“Interactions Working Group”:

A circumpolar initiative to measure and predict the cascading impacts of “Indirect Trophic Interactions” in Arctic terrestrial vertebrate communities

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[3] University of Moncton, CAN

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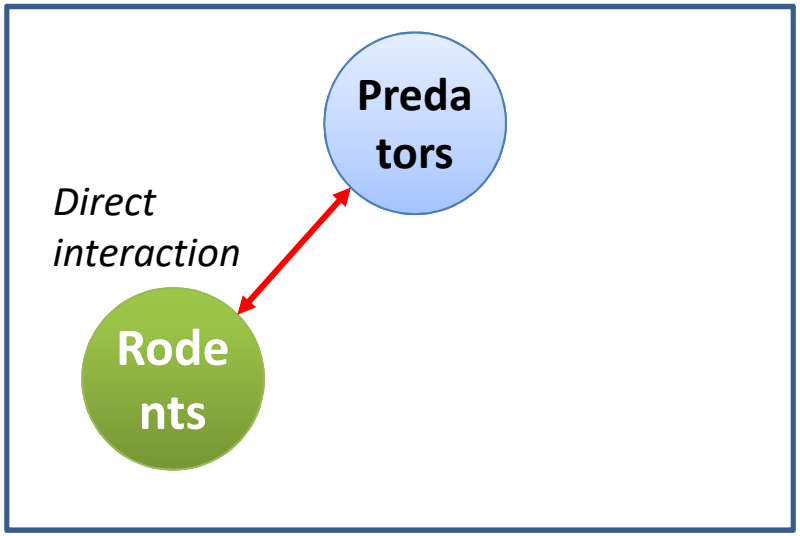
[5] University of Aarhus, DK

Indirect trophic interactions?


Preda
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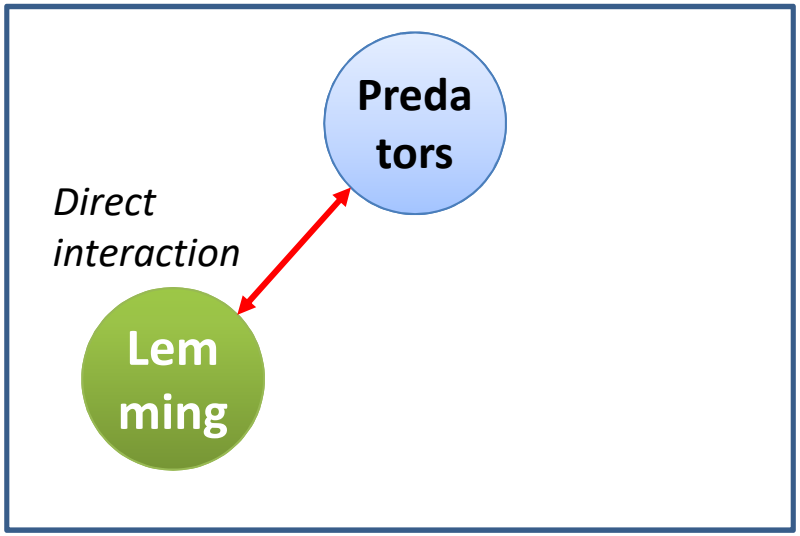
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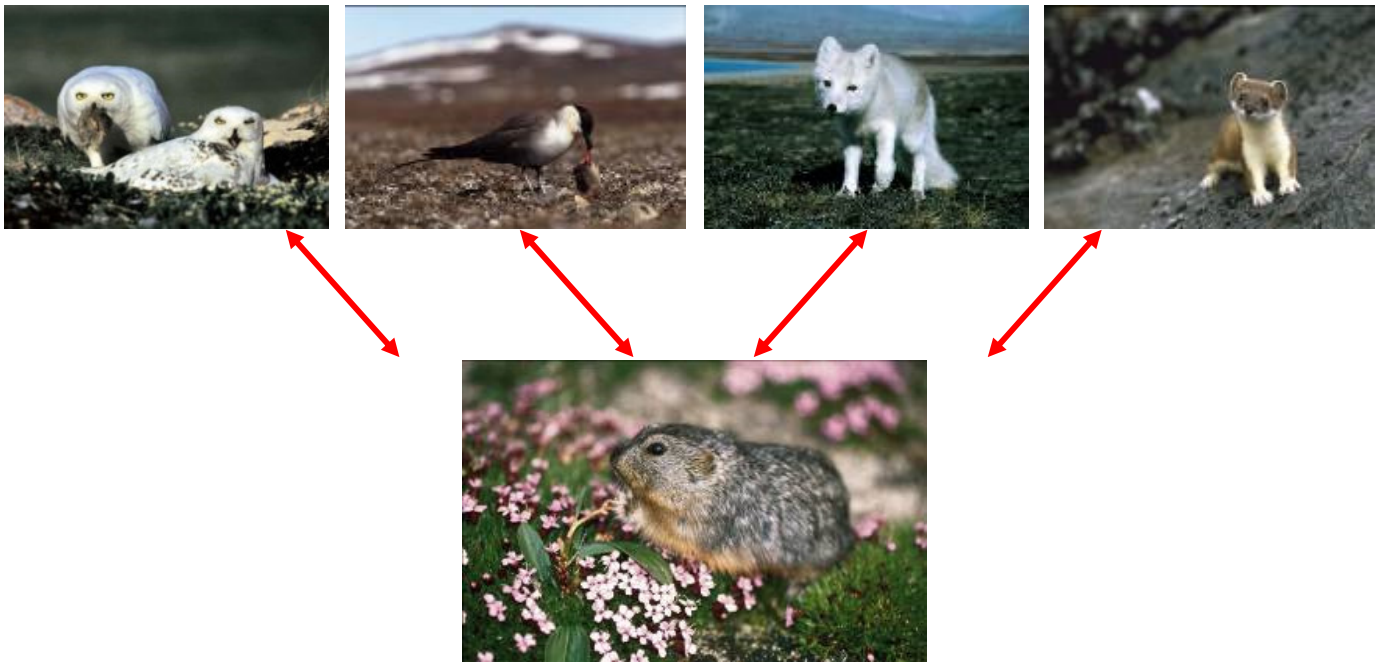

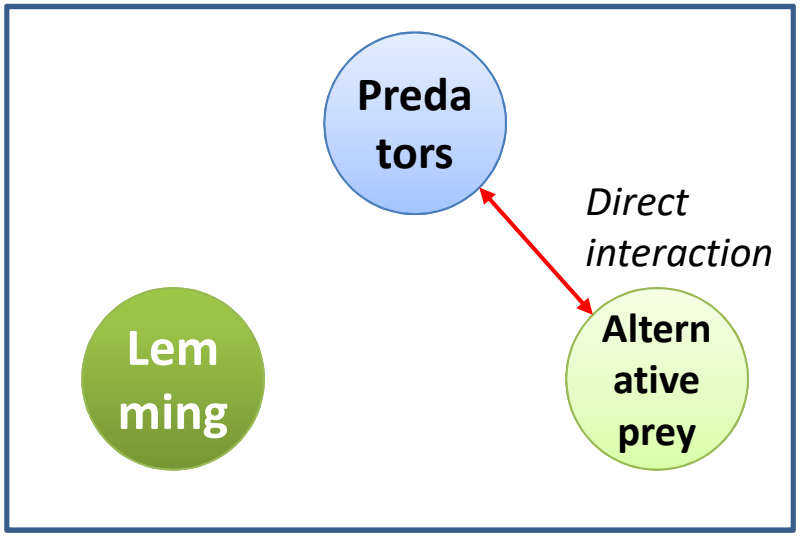
Preda
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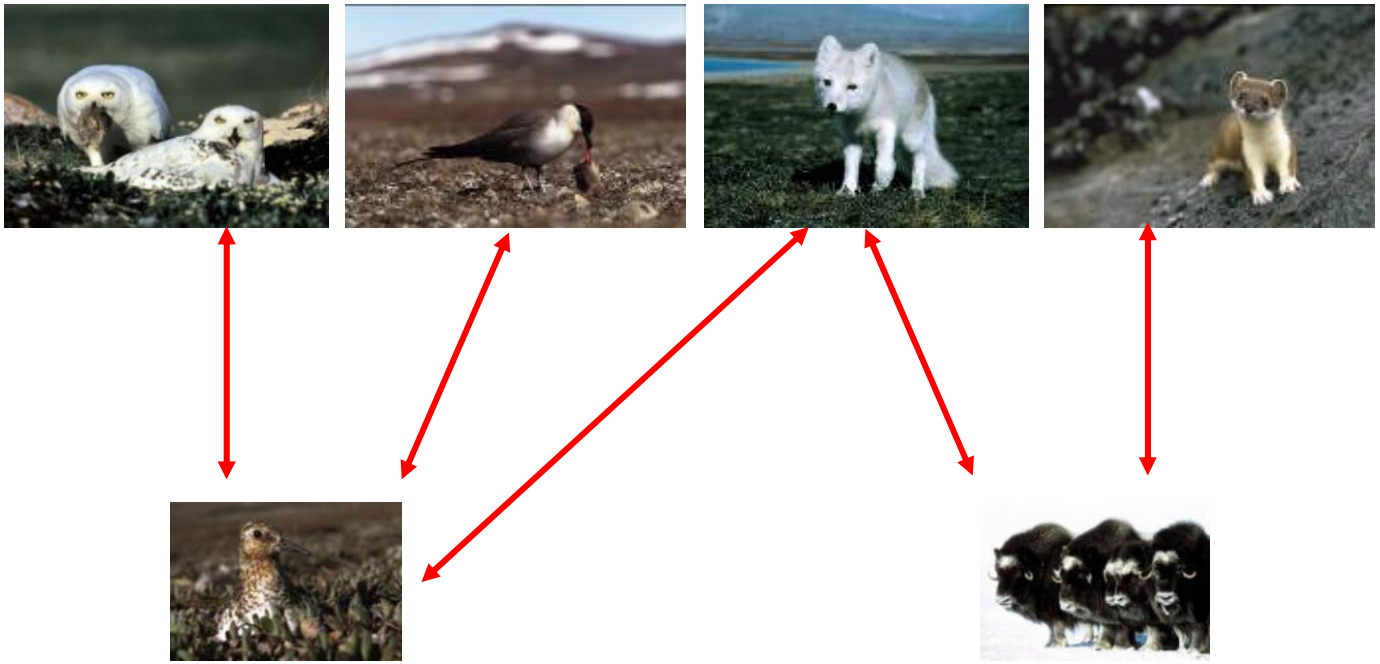

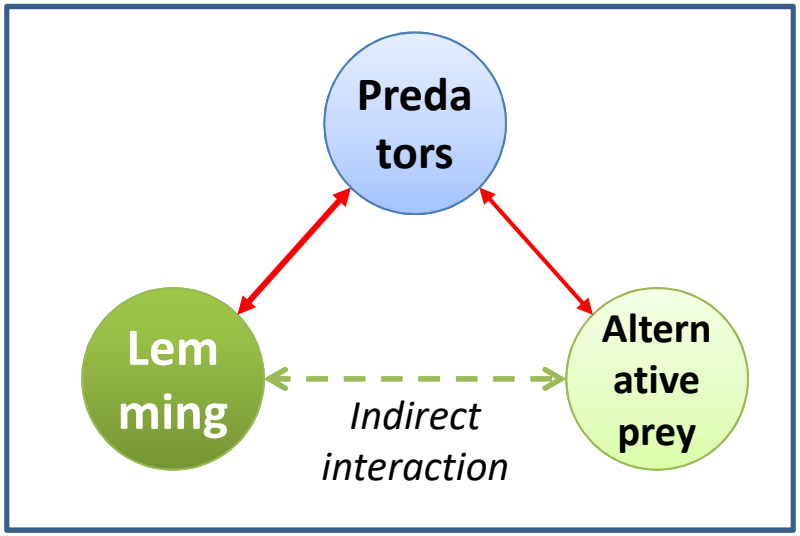
Preda
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Altern
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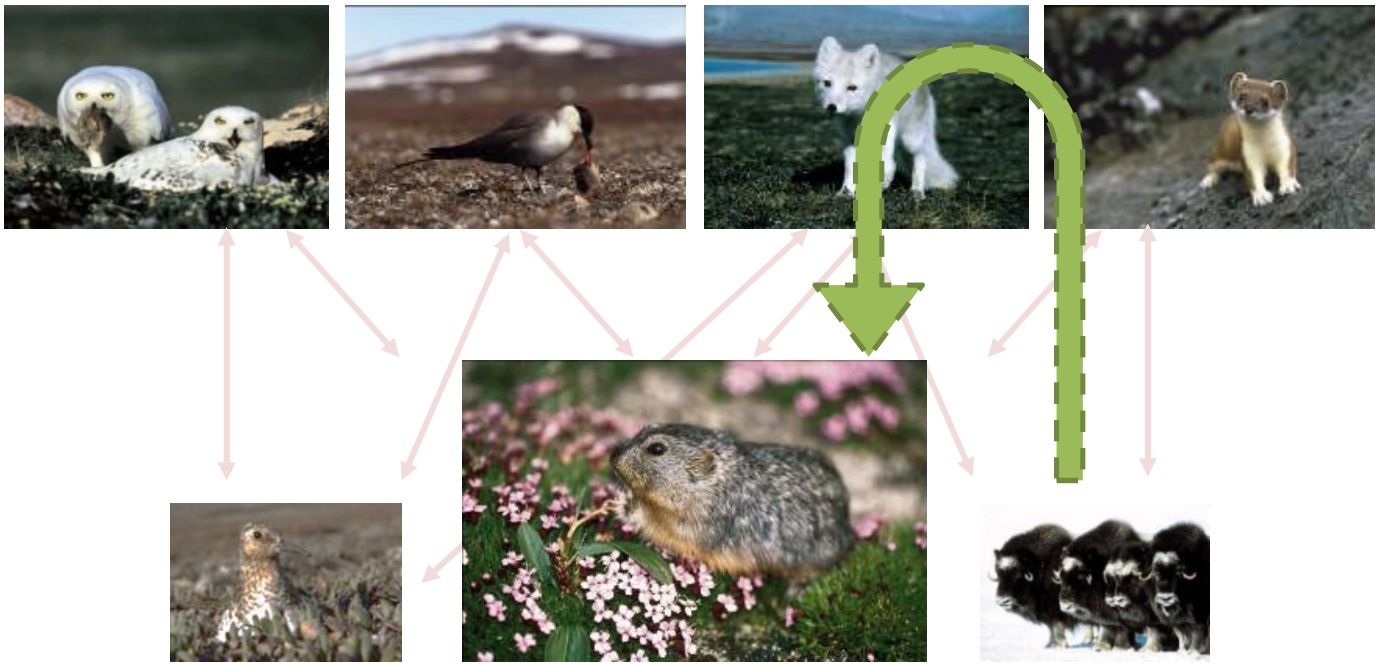
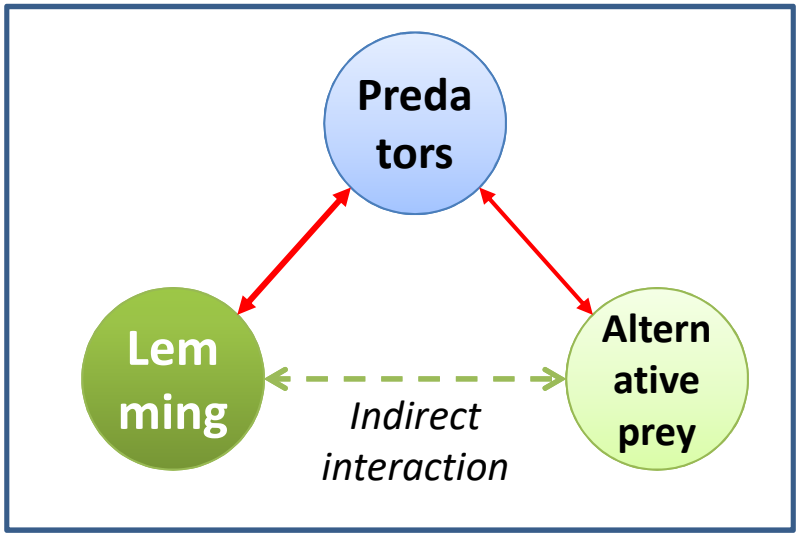
Indirect
interaction




Preda
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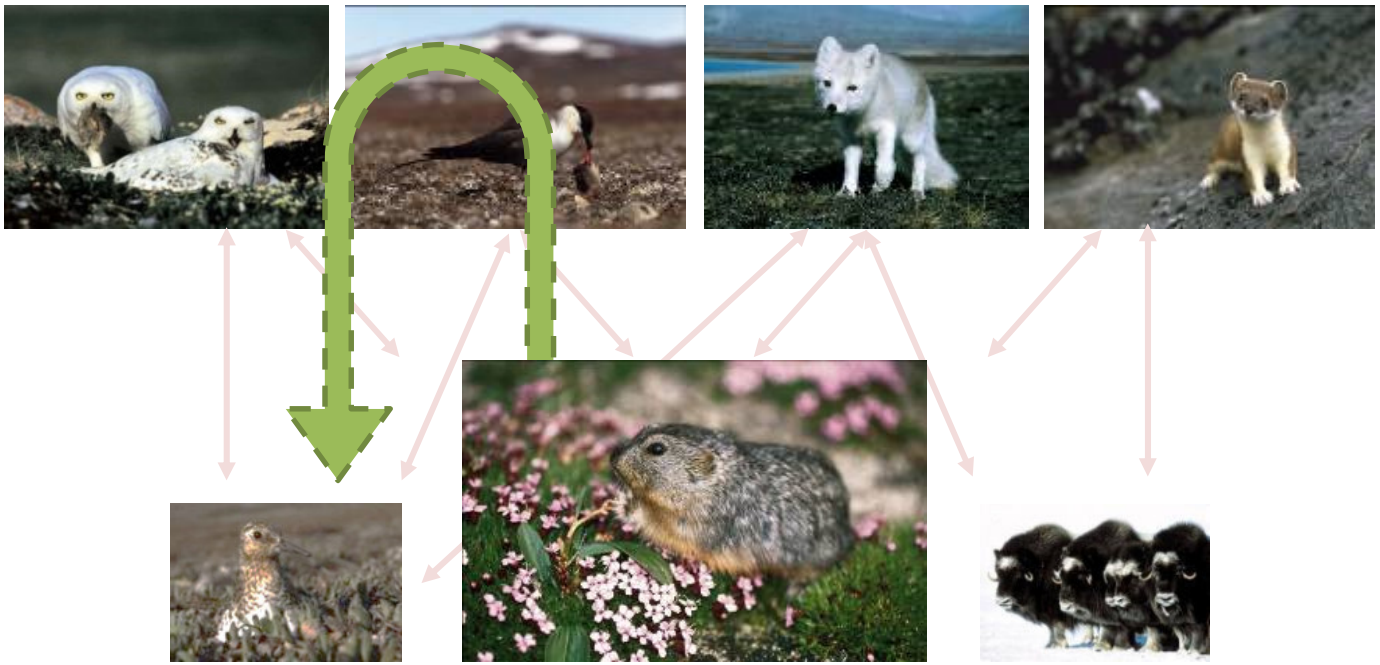
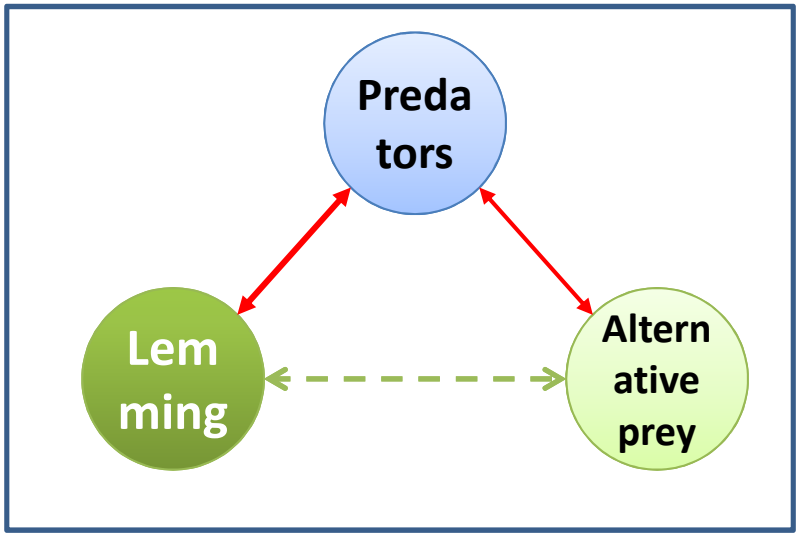
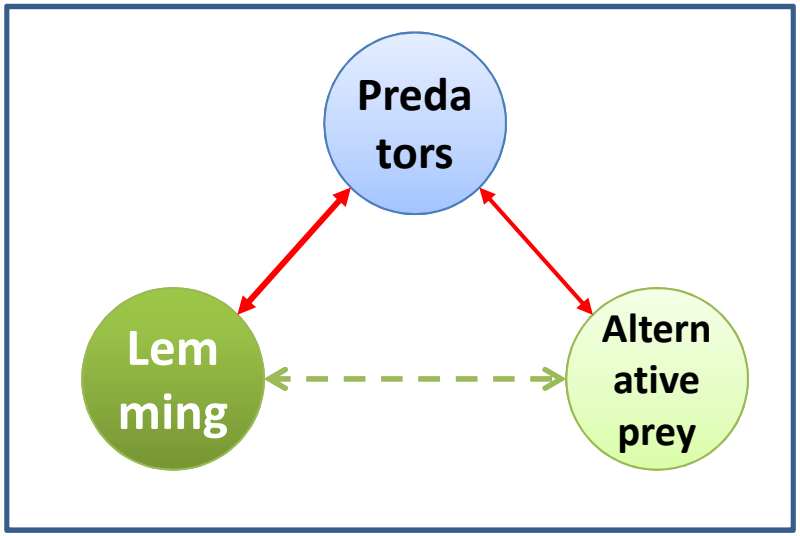
interaction

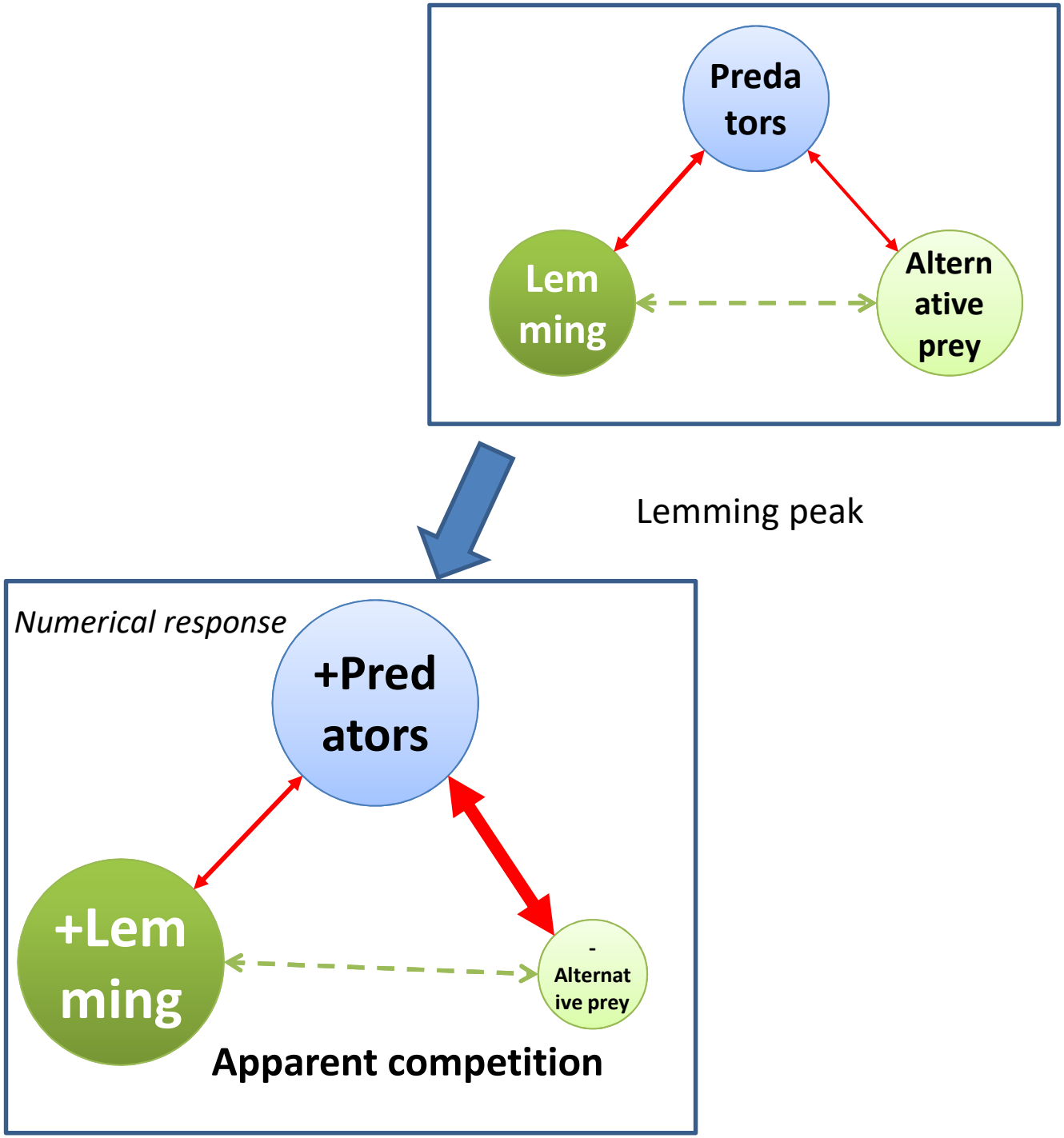


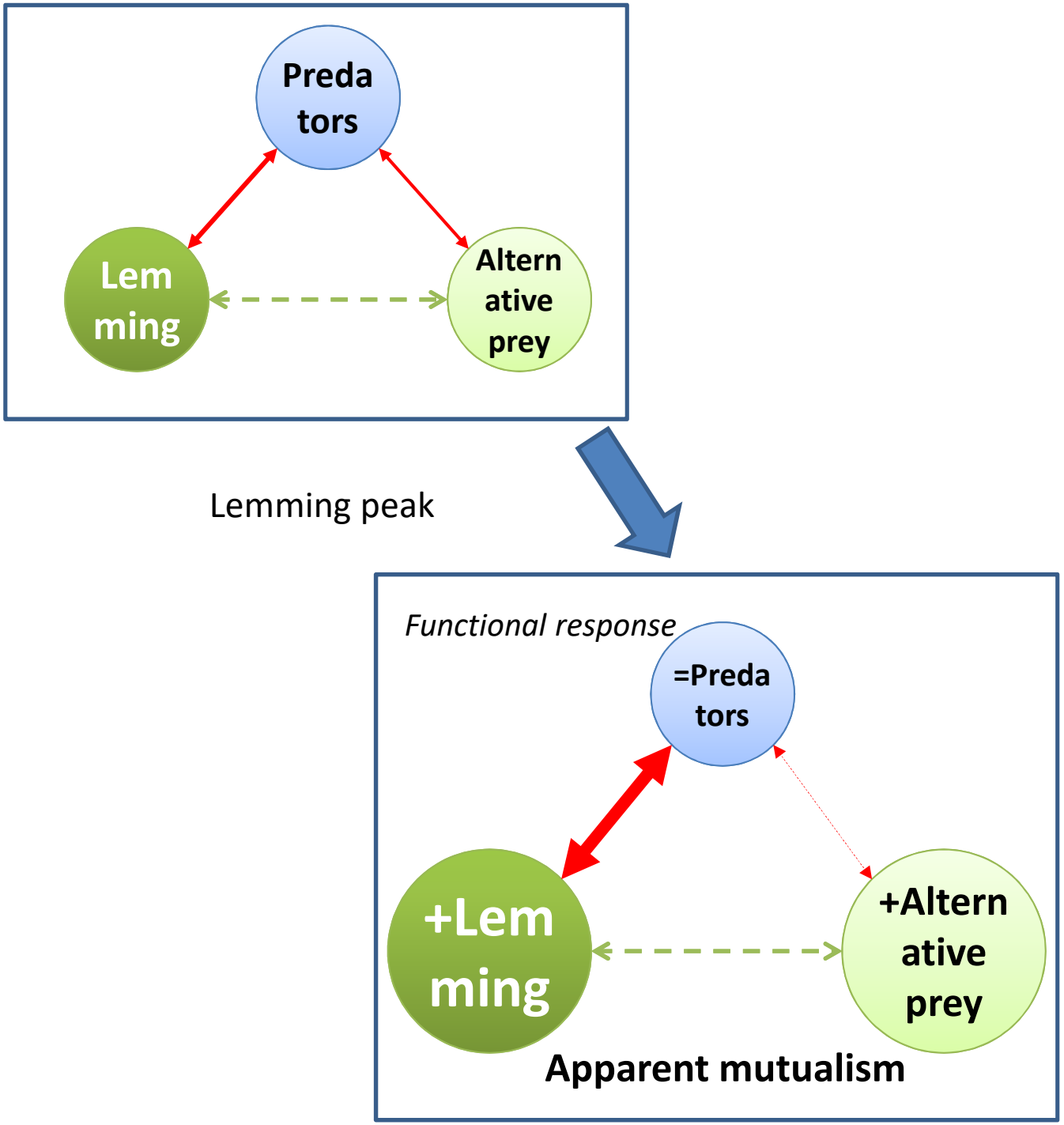


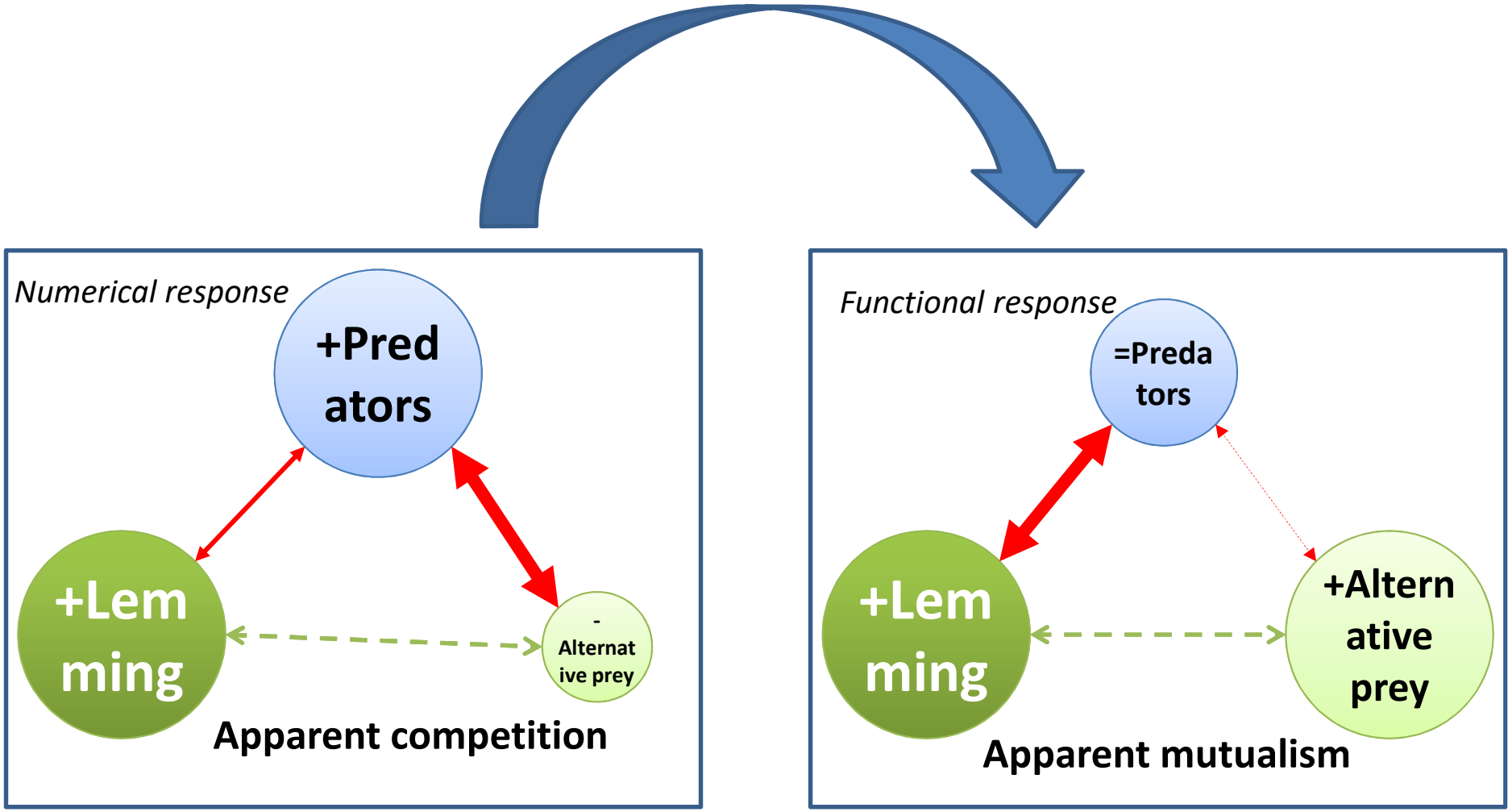
Strength of Interactions varies in space and time

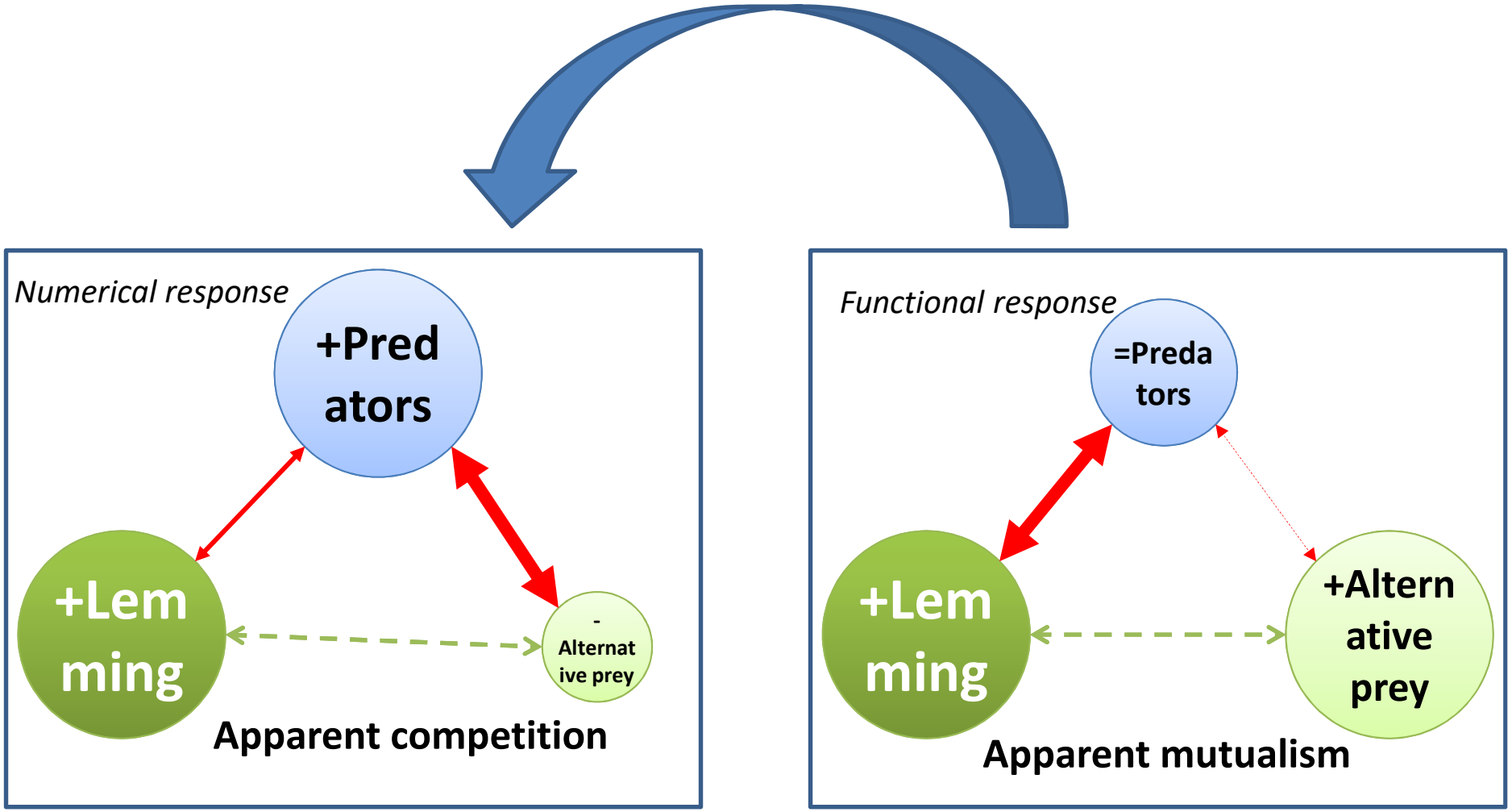


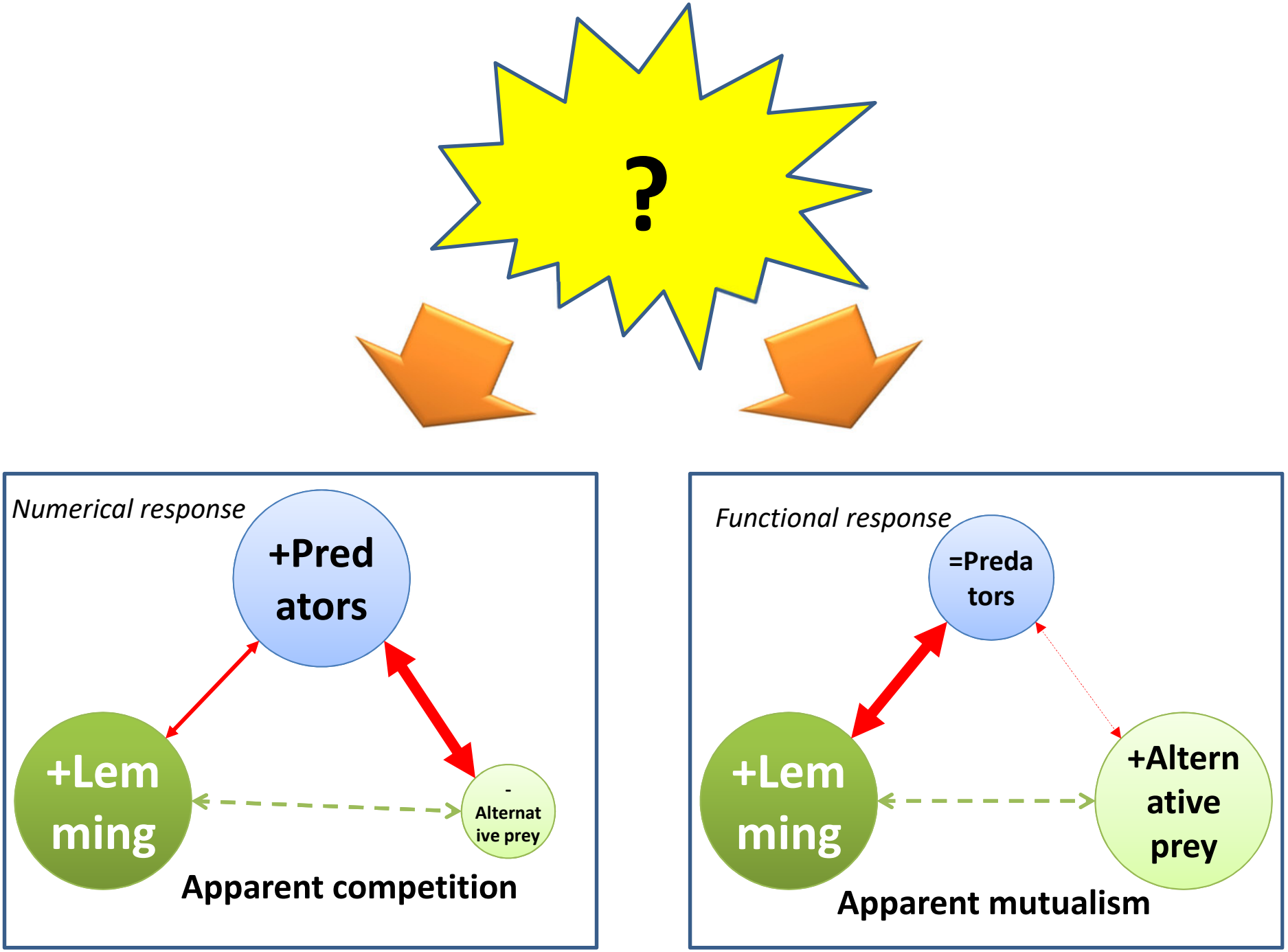
Lemming peak?


Preda tors
Lem ming
Altern ative prey
Lemming peak
Numerical response
+Pred ators
+Lem ming
- Alternat ive prey
Apparent competition


Preda tors
Lem ming
Altern ative prey
Lemming peak
Functional response
=Preda tors
+Lem ming
+Altern ative prey
Apparent mutualism


Numerical response
+Predators
+Lemming
-Alternative prey
Apparent competition
Functional response
=Predators
+Lemming
+Alternative prey
Apparent mutualism


Numerical response
+Predators
+Lemming
-Alternative prey
Apparent competition
Functional response
=Predators
+Lemming
+Alternative prey
Apparent mutualism


?
Numerical response
+Pred ators
+Lem ming
- Alternat ive prey
Apparent competition
Functional response
=Preda tors
+Lem ming
+Altern ative prey
Apparent mutualism

Research questions

1. **What is the role of food subsidies in shaping predator-prey interactions in the Arctic?**
   (implications for bird conservation and management)

2. **Can shorebird cope with changes in temperature and predation pressure through the phenotypic plasticity of some traits (breeding behaviour)?**

3. **Can predator-prey interactions explain the distribution of some Arctic birds?**

4. **And many others…**

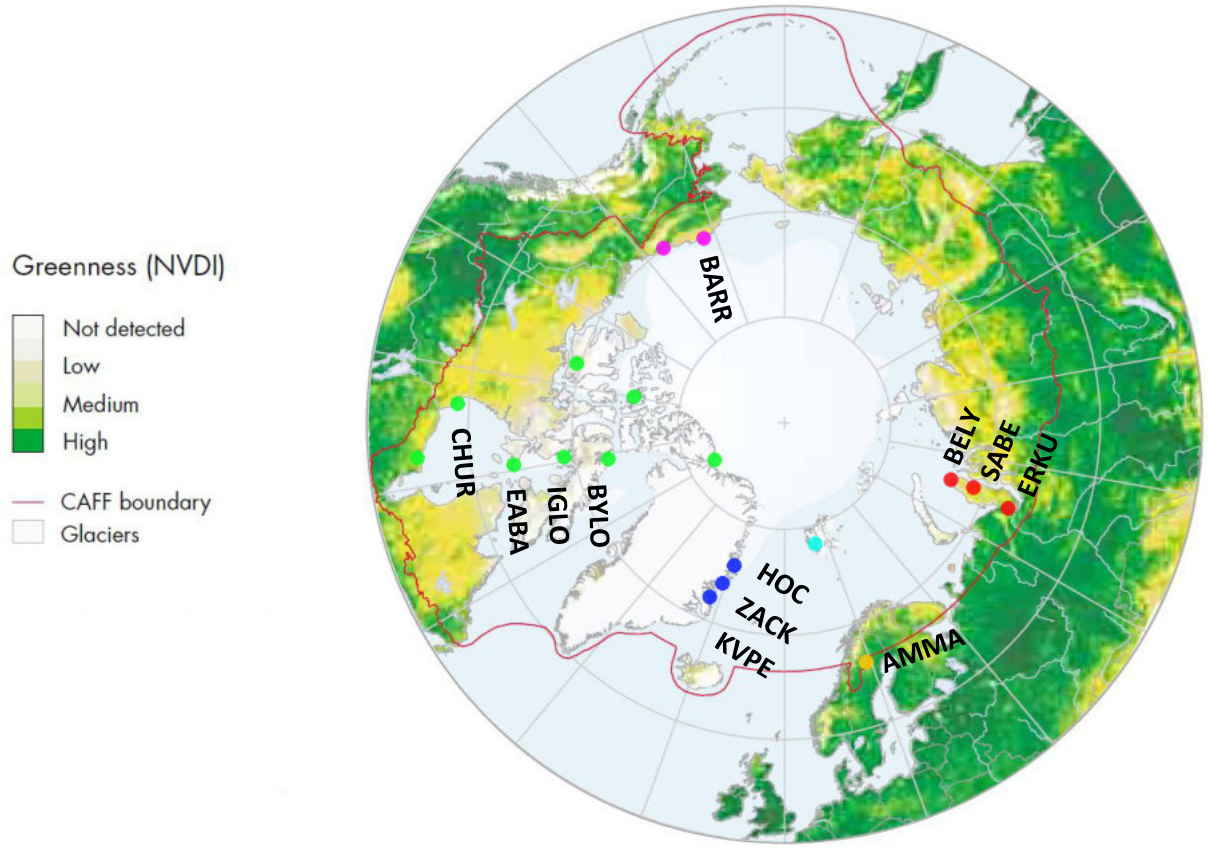
Links with CAFF and its Arctic Biodiversity Assessement?

In terrestrial ecosystems, biotic processes (e.g., direct and indirect inter-specific interactions within and between trophic levels) **are shaping biodiversity and ecosystem functioning**
(ABA 2013; Terrestrial Ecosystems: Key findings).

"Coordinated ecosystem-level oriented monitoring and modelling effort is needed to support biodiversity conservation efforts in a time of rapid change"
*(ABA Synthesis 2013; p113)***.**

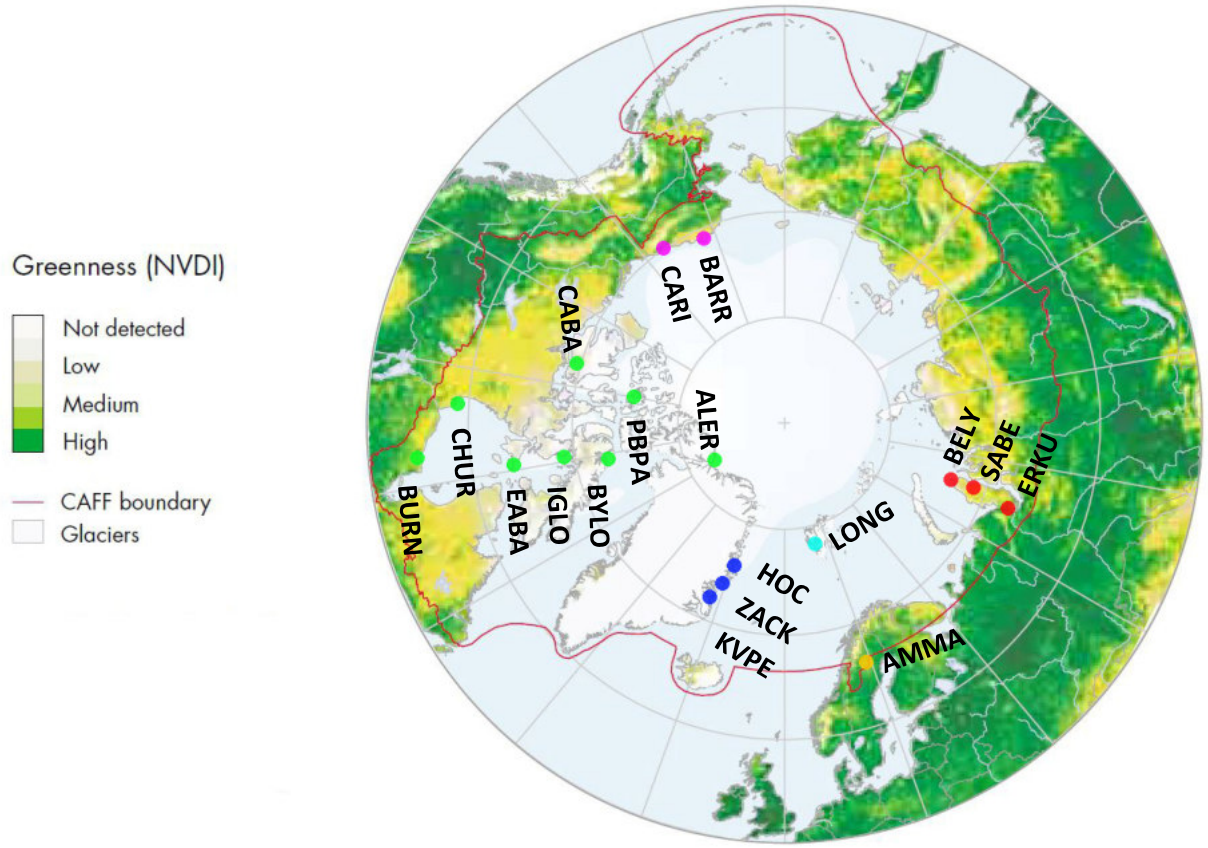
Long-term monitoring programs must be promoted to address key knowledge gaps currently harming the development and implementation of conservation and management strategies
(Recommendation #13 in: ABA, Report for Policy Makers, 2013).

Study sites



* 12 study sites that implemented our 5 protocols in 2016-2018 (Ammarnas in Sweden (AMMA), Point Barrow in Alaska-US (BARR), Belyi Island (BELY), Sabetta (SABE) and Erkuta (ERKU) in Yamal-Russia, Churchill (CHUR), East Bay (EABA), Igloolik (IGLO) and Bylot (BYLO) Islands in Canada, Hochstetter Forland (HOCH), Zackenberg (ZACK) and Karupelv Valley (KVPE) in NE Greenland)
* 6 additional sites that started to implement some of the protocols in 2018 (Burnpoint Creek –BURN-,Polar Bear Pass –PBPA-, Alert –ALER-, Cambridge Bay –CABA-, Caning River –CARI- and Longyearbyen –LONG-).

Study sites



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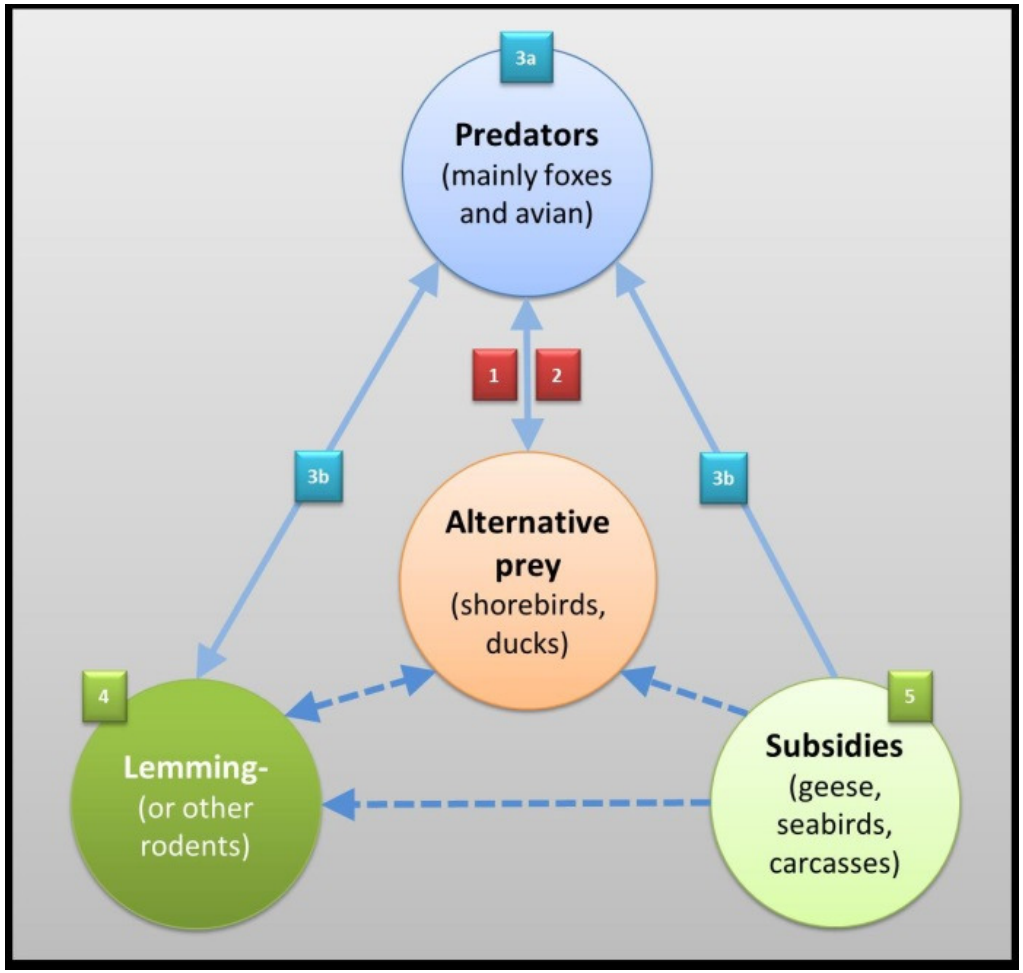
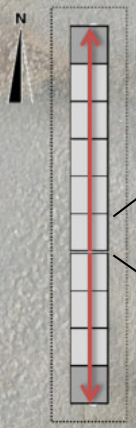
5 protocols

1. **Monitor predation pressure using artificial nests**
2. **Monitor predation rates on *Calidris* nests**
3. **Measure relative abundance of predators and lemmings**
4. **Estimate lemming (or "rodent") densities**
5. **Assess "herbivores" (excl. rodents) relative abundance**

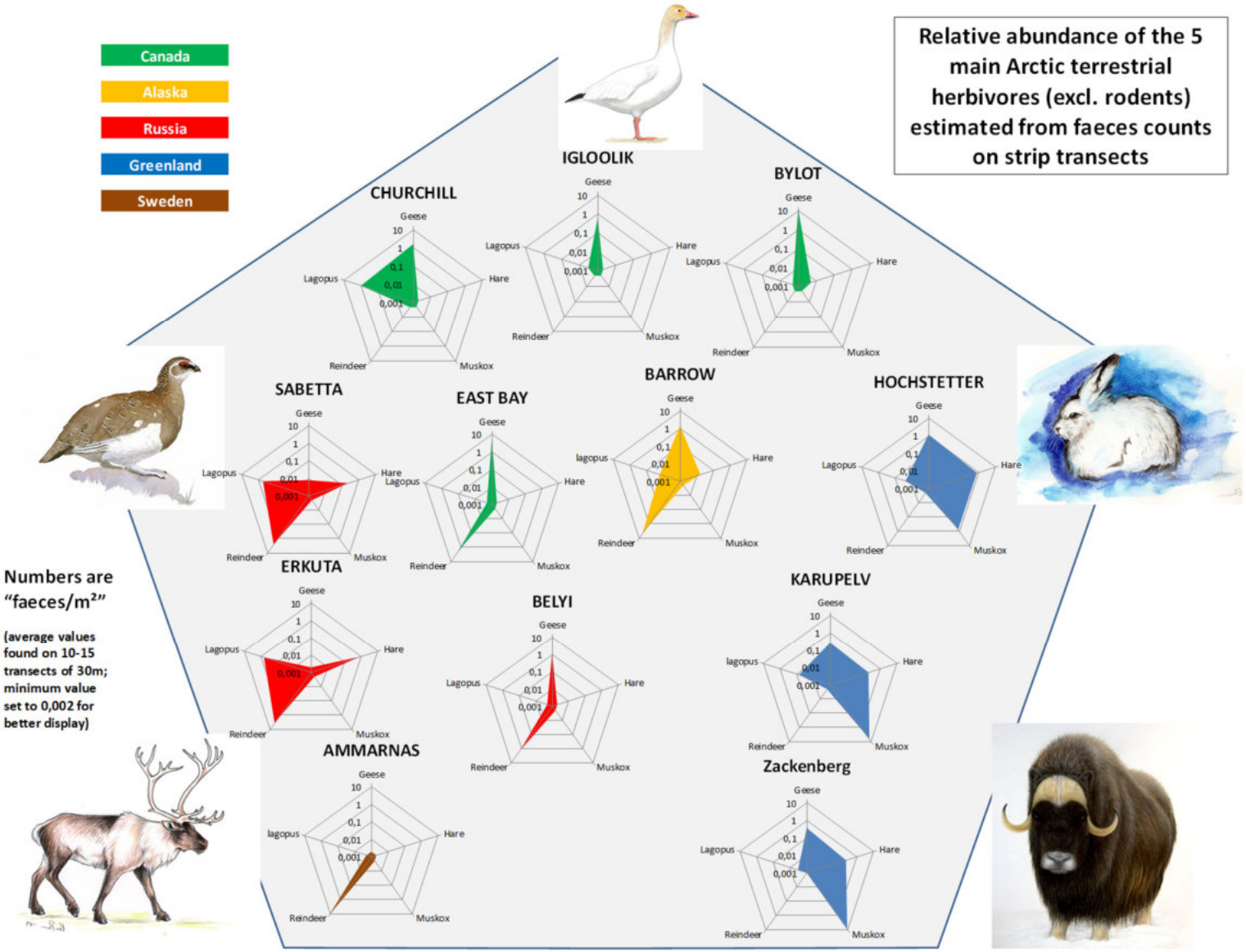


Herbivores

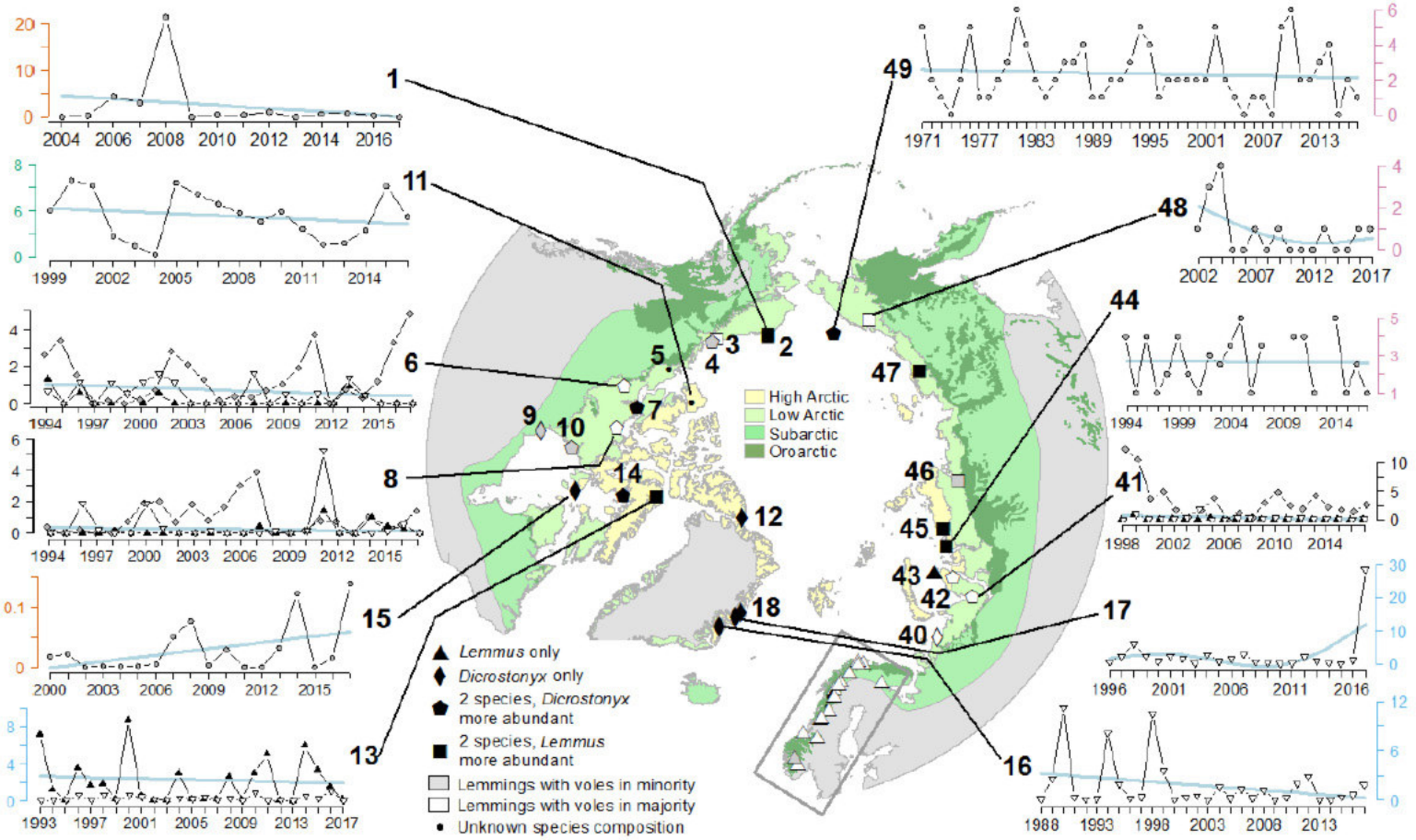
30 transects * 10m



Herbivores

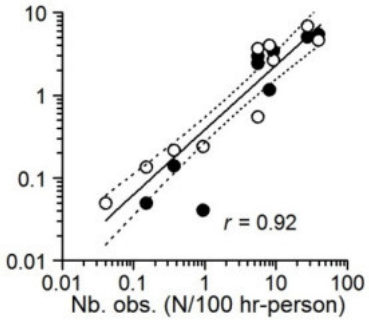

Canada
Alaska
Russia
Greenland
Sweden
Relative abundance of the 5 main Arctic terrestrial herbivores (excl. rodents) estimated from faeces counts on strip transects
IGLOOLIK
CHURCHILL
BYLOT
SABETTA
EAST BAY
BARROW
HOCHSTETTER
ERKUTA
BELYI
KARUPELV
AMMARNAS
Zackenberg
Geese
Hare
Muskox
Reindeer
Lagopus
10
1
0,1
0,01
0,001
Numbers are "faeces/m²"
(average values found on 10-15 transects of 30m; minimum value set to 0,002 for better display)

Rodents

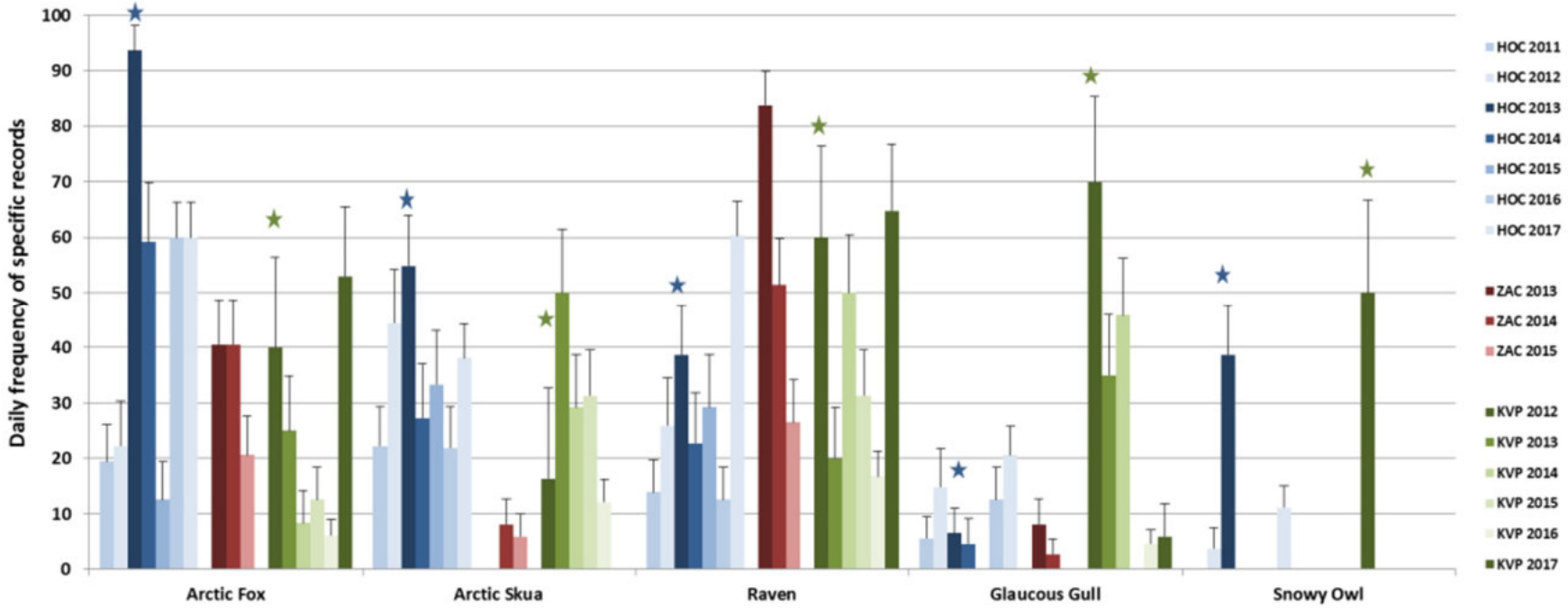


Ehrich et al submitted

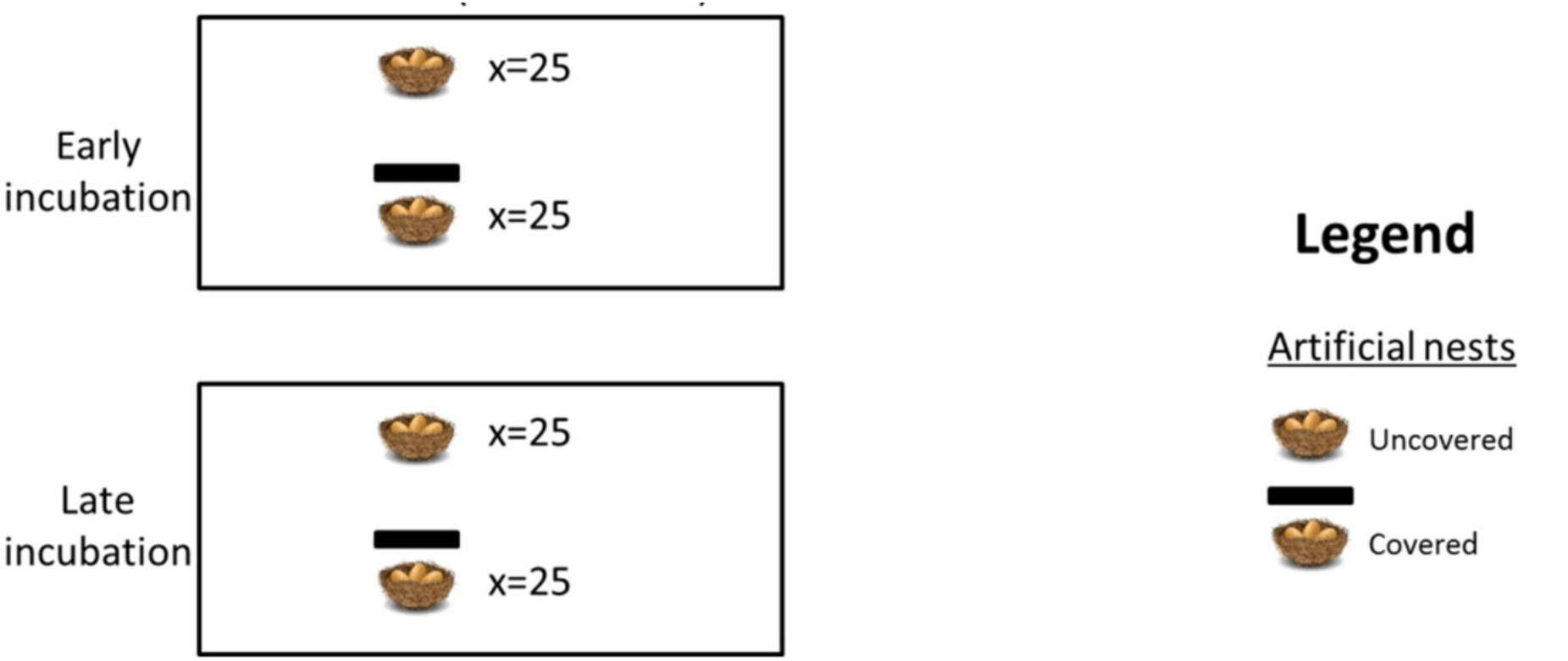
Incidental



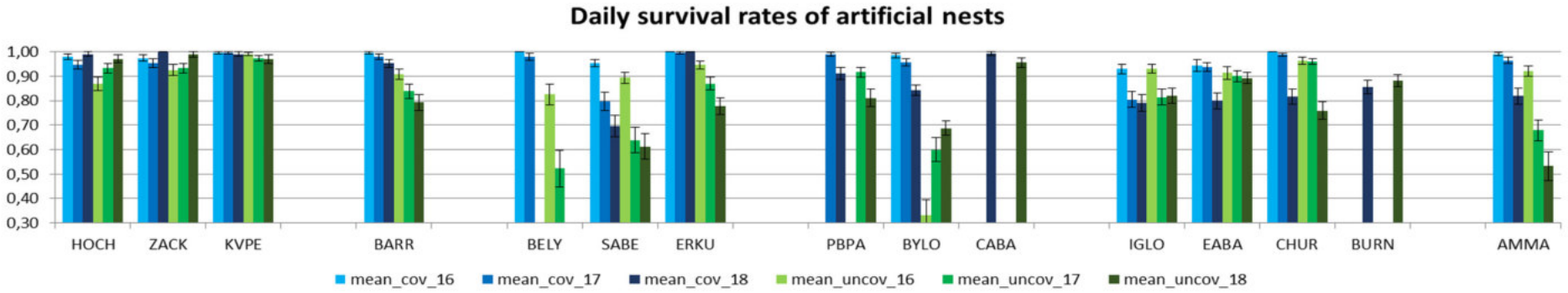
Fauteux et al 2018

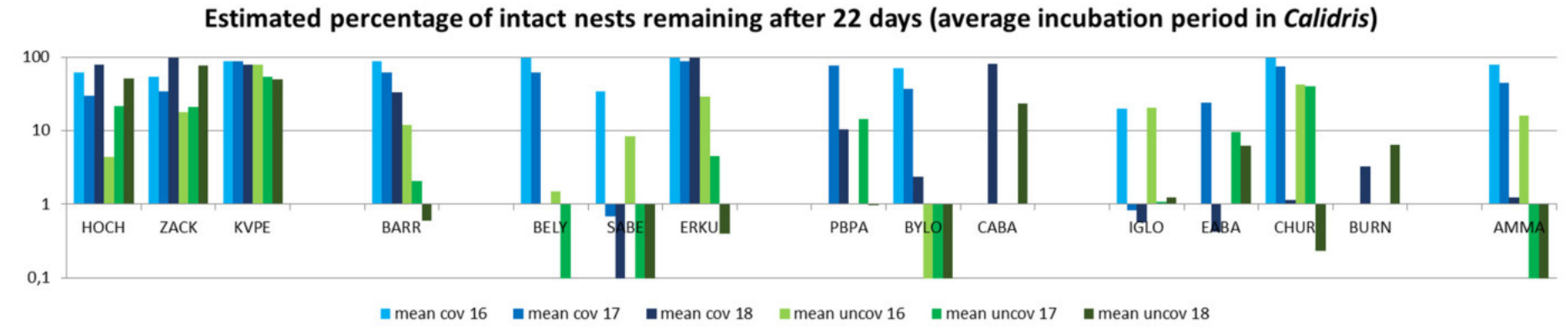


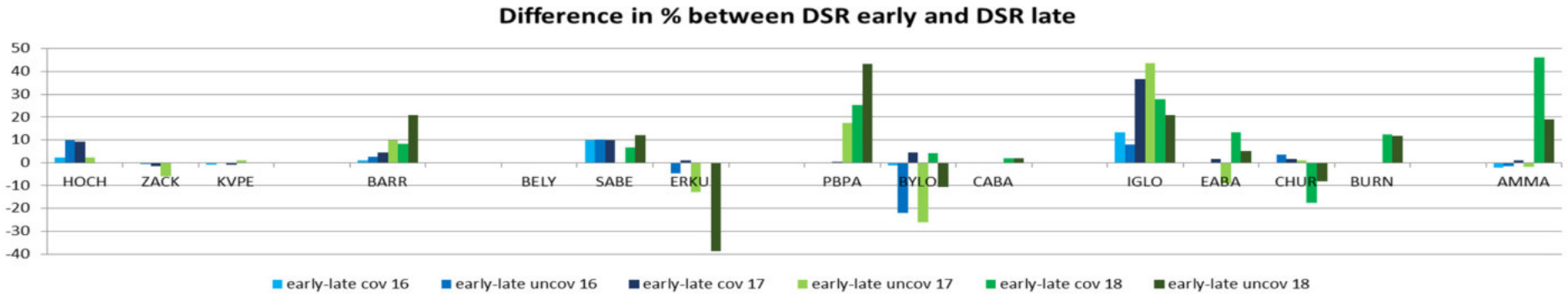
Artificial nests



Artificial nests

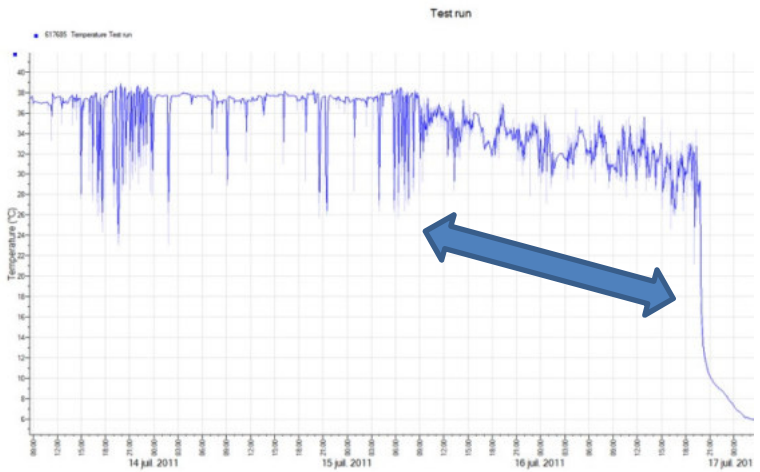


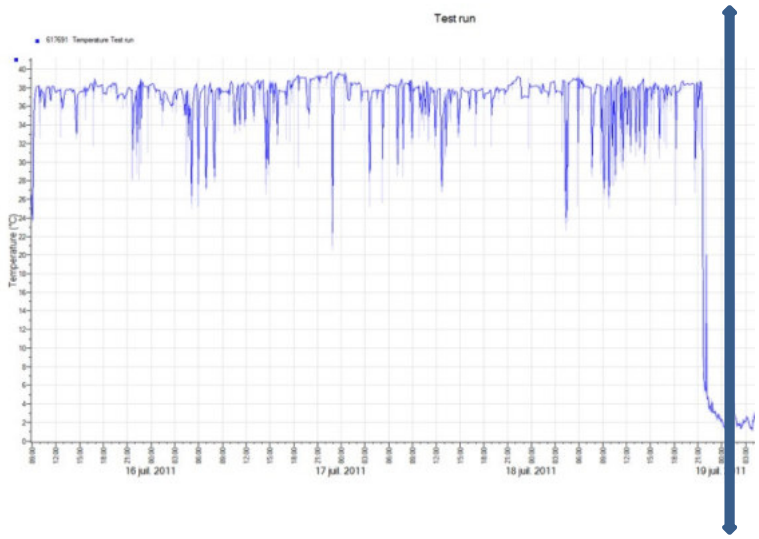




Real nests

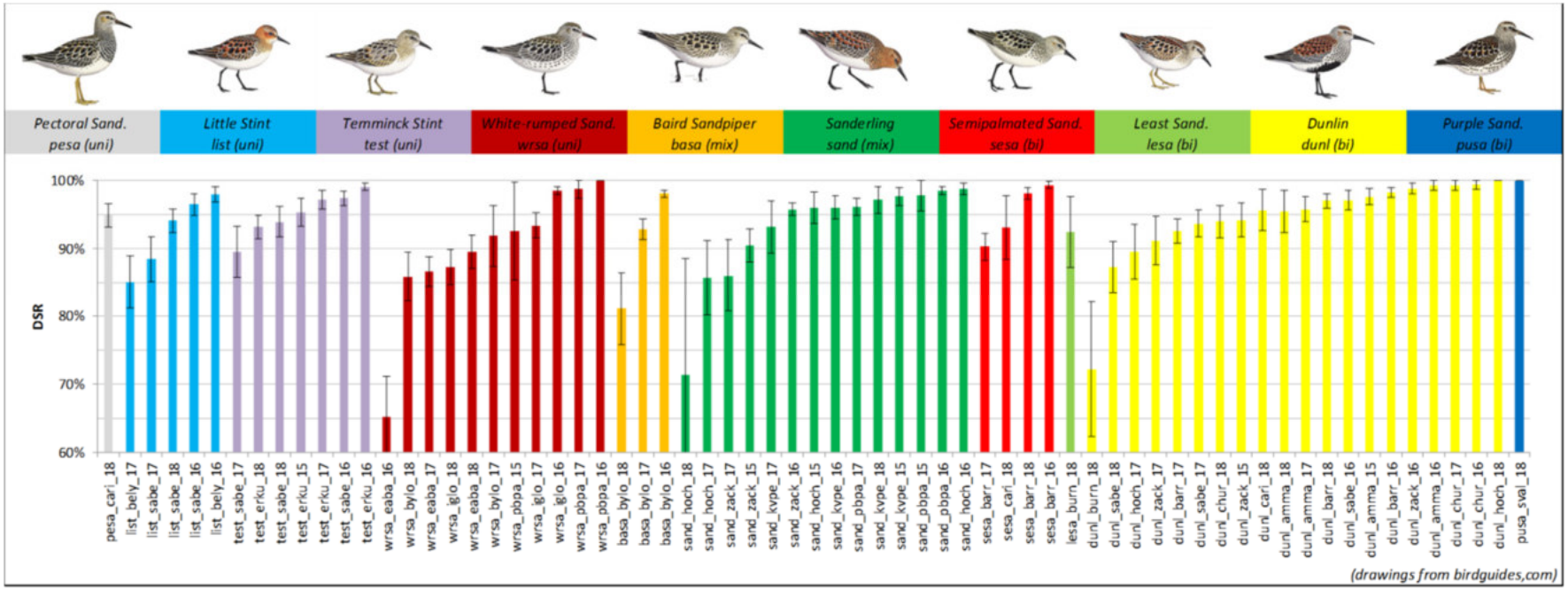
Real nests



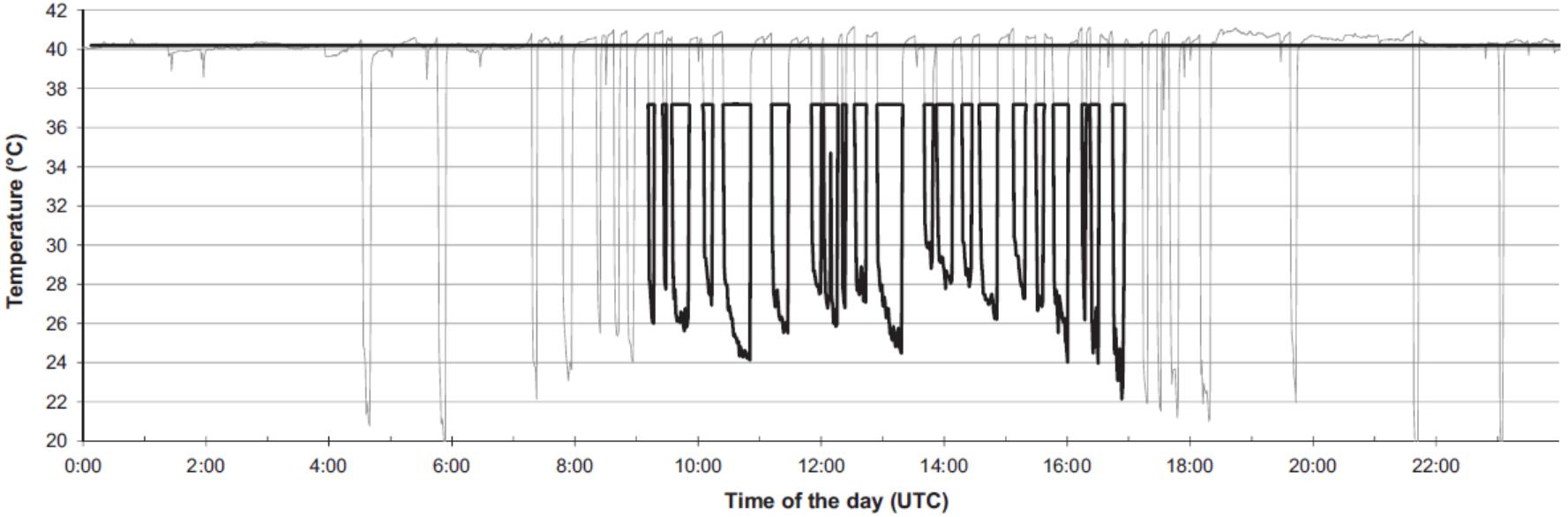


Successful **vs.** **Predated**

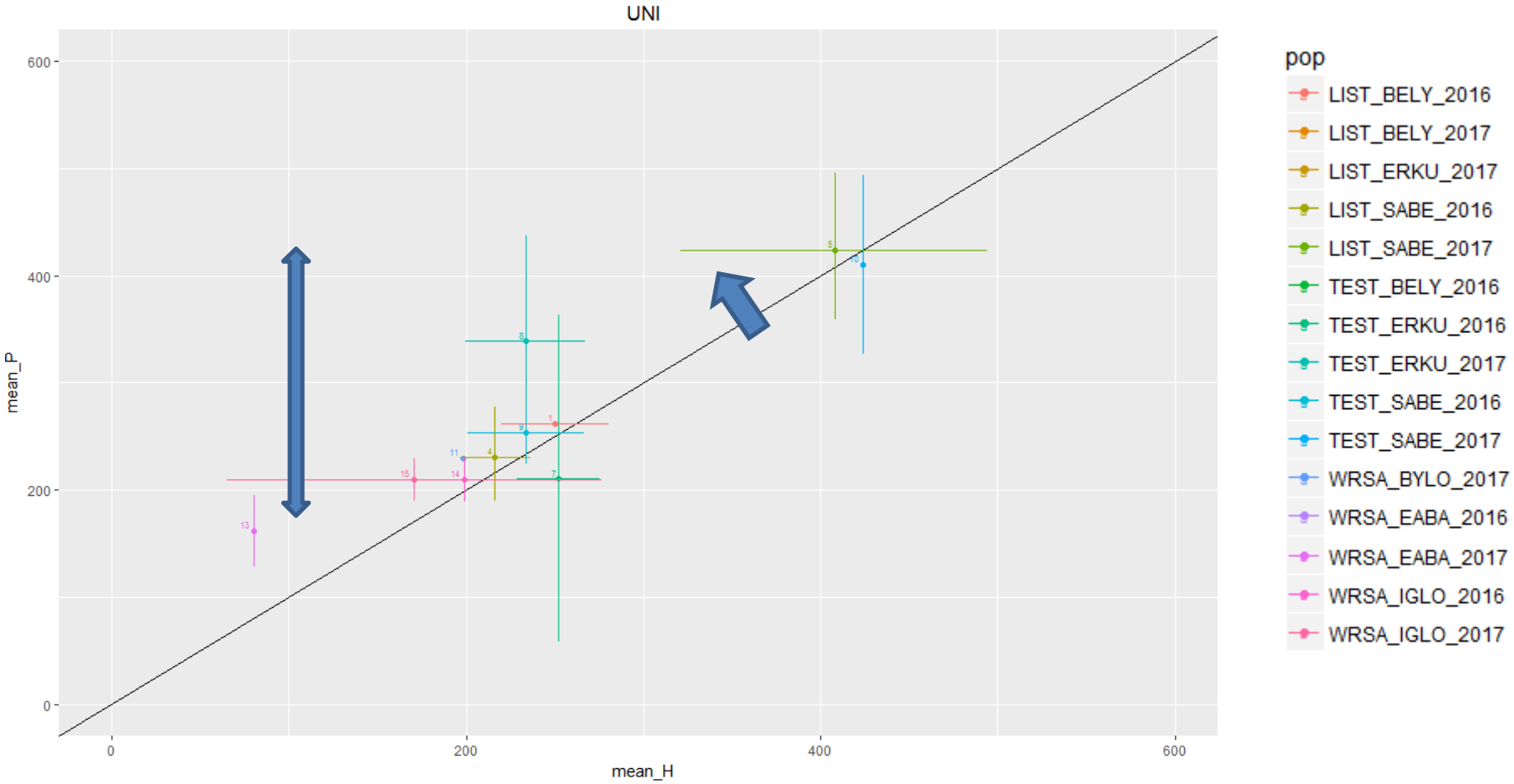
Real nests


Pectoral Sand.
pesa (uni)
Little Stint
list (uni)
Temminck Stint
test (uni)
White-rumped Sand.
wrsa (uni)
Baird Sandpiper
basa (mix)
Sanderling
sand (mix)
Semipalmated Sand.
sesa (bi)
Least Sand.
lesa (bi)
Dunlin
dunl (bi)
Purple Sand.
pusa (bi)
DSR
100%
90%
80%
70%
60%
pesa_cari_18
list_bely_17
list_sabe_17
list_sabe_18
list_sabe_16
list_bely_16
test_sabe_17
test_erku_18
test_sabe_18
test_erku_15
test_erku_17
test_sabe_16
test_erku_16
wrsa_eaba_16
wrsa_bylo_18
wrsa_eaba_17
wrsa_iglo_18
wrsa_eaba_18
wrsa_bylo_17
wrsa_pbpa_15
wrsa_iglo_17
wrsa_iglo_16
wrsa_pbpa_17
wrsa_pbpa_16
basa_bylo_18
basa_bylo_17
basa_bylo_16
sand_hoch_18
sand_hoch_17
sand_zack_17
sand_zack_15
sand_kvpe_17
sand_zack_16
sand_hoch_15
sand_kvpe_16
sand_pbpa_17
sand_kvpe_18
sand_kvpe_15
sand_pbpa_15
sand_pbpa_16
sand_hoch_16
sesa_barr_17
sesa_cari_18
sesa_barr_18
sesa_barr_16
lesa_burn_18
dunl_burn_18
dunl_sabe_18
dunl_hoch_17
dunl_zack_17
dunl_barr_17
dunl_sabe_17
dunl_chur_18
dunl_zack_15
dunl_cari_18
dunl_amma_18
dunl_amma_17
dunl_barr_18
dunl_sabe_16
dunl_amma_15
dunl_barr_16
dunl_zack_16
dunl_amma_16
dunl_chur_17
dunl_chur_16
dunl_hoch_18
pusa_sval_18
(drawings from birdguides,com)

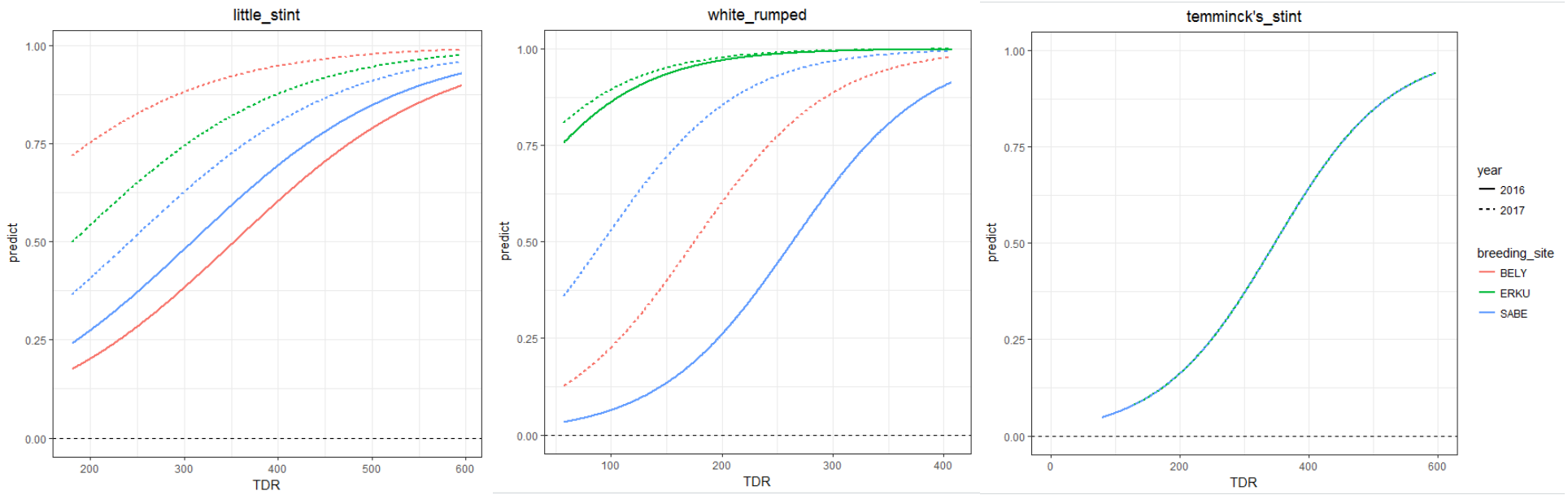
Real nests


Temperature (°C)
42
40
38
36
34
32
30
28
26
24
22
20
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Time of the day (UTC)

Real nests


UNI
mean_P
mean_H
0
200
400
600
pop
LIST_BELY_2016
LIST_BELY_2017
LIST_ERKU_2017
LIST_SABE_2016
LIST_SABE_2017
TEST_BELY_2016
TEST_ERKU_2016
TEST_ERKU_2017
TEST_SABE_2016
TEST_SABE_2017
WRSA_BYLO_2017
WRSA_EABA_2016
WRSA_EABA_2017
WRSA_IGLO_2016
WRSA_IGLO_2017

Real nests


little_stint
white_rumped
temminck's_stint
predict
TDR
1.00
0.75
0.50
0.25
0.00
200
300
400
500
600
100
0
year
2016
2017
breeding_site
BELY
ERKU
SABE

Progress and perspectives

- **12 “core sites” with full implementation (5 protocols) since 2016 (most with additional/earlier data for some protocols)**
- **7 additional sites with partial implementation (some years or some protocols only)**
- **Close to 1000 *Calidris* nests from 10 species monitored under different conditions of predation pressure and alternative prey/subsidies**
- **About 50 collaborators involved annually (with no specific funding from IWG!)**
- **2 PhD students (CAN and F) working hard to publish first IWG joint results in 2019**
- **4th and last year of initial plan will be 2019 but many (most?) sites will keep going…**

Thanks!

Core Sites (alphabetical)	**Site ID** (4 letters)	**Name** (alphabetical)
Ammarnas, Sweden 65.96N 16.29E	AMMA	Anders Angerbjörn
Ammarnas, Sweden 65.96N 16.29E	AMMA	Rob van Bemmelen
Barrow, Alaska USA 71.23N 156.75W	BARR	Ben Lagasse
Barrow, Alaska USA 71.23N 156.75W	BARR	Richard Lanctot
Barrow, Alaska USA 71.23N 156.75W	BARR	Sarah Saalfeld
Barrow, Alaska USA 71.23N 156.75W	BARR	Willow Englllish
Belyi Is., Russia 73.32N 70.09E	BELY	Aleksander Sokolov
Belyi Is., Russia 73.32N 70.09E	BELY	Dorothée Ehrich
Bylot, Canada 73.15N 80.00W	BYLO	Dominique Berteaux
Bylot, Canada 73.15N 80.00W	BYLO	Marie-Jeanne Rioux
Bylot, Canada 73.15N 80.00W	BYLO	Gilles Gauthier
Bylot, Canada 73.15N 80.00W	BYLO	Joël Bêty
Churchill, Canada 58.70N 94.08W	CHUR	James Roth
Churchill, Canada 58.70N 94.08W	CHUR	Laura McKinnon
Churchill, Canada 58.70N 94.08W	CHUR	Leah Wrigth
Churchill, Canada 58.70N 94.08W	CHUR	Taylor Brown
East Bay, Canada 63.98N 81.67W	EABA	Paul Smith
East Bay, Canada 63.98N 81.67W	EABA	Scott Flemming
Erkuta, Russia 68.22N 69.15E	ERKU	Aleksander Sokolov
Erkuta, Russia 68.22N 69.15E	ERKU	Dorothée Ehrich
Erkuta, Russia 68.22N 69.15E	ERKU	Natasha Sokolova
Erkuta, Russia 68.22N 69.15E	ERKU	Vasiliy Sokolov
Hochstetter, Gree. 75.15N 19.70W	HOCH	Brigitte Sabard
Hochstetter, Gree. 75.15N 19.70W	HOCH	Glenn Yannic
Hochstetter, Gree. 75.15N 19.70W	HOCH	Nicolas Meyer
Hochstetter, Gree. 75.15N 19.70W	HOCH	Jérome Moreau
Hochstetter, Gree. 75.15N 19.70W	HOCH	Loïc Bollache
Hochstetter, Gree. 75.15N 19.70W	HOCH	Olivier Gilg
Hochstetter, Gree. 75.15N 19.70W	HOCH	Vladimir Gilg
Igloolik, Canada 69.40N 81.60W	IGLO	Audrey Bédard
Igloolik, Canada 69.40N 81.60W	IGLO	Marie-Andrée Giroux
Igloolik, Canada 69.40N 81.60W	IGLO	Nicolas Lecomte
Karupelv, Greenl. 72.50N 24W	KVPE	Benoît Sittler
Karupelv, Greenl. 72.50N 24W	KVPE	Johannes Lang
Sabetta, Russia 71.24N 71.80E	SABE	Aleksander Sokolov
Sabetta, Russia 71.24N 71.80E	SABE	Dorothée Ehrich
Sabetta, Russia 71.24N 71.80E	SABE	Natasha Sokolova
Zackenberg, Gree. 74.47N 20.57W	ZACK	Jannik Hansen
Zackenberg, Gree. 74.47N 20.57W	ZACK	Jeroen Reneerkens
Zackenberg, Gree. 74.47N 20.57W	ZACK	Lars Hansen
Zackenberg, Gree. 74.47N 20.57W	ZACK	Niels M. Schmidt

Additional Sites (alphabetical)	**Site ID** (4 letters)	**Name** (alphabetical)
Alert, Canada 82.50N 62.35W	*ALER*	François Vézina
Burnpoint Creek, Canada 55.24N 84.31W	*BURN*	Glen Brown
Cambridge Bay, Canada 69.12N 105.05W	*CABA*	Jean-François Lamarre
Canning River, Alaska 70.11N 145.8W	*CARI*	Christopher Latty
Canning River, Alaska 70.11N 145.8W	*CARI*	Lisa Kennedy
Polar Bear Pass (Nanuit Itillinga), Canada 75.72I	*PBPA*	Paul Woodard
Polar Bear Pass (Nanuit Itillinga), Canada 75.72I	*PBPA*	Jennie Rausch
Salluit, Canada 62.14N 75.57W	*SALL*	*Dominique Fauteux*
Svalbard, Norway 78.20N 15.8E	*SVAL*	Øystein Varpe
Svalbard, Norway 78.20N 15.8E	*SVAL*	Eva Fuglei
Varanger, Norway 70.41N 29.50E	*VARA*	Rolf A. Ims