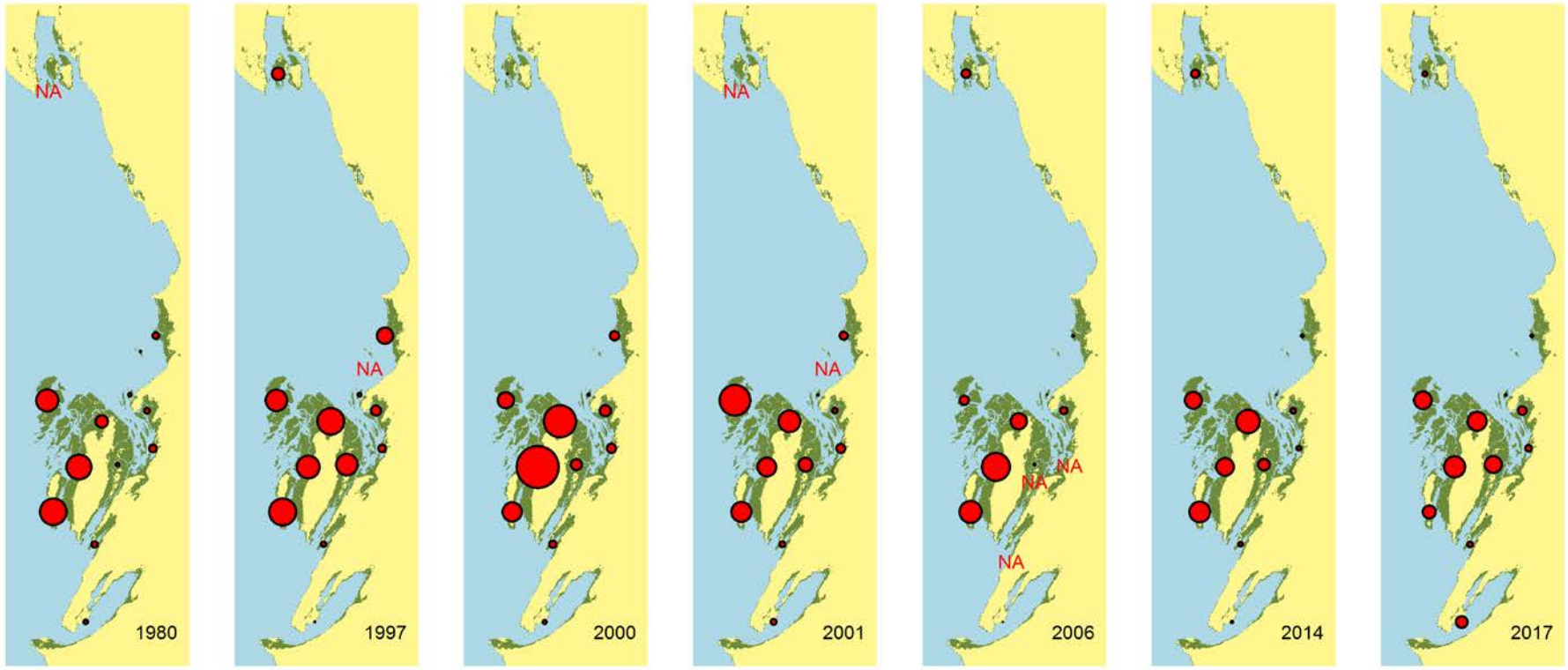

Total number in Banc d'Arguin
Curlew Sandpiper Bécasseau cocorli
0
50000
150000
250000
p = 0.129
1980
1997
2000
2001
2006
2014
2017

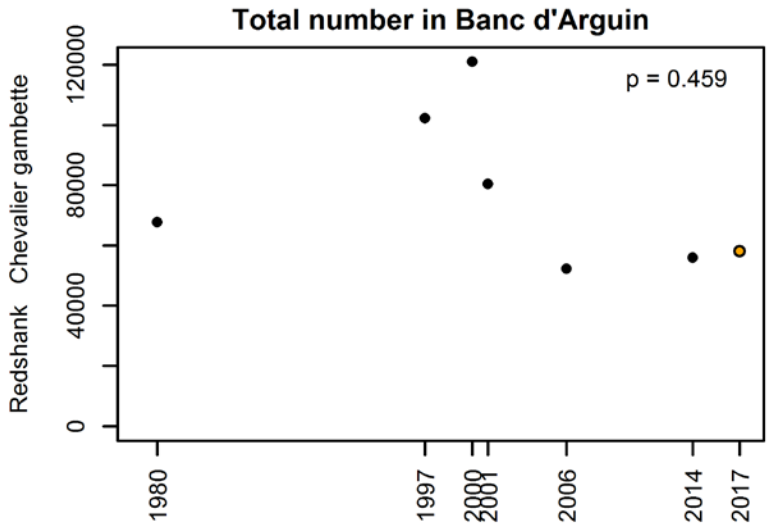

Total number in Iwik area (C+D)
Curlew Sandpiper / Bécasseau cocorli
0
5000
15000
25000
NIOZ
Other
2004
2006
2008
2010
2012
2014
2016

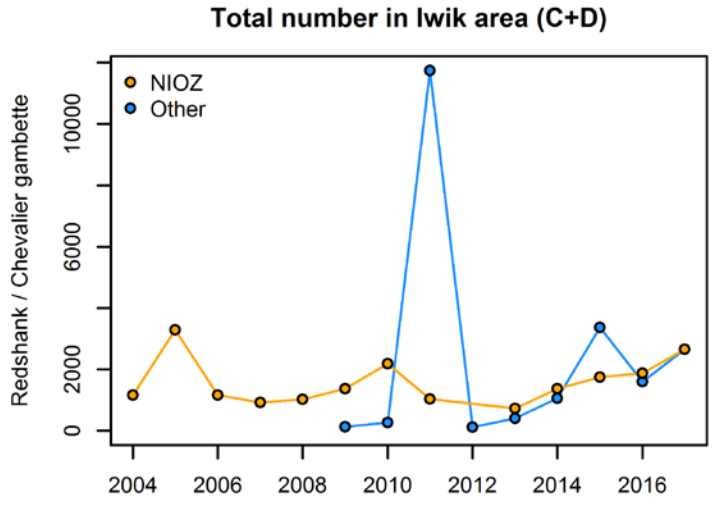

NA
1980
1997
2000
2001
2006
2014
2017
Calidris minuta
Bécasseau minute
Little Stint
10000
5000
1000

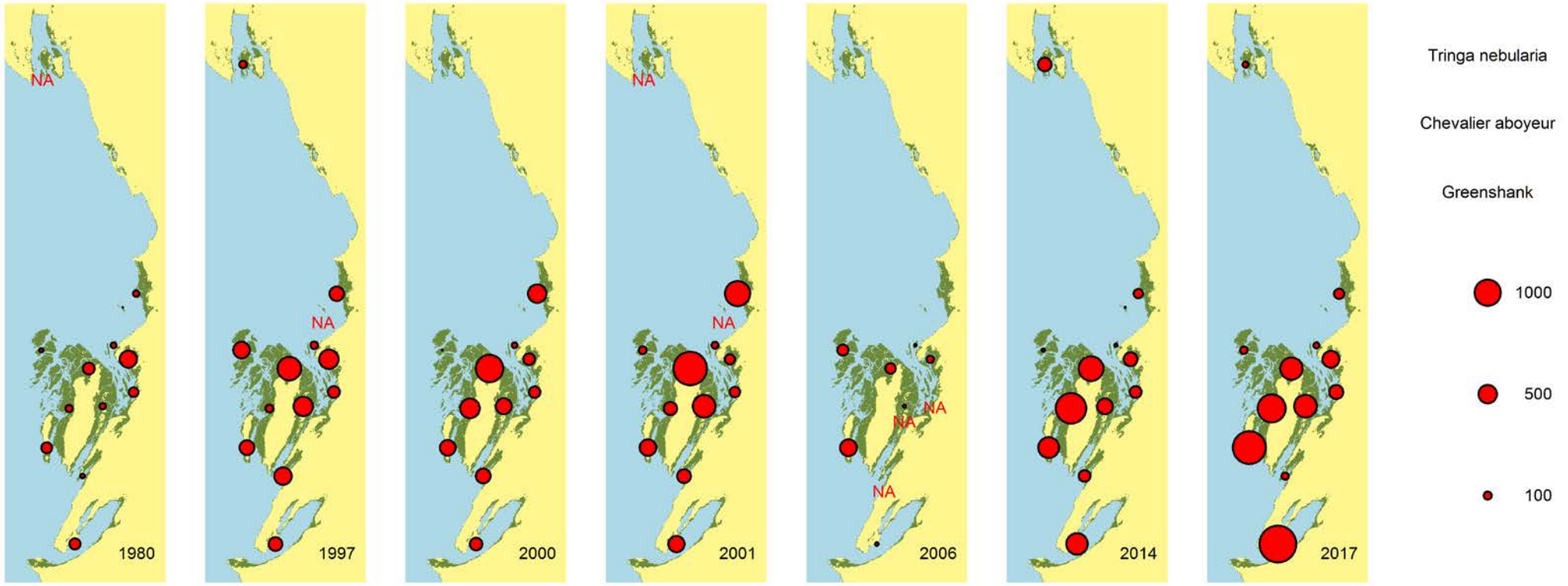

Total number in Banc d'Arguin
p = 0.314
Little Stint Bécasseau minute
0
20000
40000
60000
1980
1997
2000
2001
2006
2014
2017

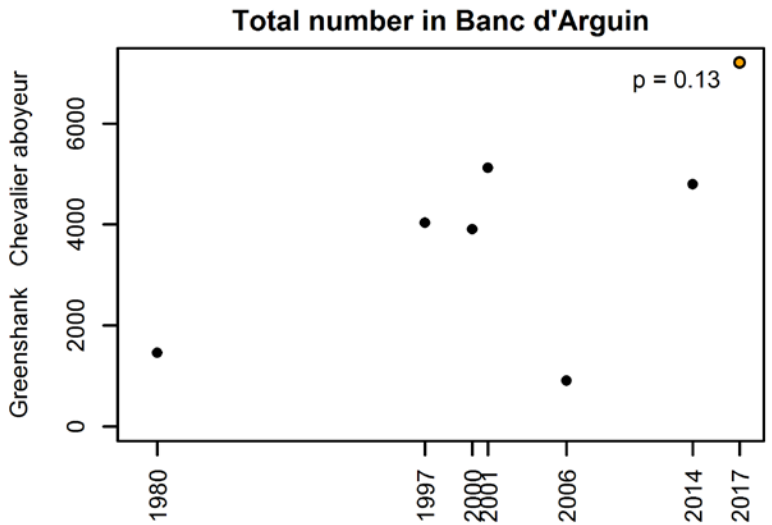

Total number in Iwik area (C+D)
NIOZ
Other
Little Stint / Bécasseau minute
0
5000
10000
20000
2004
2006
2008
2010
2012
2014
2016

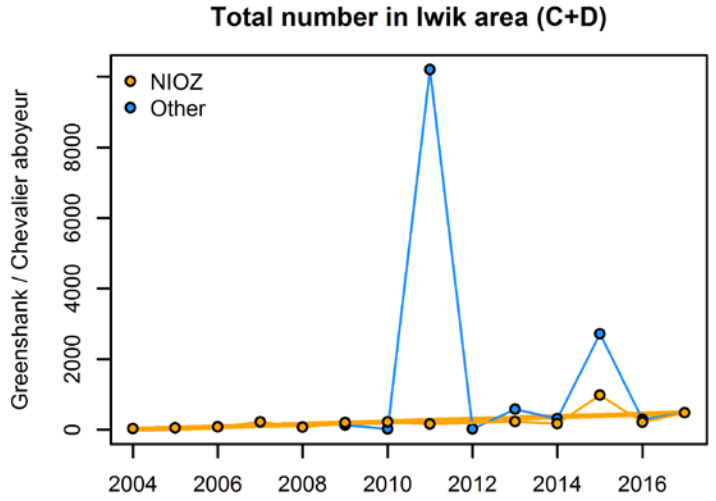

NA
1980
1997
2000
2001
2006
2014
2017
Tringa totanus
Chevalier gambette
Redshank
10000
5000
1000

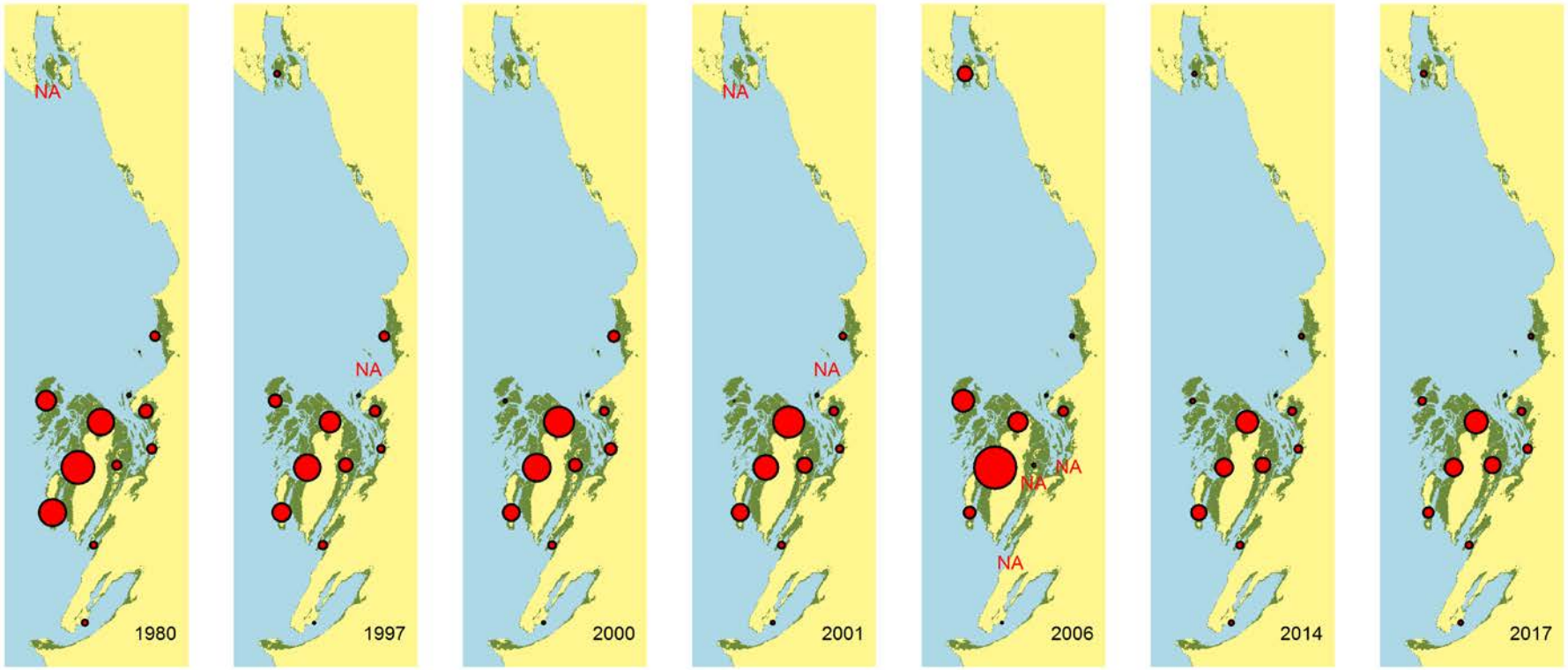

Total number in Banc d'Arguin
p = 0.459
Redshank Chevalier gambette
0
40000
80000
120000
1980
1997
2000
2001
2006
2014
2017

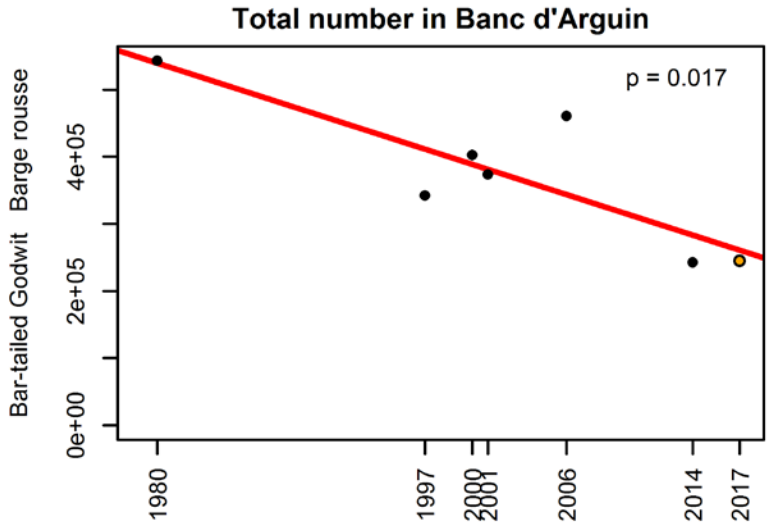

Total number in Iwik area (C+D)
NIOZ
Other
Redshank / Chevalier gambette
0
2000
6000
10000
2004
2006
2008
2010
2012
2014
2016

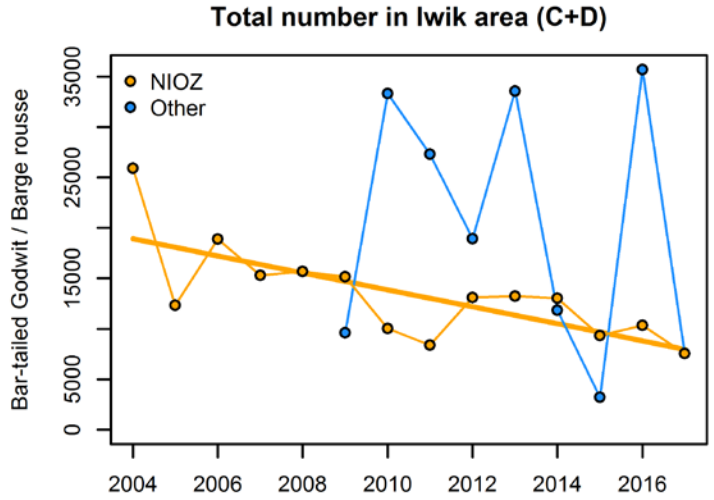

NA
1980
1997
2000
2001
2006
2014
2017
Tringa nebularia
Chevalier aboyeur
Greenshank
1000
500
100

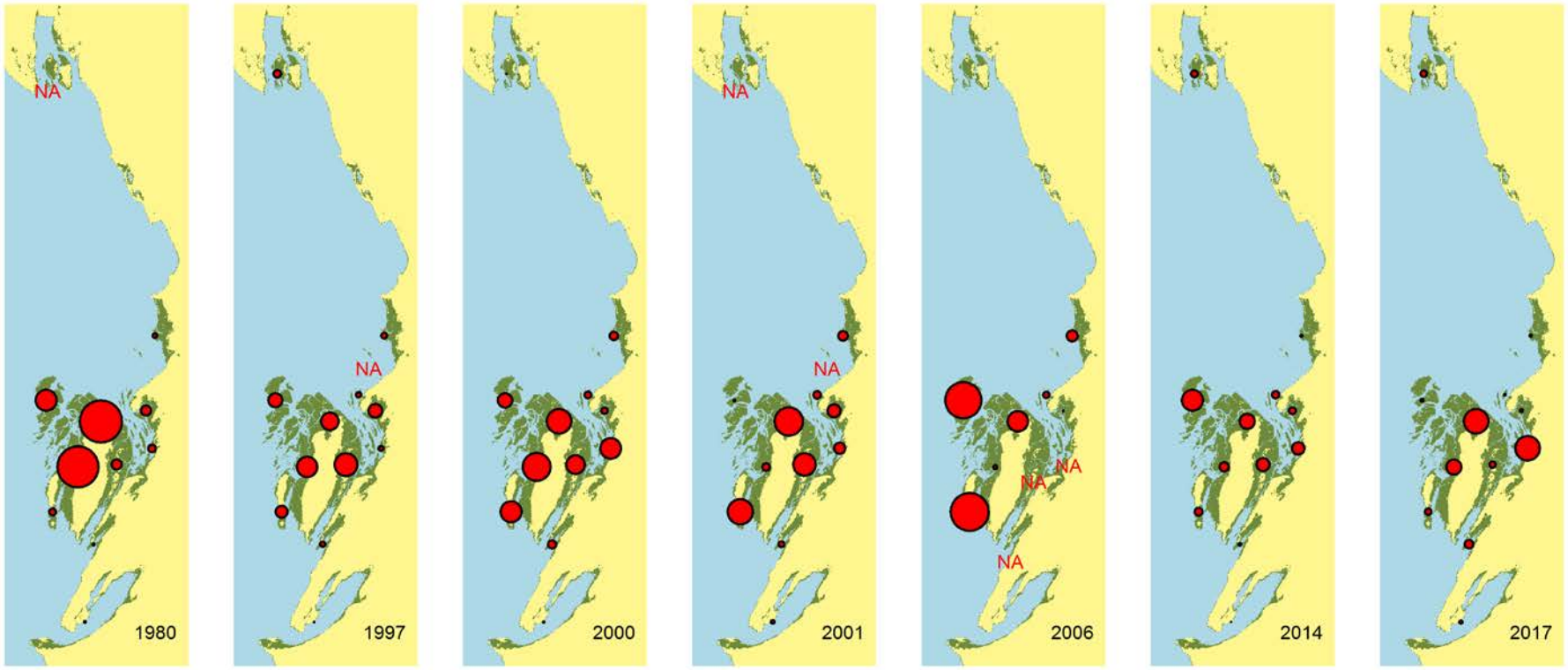

Total number in Banc d'Arguin
p = 0.13
Greenshank Chevalier aboyeur
0
2000
4000
6000
1980
1997
2000
2001
2006
2014
2017

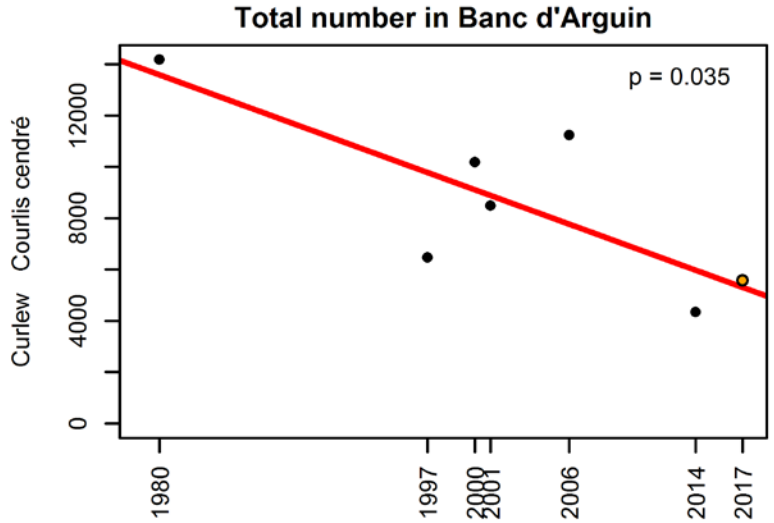

Total number in Iwik area (C+D)
NIOZ
Other
Greenshank / Chevalier aboyeur
0
2000
4000
6000
8000
2004
2006
2008
2010
2012
2014
2016

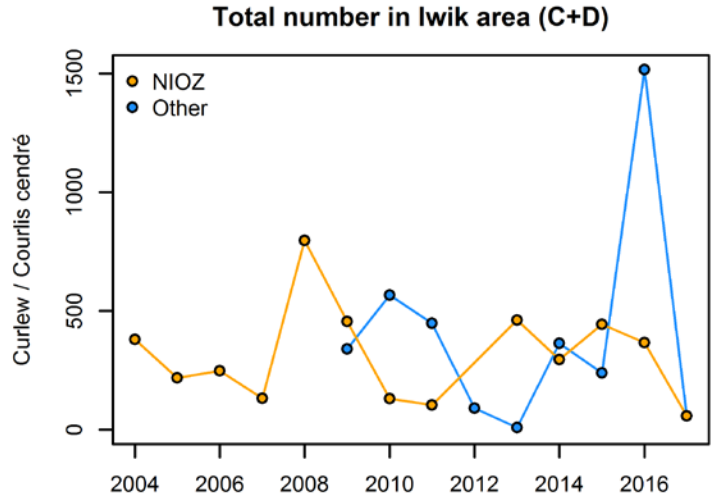

NA
1980
1997
2000
2001
2006
2014
2017
Limosa lapponica
Barge rousse
Bar-tailed Godwit
1e+05
50000
10000

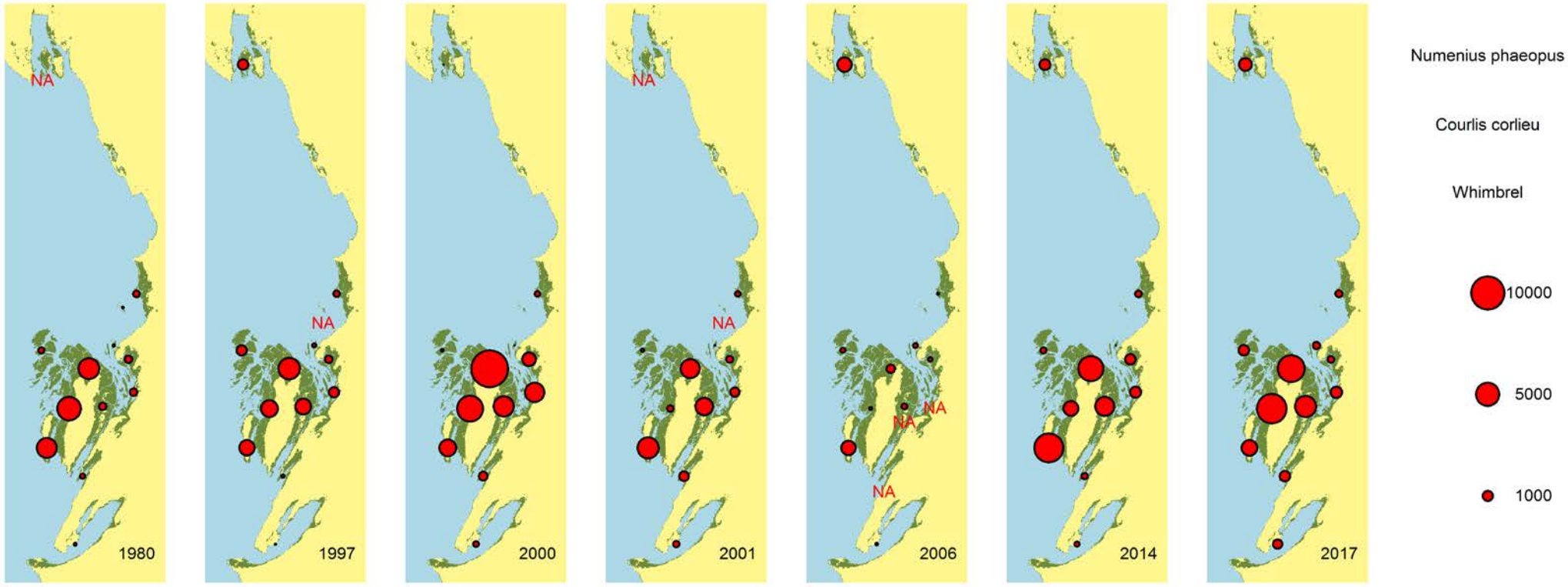

Total number in Banc d'Arguin
p = 0.017
Bar-tailed Godwit Barge rousse
0e+00
2e+05
4e+05
1980
1997
2000
2001
2006
2014
2017

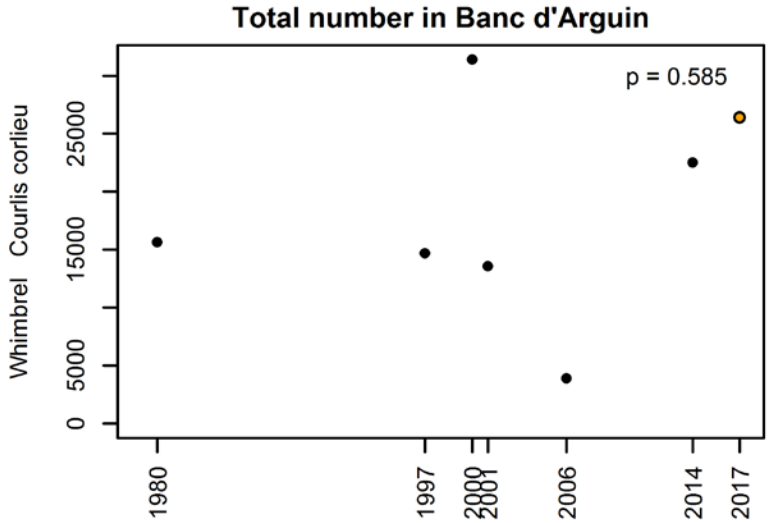

Total number in Iwik area (C+D)
NIOZ
Other
Bar-tailed Godwit / Barge rousse
0
5000
15000
25000
35000
2004
2006
2008
2010
2012
2014
2016

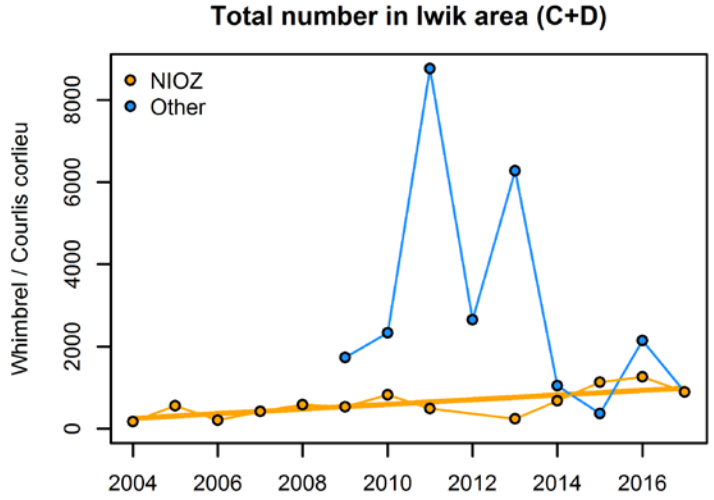

NA
1980
1997
2000
2001
2006
2014
2017
Numenius arquata
Courlis cendré
Curlew
1000
500
100

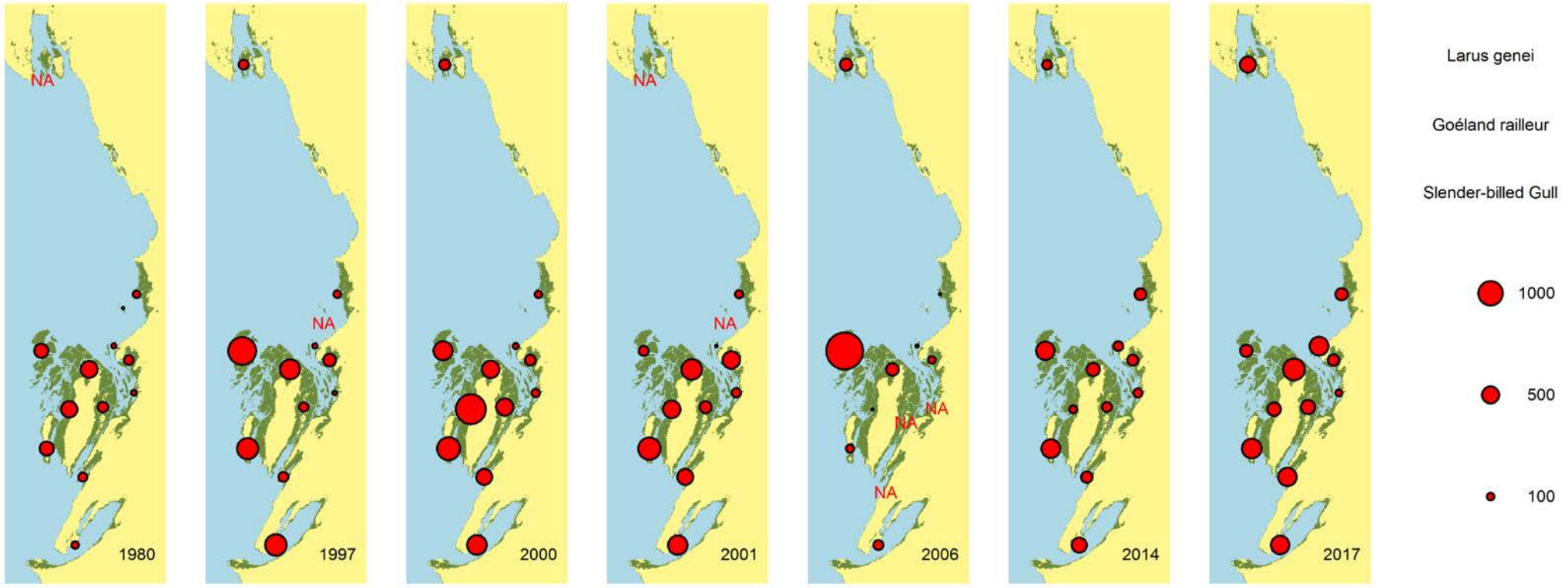

Total number in Banc d'Arguin
p = 0.035
Curlew Courlis cendré
0
4000
8000
12000
1980
1997
2000
2001
2006
2014
2017

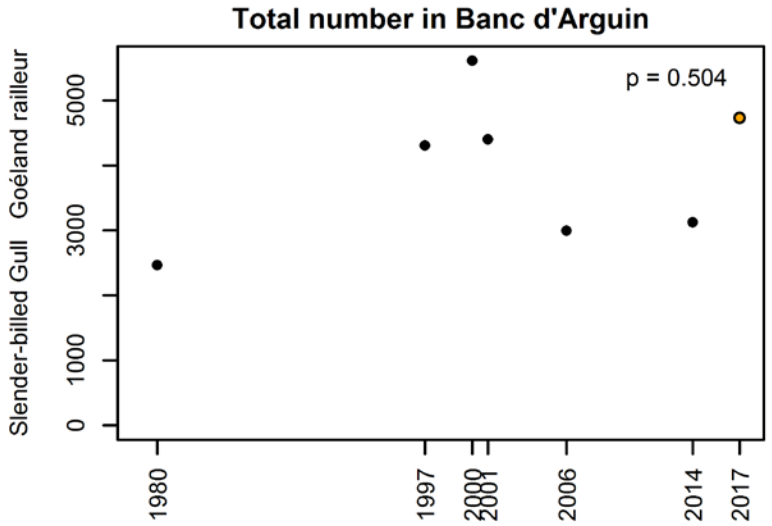

Total number in Iwik area (C+D)
NIOZ
Other
Curlew / Courlis cendré
0
500
1000
1500
2004
2006
2008
2010
2012
2014
2016

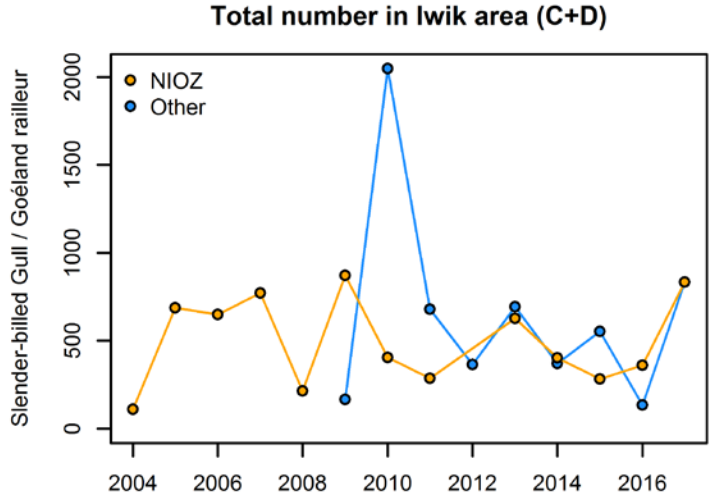

NA
1980
1997
2000
2001
2006
2014
2017
Numenius phaeopus
Courlis corlieu
Whimbrel
10000
5000
1000

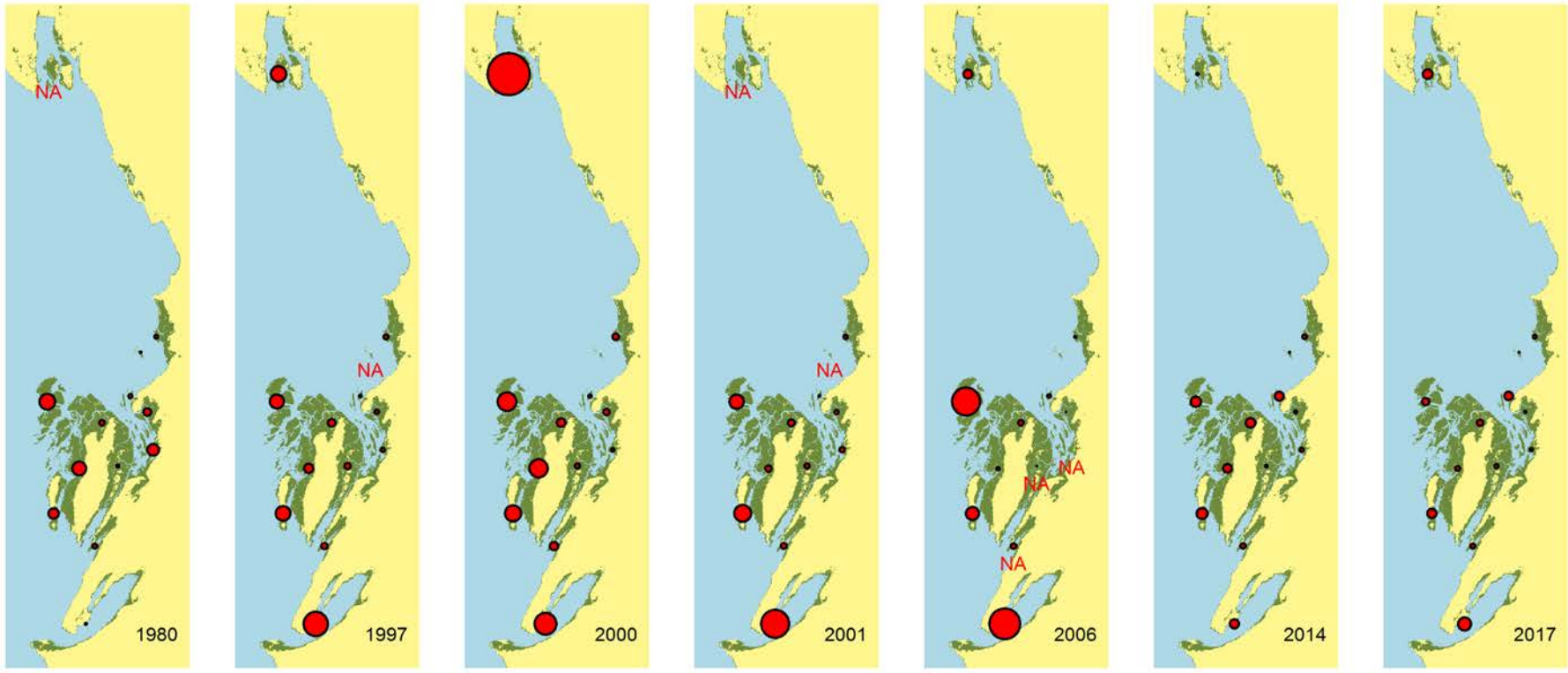

Total number in Banc d'Arguin
p = 0.585
Whimbrel Courlis corlieu
0
5000
15000
25000
1980
1997
2000
2001
2006
2014
2017

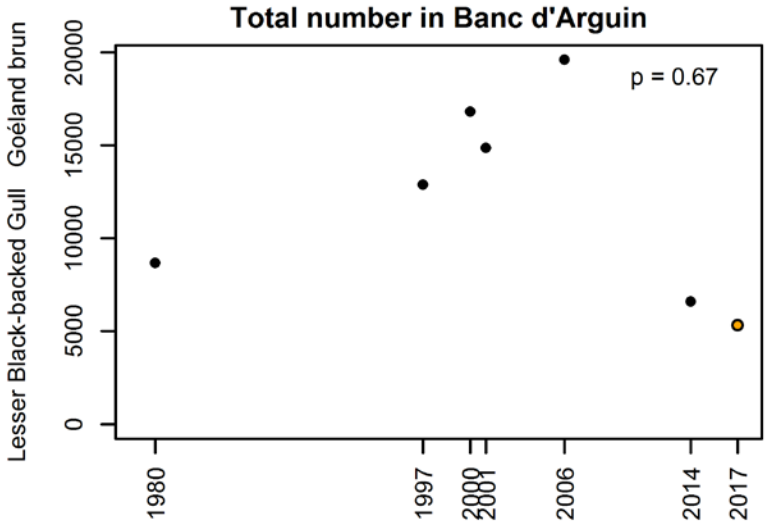

Total number in Iwik area (C+D)
NIOZ
Other
Whimbrel / Courlis corlieu
0
2000
4000
6000
8000
2004
2006
2008
2010
2012
2014
2016

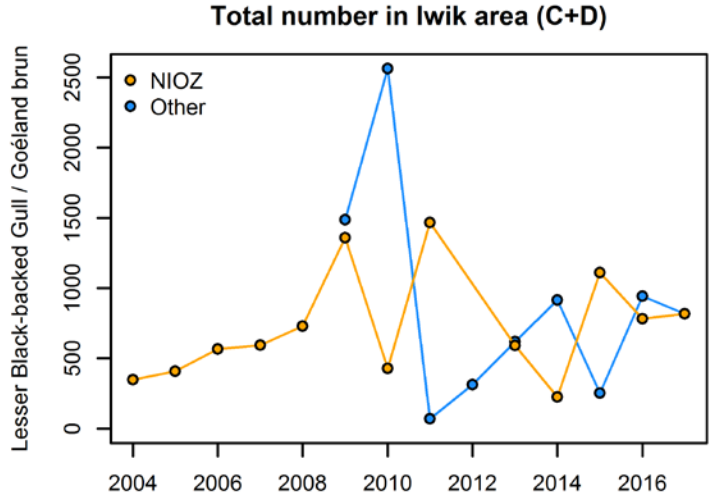

NA
1980
1997
2000
2001
2006
2014
2017
Larus genei
Goéland railleur
Slender-billed Gull
1000
500
100

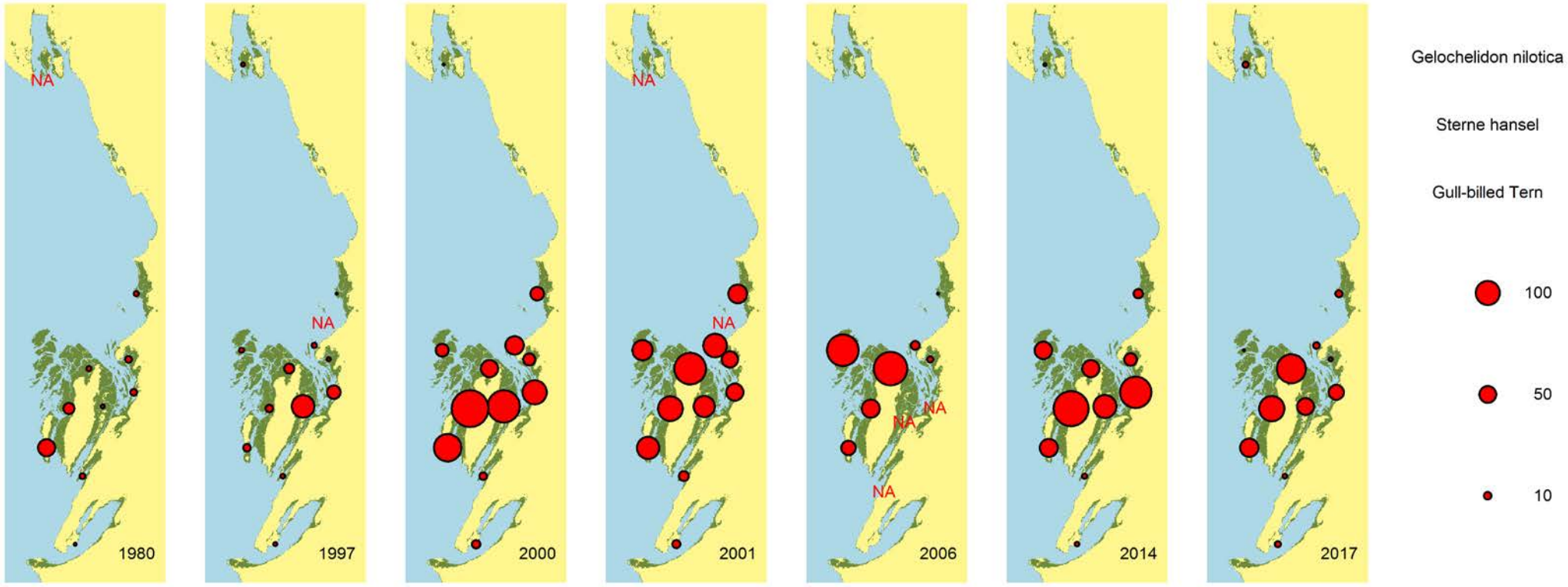

Total number in Banc d'Arguin
Slender-billed Gull Goéland railleur
0
1000
3000
5000
p = 0.504
1980
1997
2000
2001
2006
2014
2017

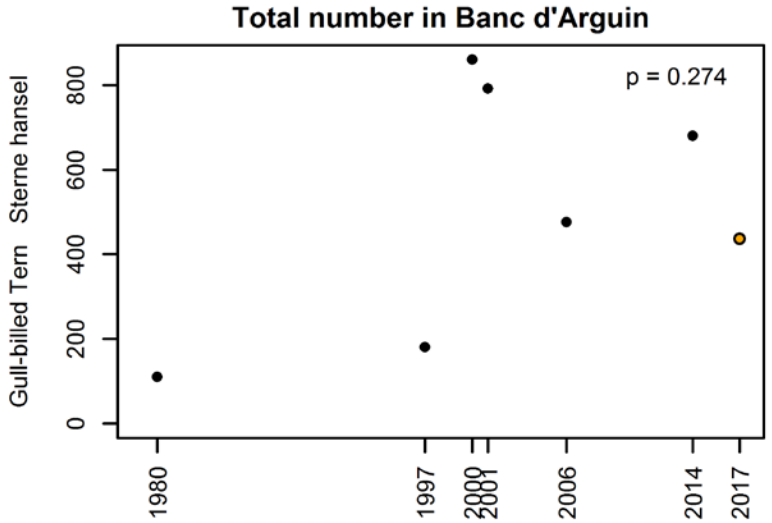

Total number in Iwik area (C+D)
Slender-billed Gull / Goéland railleur
0
500
1000
1500
2000
NIOZ
Other
2004
2006
2008
2010
2012
2014
2016

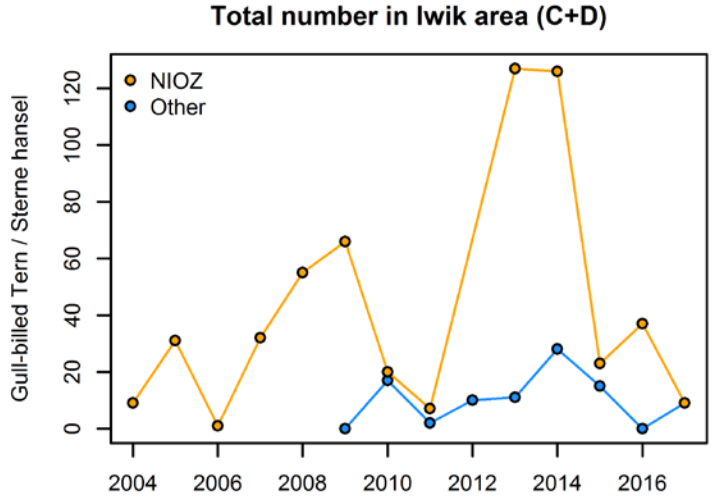

NA
1980
1997
2000
2001
2006
2014
2017
Larus fuscus
Goéland brun
Lesser Black-backed Gull
10000
5000
1000

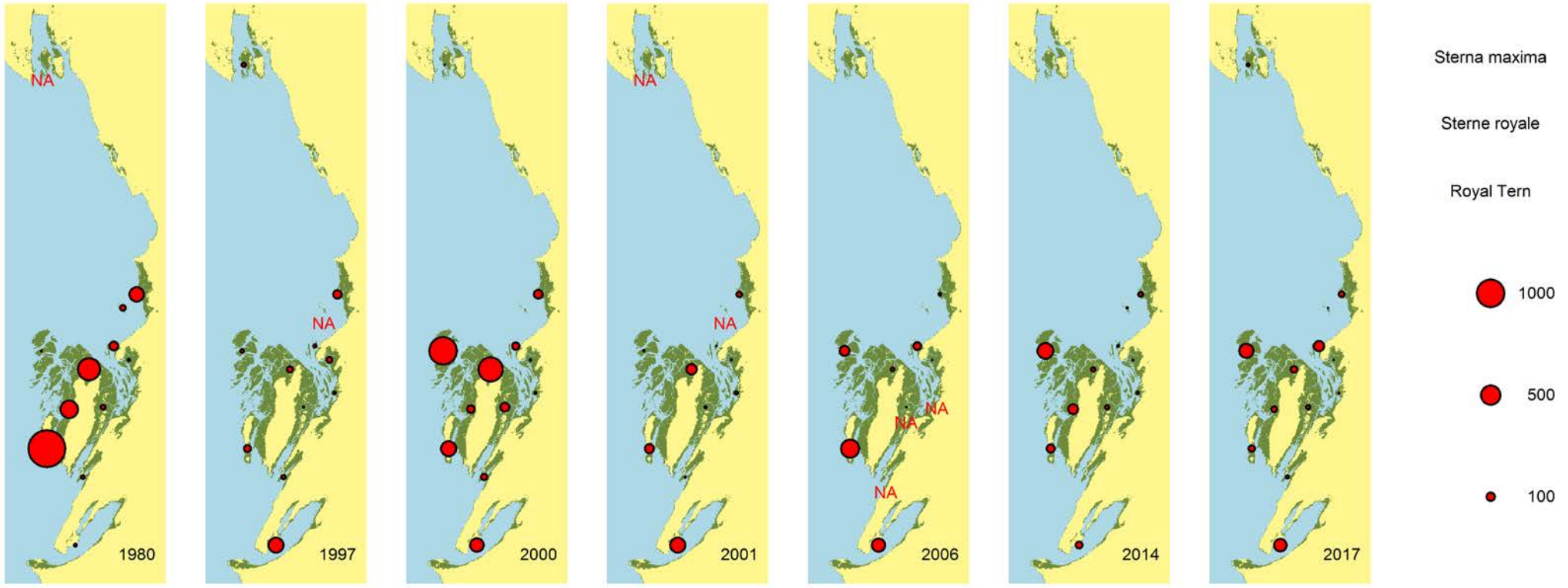

Total number in Banc d'Arguin
Lesser Black-backed Gull Goéland brun
0
5000
10000
15000
20000
p = 0.67
1980
1997
2000
2001
2006
2014
2017

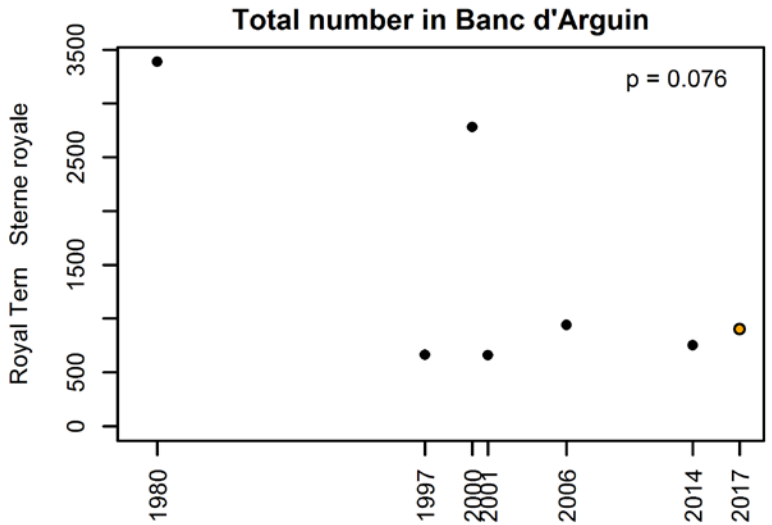

Total number in Iwik area (C+D)
Lesser Black-backed Gull / Goéland brun
0
500
1000
1500
2000
2500
NIOZ
Other
2004
2006
2008
2010
2012
2014
2016

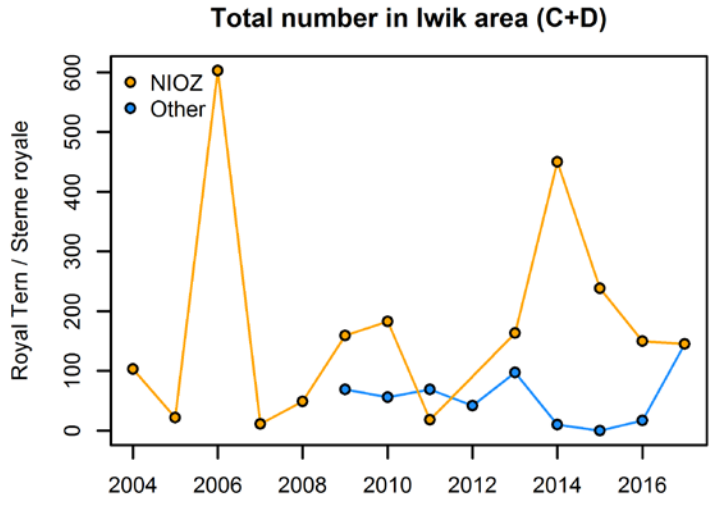

NA
1980
1997
2000
2001
2006
2014
2017
Gelochelidon nilotica
Sterne hansel
Gull-billed Tern
100
50
10

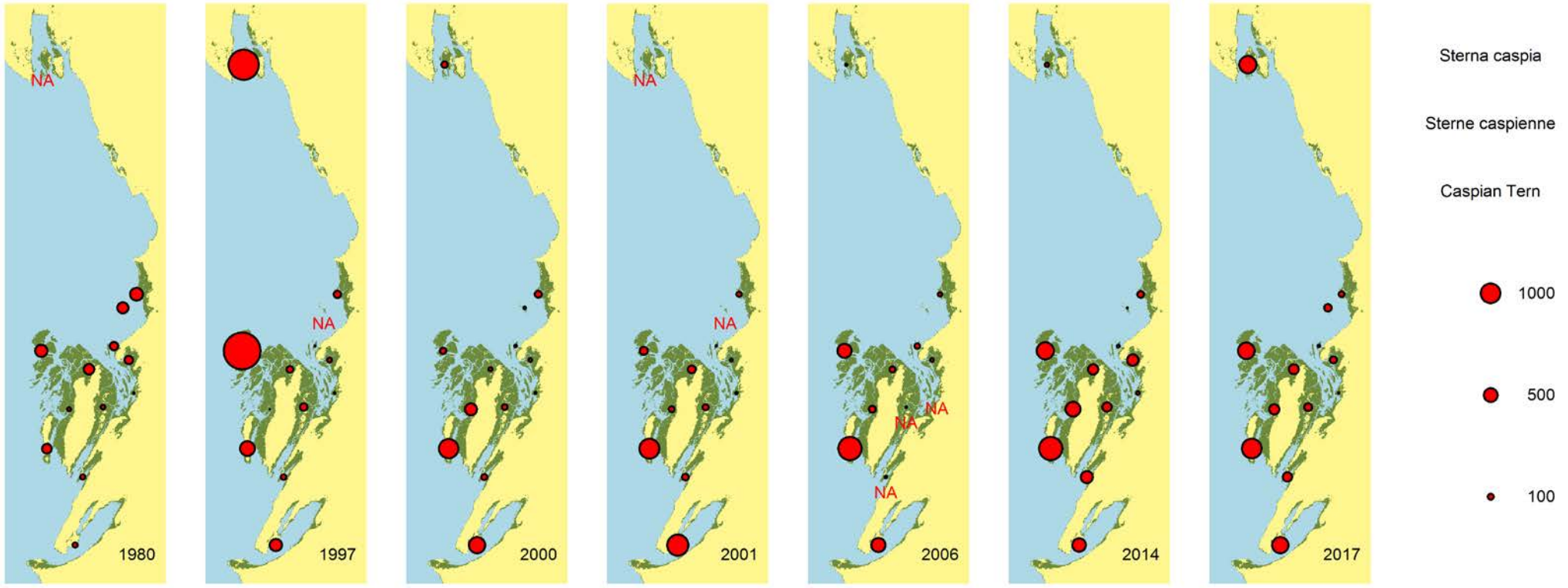

Total number in Banc d'Arguin
Gull-billed Tern Sterne hansel
p = 0.274
0
200
400
600
800
1980
1997
2000
2001
2006
2014
2017

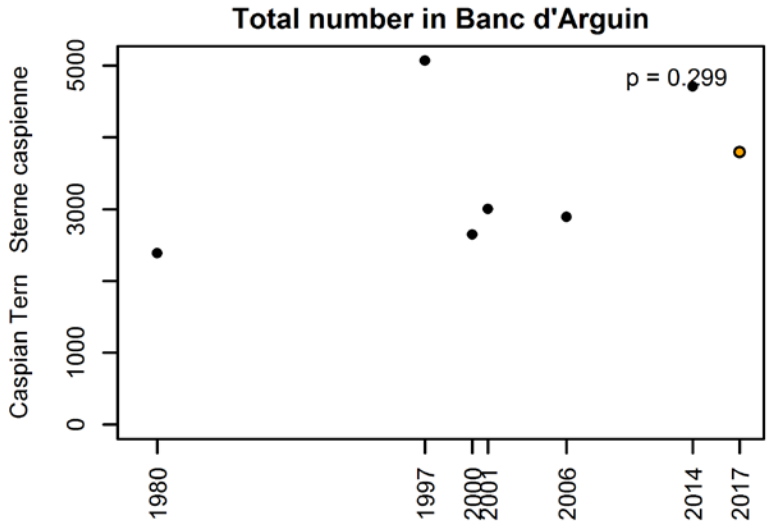

Total number in Iwik area (C+D)
Gull-billed Tern / Sterne hansel
NIOZ
Other
0
20
40
60
80
100
120
2004
2006
2008
2010
2012
2014
2016

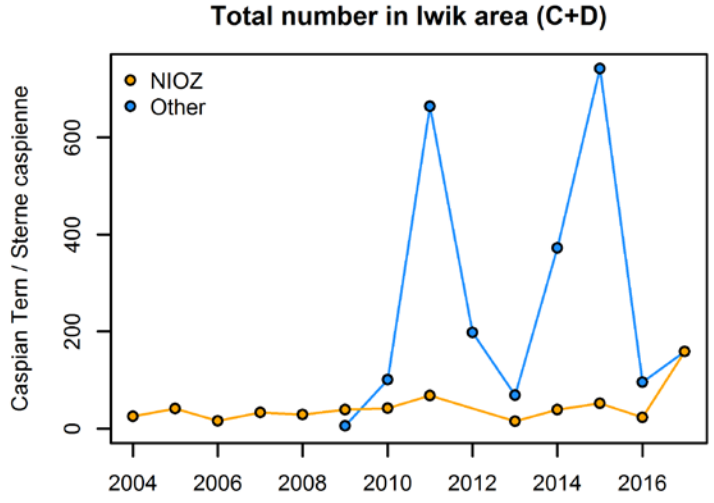

NA
1980
1997
2000
2001
2006
2014
2017
Sterna maxima
Sterne royale
Royal Tern
1000
500
100

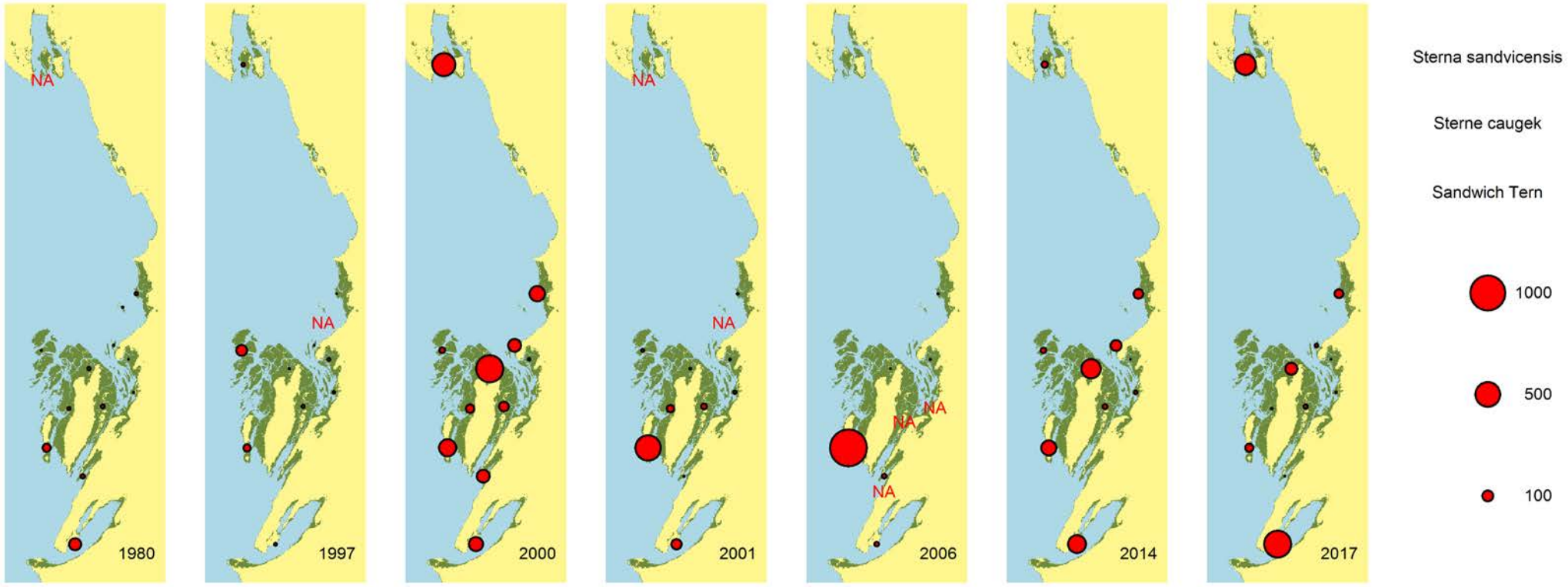

Total number in Banc d'Arguin
p = 0.076
Royal Tern Sterne royale
0
500
1500
2500
3500
1980
1997
2000
2001
2006
2014
2017

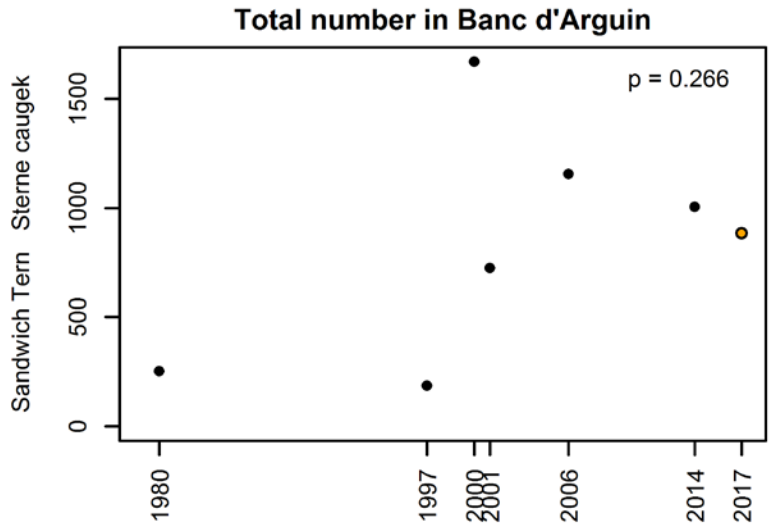

Total number in Iwik area (C+D)
NIOZ
Other
Royal Tern / Sterne royale
0
100
200
300
400
500
600
2004
2006
2008
2010
2012
2014
2016

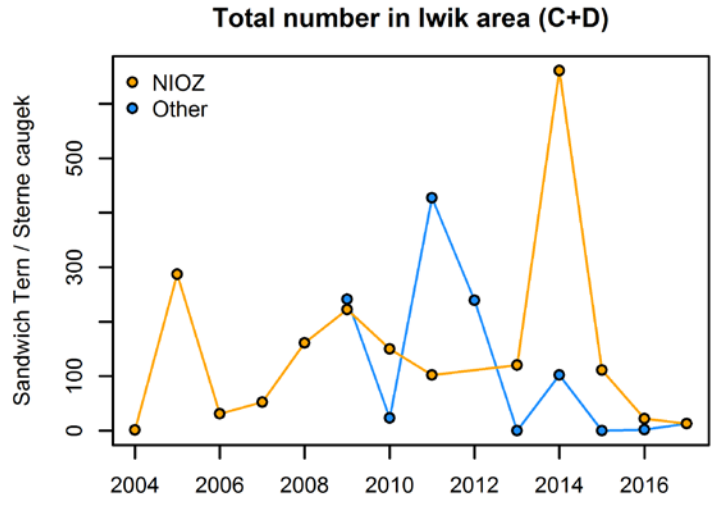

NA
1980
1997
2000
2001
2006
2014
2017
Sterna caspia
Sterne caspienne
Caspian Tern
1000
500
100

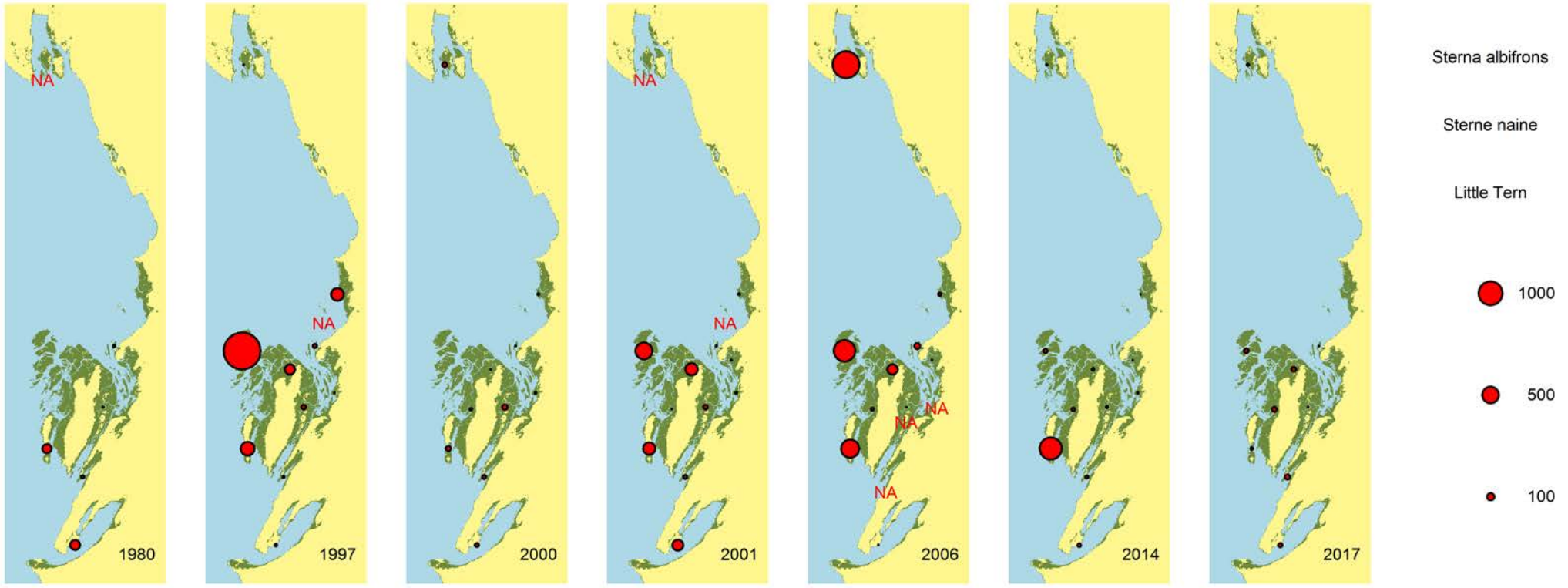

Total number in Banc d'Arguin
Caspian Tern Sterne caspienne
0
1000
3000
5000
p = 0.299
1980
1997
2000
2001
2006
2014
2017

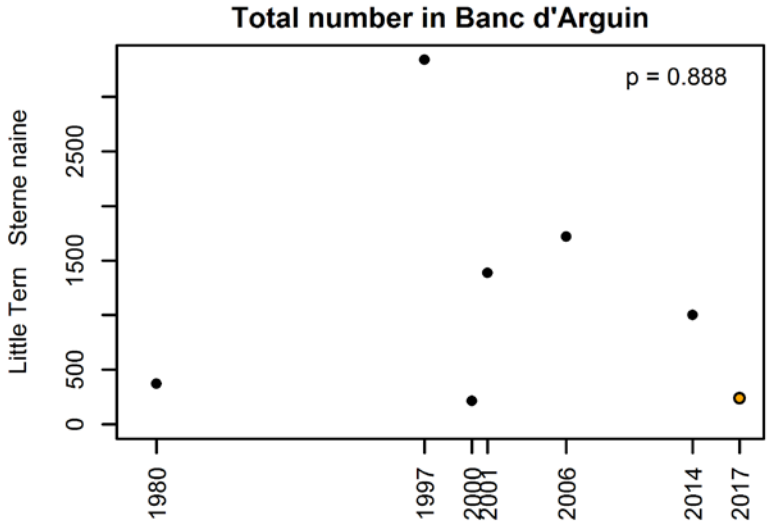

Total number in Iwik area (C+D)
Caspian Tern / Sterne caspienne
NIOZ
Other
0
200
400
600
2004
2006
2008
2010
2012
2014
2016

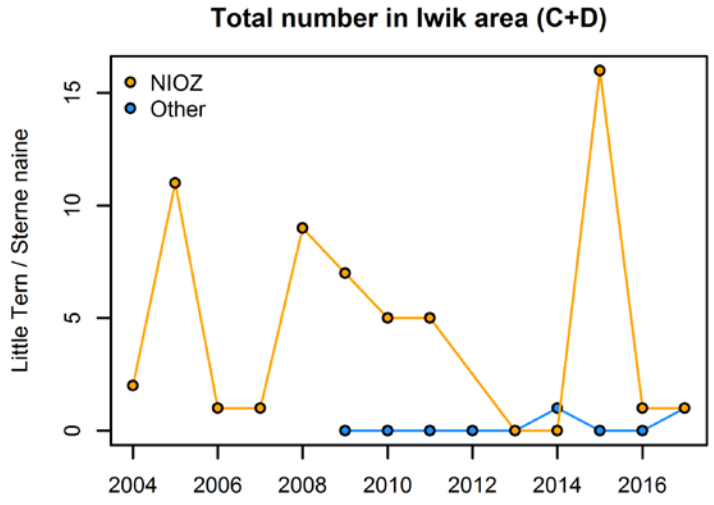

NA
1980
1997
2000
2001
2006
2014
2017
Sterna sandvicensis
Sterne caugek
Sandwich Tern
1000
500
100


Total number in Banc d'Arguin
p = 0.266
Sandwich Tern Sterne caugek
0
500
1000
1500
1980
1997
2000
2001
2006
2014
2017

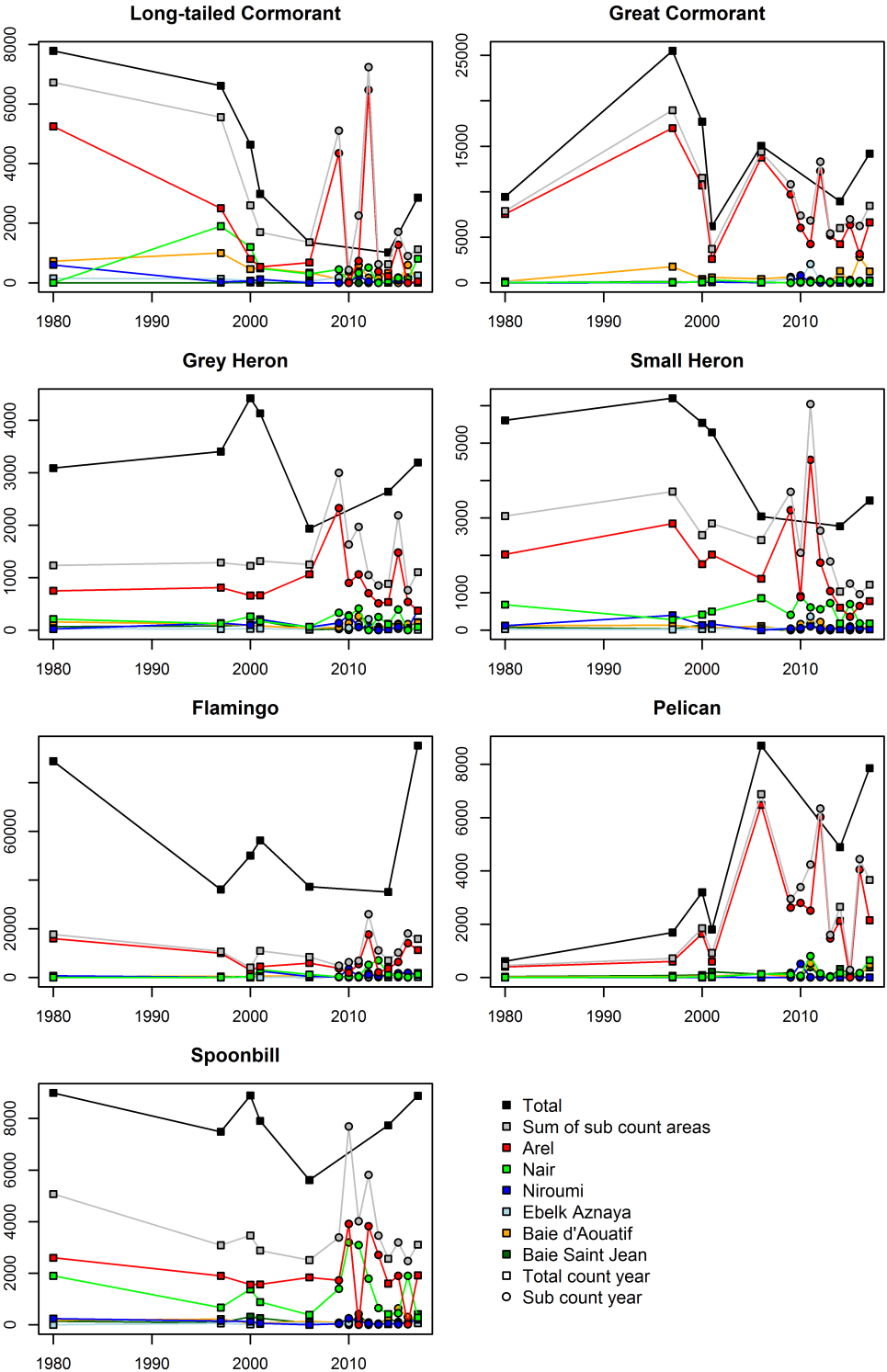

Total number in Iwik area (C+D)
NIOZ
Other
Sandwich Tern / Sterne caugek
0
100
300
500
2004
2006
2008
2010
2012
2014
2016

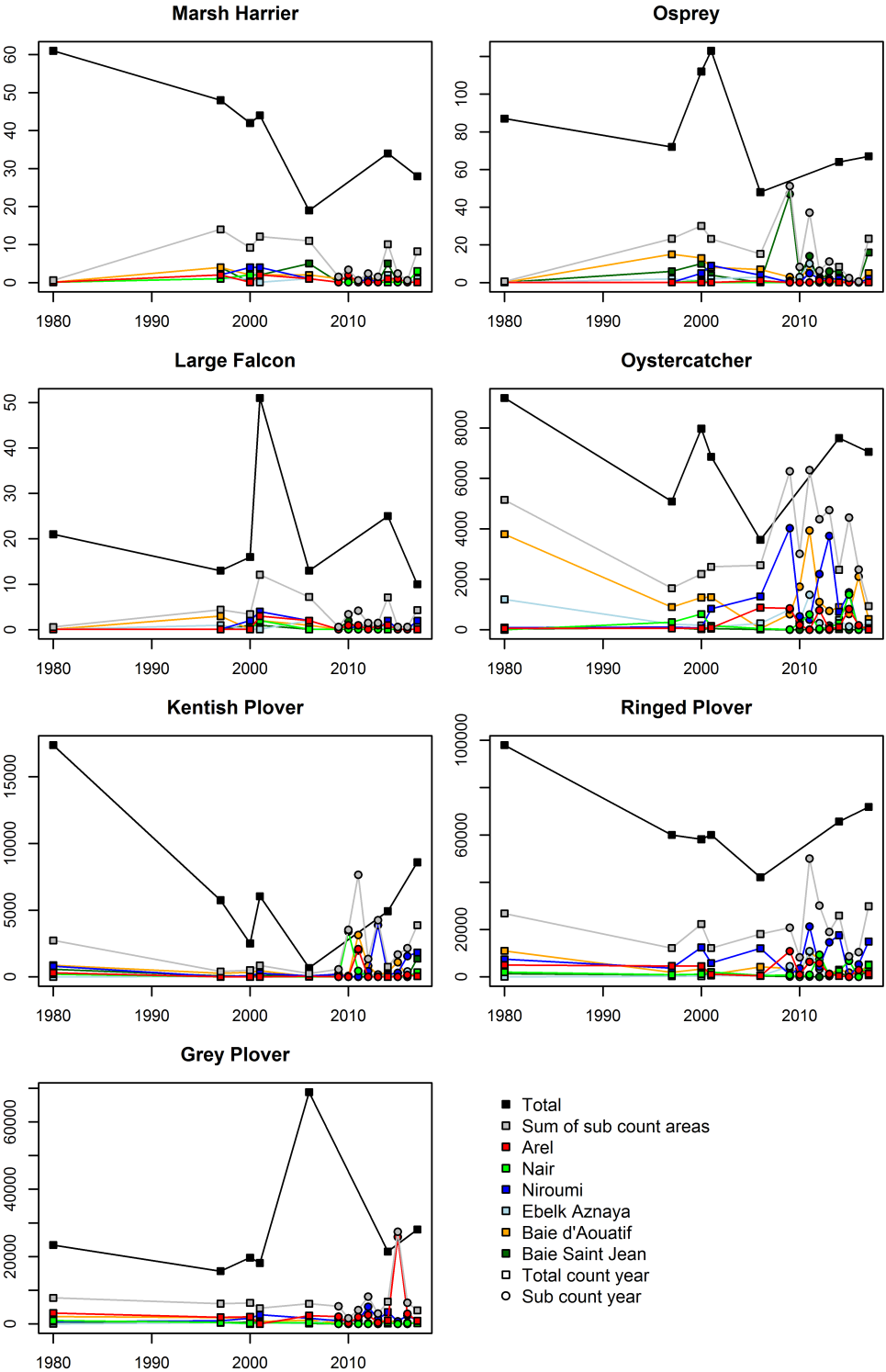

NA
1980
1997
2000
2001
2006
2014
2017
Sterna albifrons
Sterne naine
Little Tern
1000
500
100

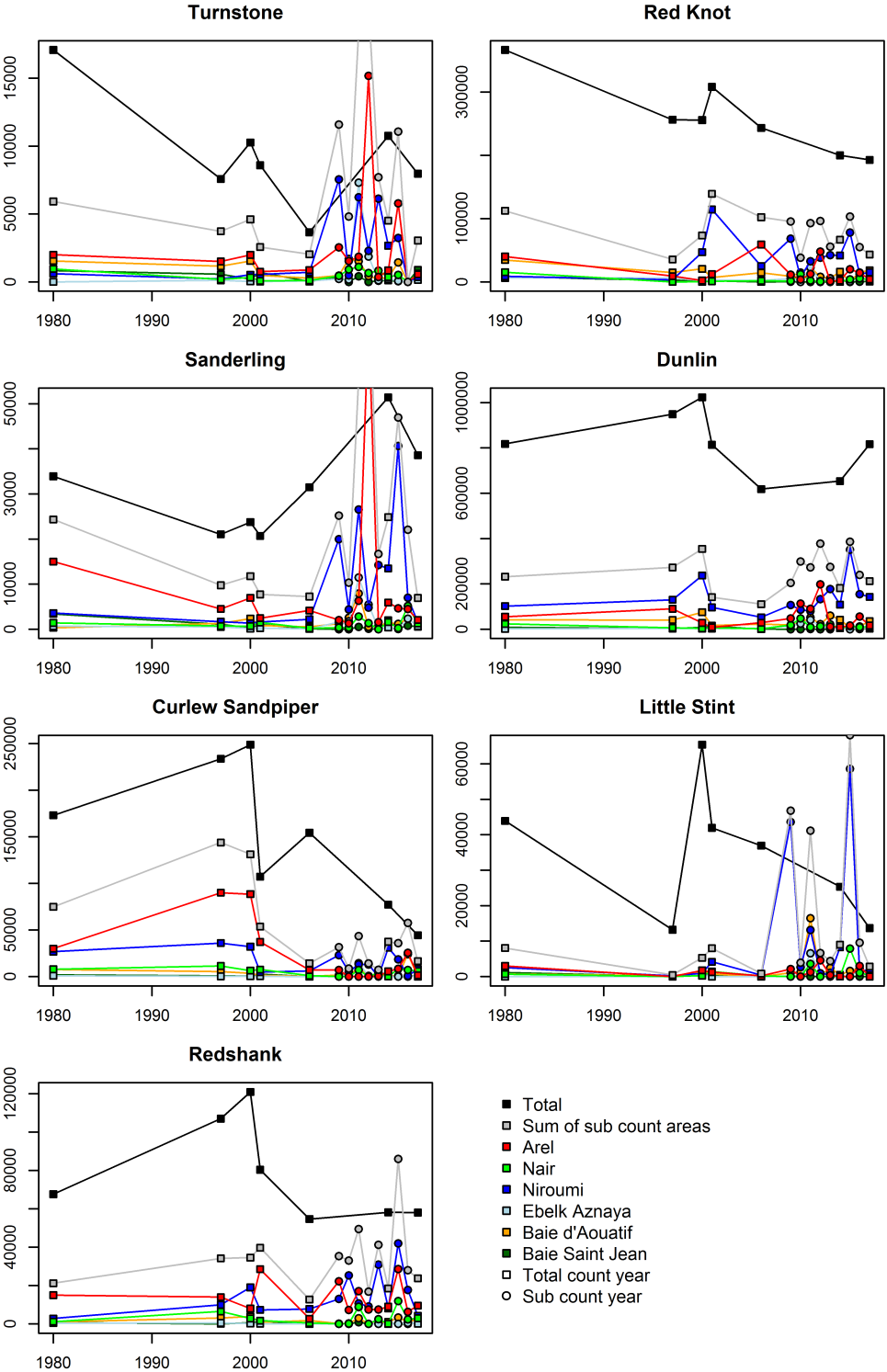

Total number in Banc d'Arguin
p = 0.888
Little Tern Sterne naine
0
500
1500
2500
1980
1997
2000
2001
2006
2014
2017

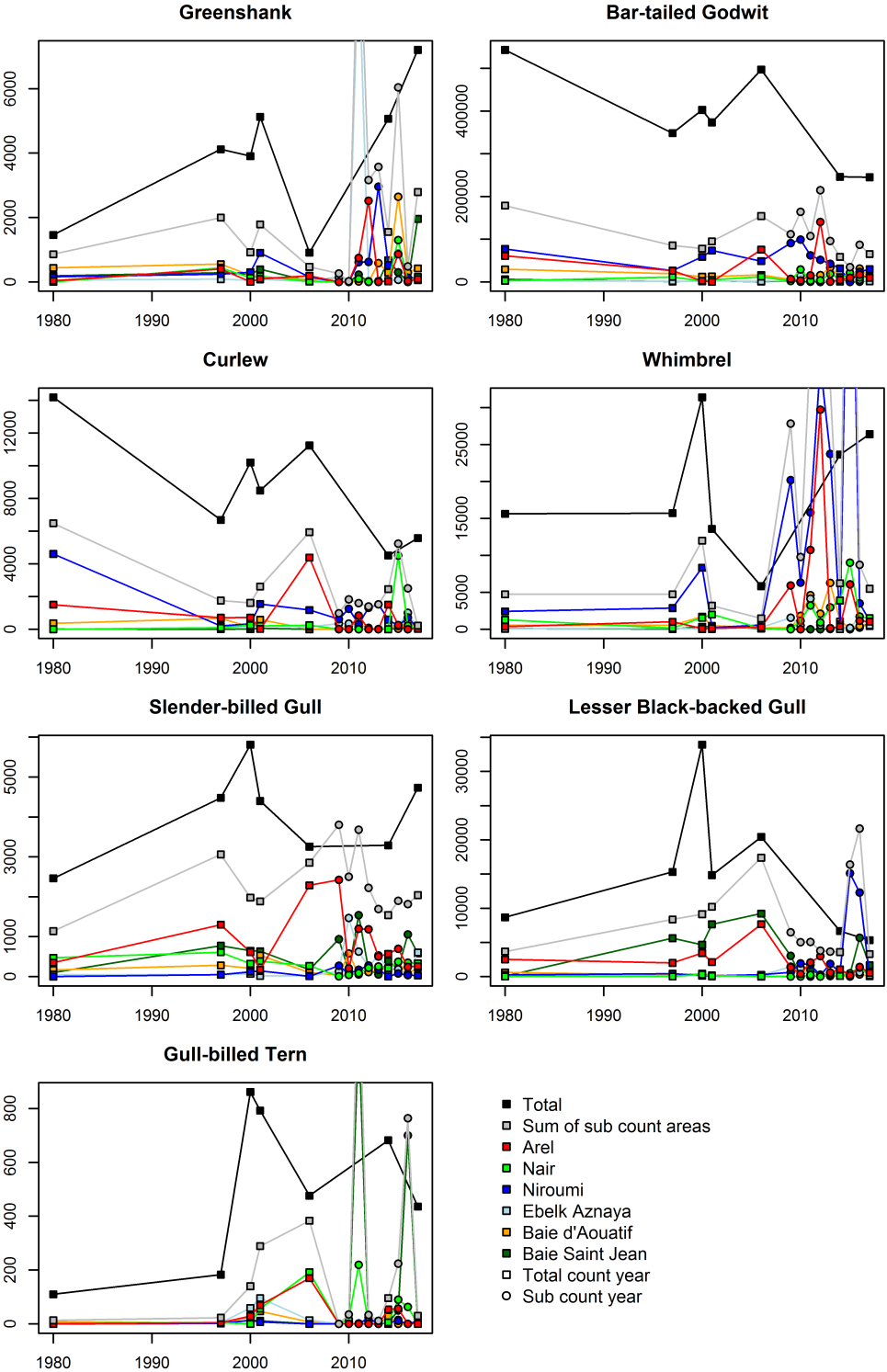

Total number in Iwik area (C+D)
NIOZ
Other
Little Tern / Sterne naine
0
5
10
15
2004
2006
2008
2010
2012
2014
2016

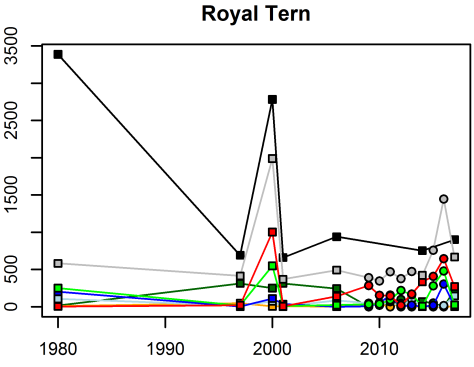
APPENDIX III

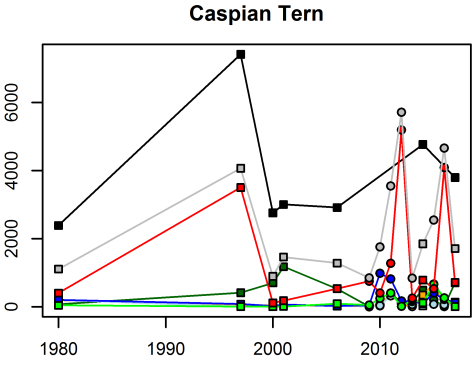

Long-tailed Cormorant
Great Cormorant
Grey Heron
Small Heron
Flamingo
Pelican
Spoonbill
0
2000
4000
6000
8000
5000
15000
25000
1000
3000
20000
60000
1980
1990
2000
2010
Total
Sum of sub count areas
Arel
Nair
Niroumi
Ebelk Aznaya
Baie d'Aouatif
Baie Saint Jean
Total count year
Sub count year

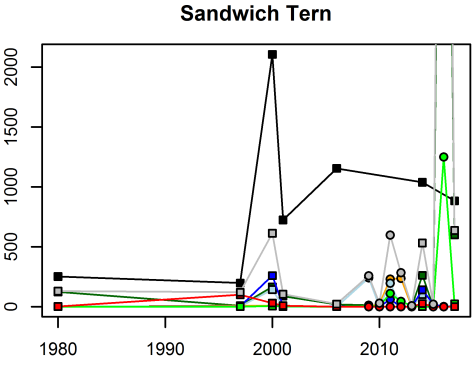

Marsh Harrier
Osprey
Large Falcon
Oystercatcher
Kentish Plover
Ringed Plover
Grey Plover
1980
1990
2000
2010
Total
Sum of sub count areas
Arel
Nair
Niroumi
Ebelk Aznaya
Baie d'Aouatif
Baie Saint Jean
Total count year
Sub count year

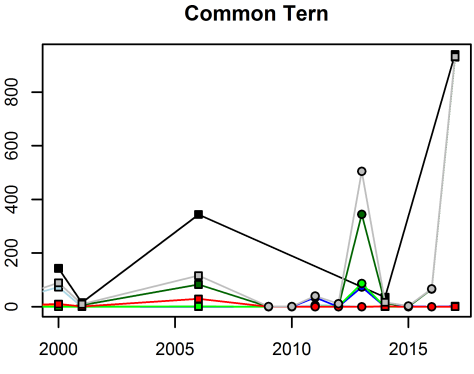

Turnstone
Red Knot
Sanderling
Dunlin
Curlew Sandpiper
Little Stint
Redshank
0
5000
10000
15000
100000
300000
30000
50000
200000
600000
1000000
40000
60000
80000
120000
150000
250000
1980
1990
2000
2010
Total
Sum of sub count areas
Arel
Nair
Niroumi
Ebelk Aznaya
Baie d'Aouatif
Baie Saint Jean
Total count year
Sub count year

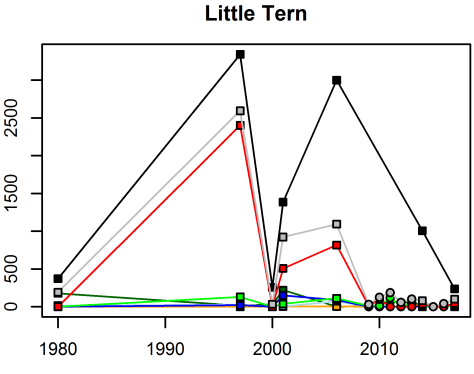

Greenshank
Bar-tailed Godwit
Curlew
Whimbrel
Slender-billed Gull
Lesser Black-backed Gull
Gull-billed Tern
0
2000
4000
6000
200000
400000
8000
12000
5000
15000
25000
1000
3000
10000
20000
30000
800
600
400
200
1980
1990
2000
2010
Total
Sum of sub count areas
Arel
Nair
Niroumi
Ebelk Aznaya
Baie d'Aouatif
Baie Saint Jean
Total count year
Sub count year

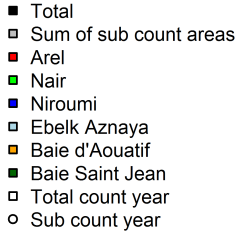

Royal Tern
0
500
1500
2500
3500
1980
1990
2000
2010


Caspian Tern
0
2000
4000
6000
1980
1990
2000
2010


Sandwich Tern
0
500
1000
1500
2000
1980
1990
2000
2010


Common Tern
0
200
400
600
800
2000
2005
2010
2015


Little Tern
0
500
1500
2500
1980
1990
2000
2010


Total
Sum of sub count areas
Arel
Nair
Niroumi
Ebelk Aznaya
Baie d'Aouatif
Baie Saint Jean
Total count year
Sub count year

APPENDIX IV. AIC_c comparison of statistical models.

Model	Explanatory variables[a]	K[b]	ΔAICc	AICc weight	Cum. weight	LL[c]
1	**1**	**2**	**-**	**0.23**	**0.23**	**58.6**
2	Migrant + Seabird	4	0.88	0.15	0.38	60.7
3	Seabird	3	0.96	0.14	0.52	59.4
4	Wadden Sea	3	1.37	0.12	0.64	59.2
5	Migrant	3	1.68	0.10	0.74	59.0
6	Siberia	3	2.24	0.08	0.81	58.7
7	Migrant + Siberia + Seabird	5	3.32	0.04	0.86	60.9
8	Siberia + Seabird	4	3.56	0.04	0.90	59.4
9	Migrant + Siberia	4	3.67	0.04	0.93	59.3
10	Migrant + Wadden Sea	4	3.81	0.03	0.97	59.3
11	0	1	3.96	0.03	1	55.5
12	Diet	7	13.95	0	1	58.8
13	Diet + Seabird	8	15.08	0	1	60.0
14	Diet + Wadden Sea	8	15.65	0	1	59.7
15	Diet + Migrant	8	16.29	0	1	59.4

NB. All models are linear models, and response variable is the per-capita growth rate per population. Models are compared by Akaike's Information criterion for small sample sizes (AICc). Parameters were estimated by maximizing the log-likelihood. Models are ranked according to their likelihood. Model 1 is the best model, but other models also have weak support (AICc weight can be interpreted as the chance that this model is actually underlying the patterns in the data).

[a] "Migrant" refers to whether the species is a migrant or a resident species in Banc d'Arguin. "Seabird" refers to whether the species forages at sea or on the intertidal. "Siberia" refers to whether the species breeds in Siberia. "Wadden Sea" refers to whether the species visits the Wadden Sea during migration. "1" means that there is only one parameter, a constant. 0 means that the estimated growth rate is always zero.

[b] The number of parameters in the model.

[c] Log-likelihood.

APPENDIX V

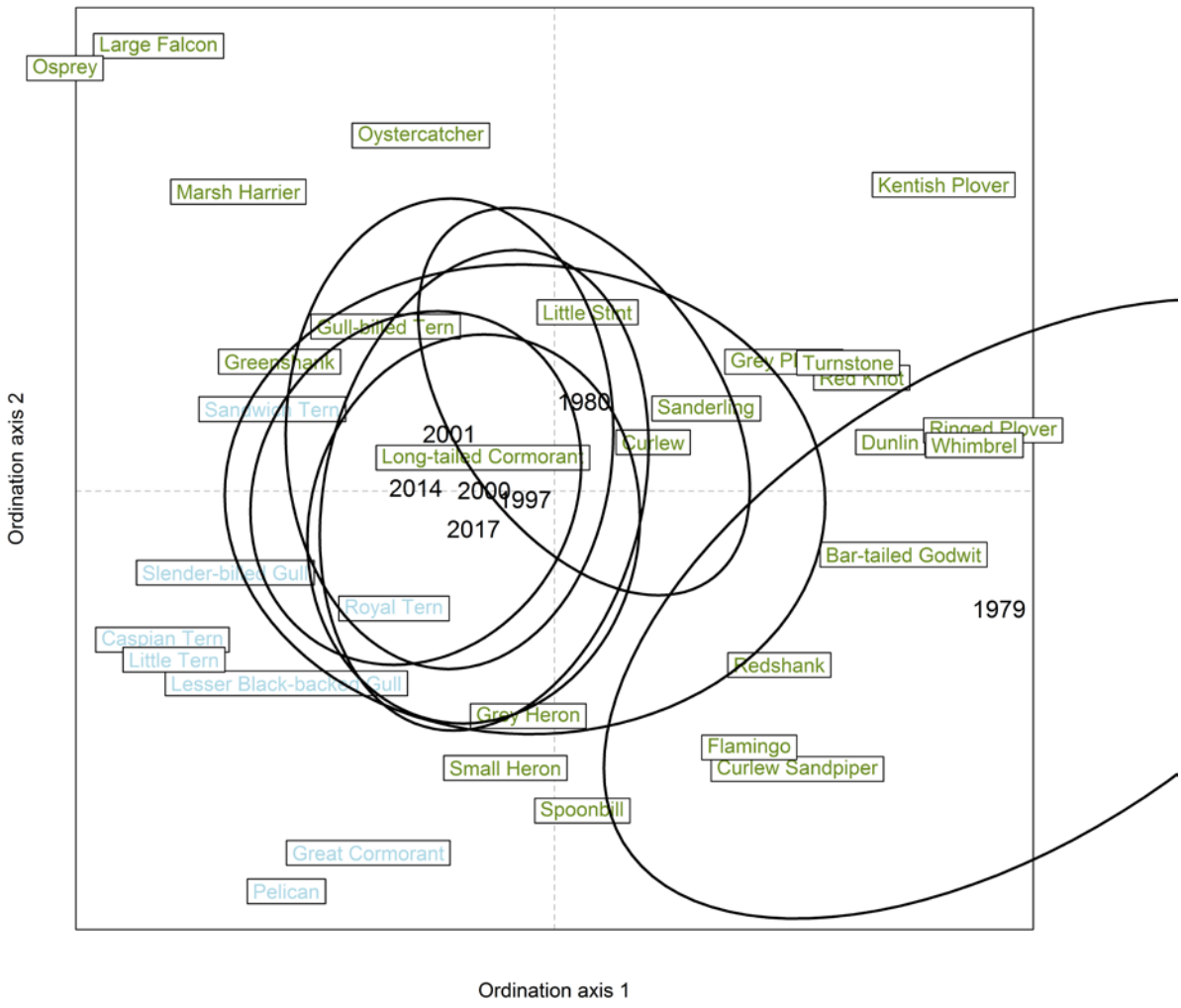


Figure A1. Ordination analysis, including the data from the 1979 count (Trotignon *et al.* 1980). This analysis was the same as for Fig. 4B in the main text, but now also including the 1979 data. Furthermore, the sections C and D are joined, as well as the sections E and L, because these were not reported separately in 1979. This was done for each year, so this is not a source of the very different species distribution pattern that is observed in the 1979 data.