



Vulnérabilité des essences à l'effet direct des changements climatiques

Catherine Périé (DRF, MRNF)

Lexique des abréviations utilisées

HOR = horizon de temps

- 1961-1990 : passé récent (PR)
- 2041-2070 : 2050 (FUT)
- 2071-2100 : 2080 (FUT)

ESS = essence

RCP = *representative concentration pathway*

- 45: 4,5 W.m⁻² (scénarios optimistes)
- 85: 8,5 W.m⁻² (scénarios pessimistes)
- 4585: combinaison de l'ensemble des scénarios

AR = aire de répartition

Le menu du jour

1

Effets anticipés des changements climatiques sur la croissance en surface terrière des principales essences en Gaspésie

2

Effets anticipés des changements climatiques sur l'habitat des essences en Gaspésie

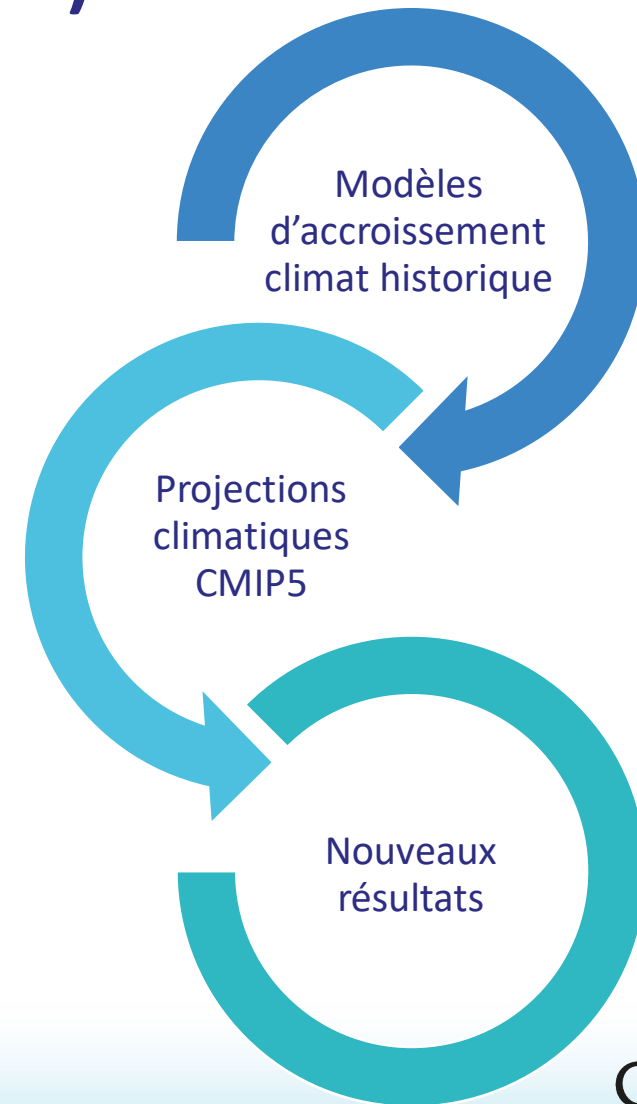
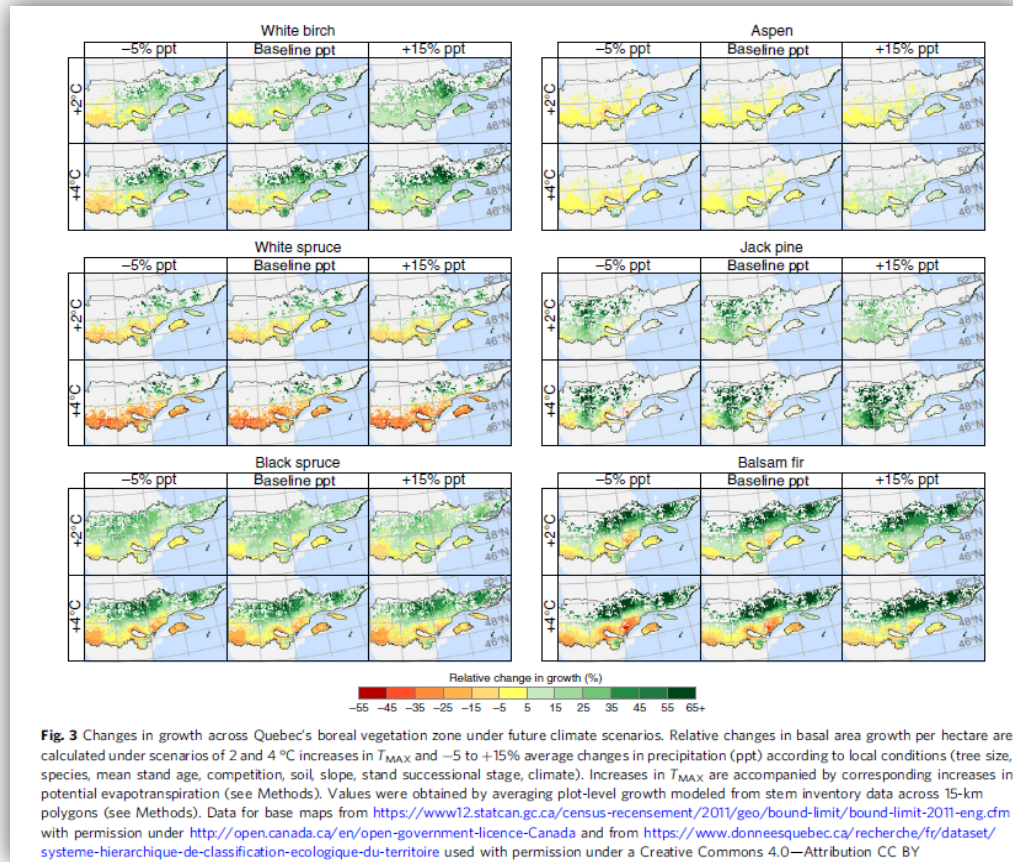
3

La forêt du futur en Gaspésie

4

Effets anticipés des changements climatiques sur la composition des peuplements actuellement sur pied

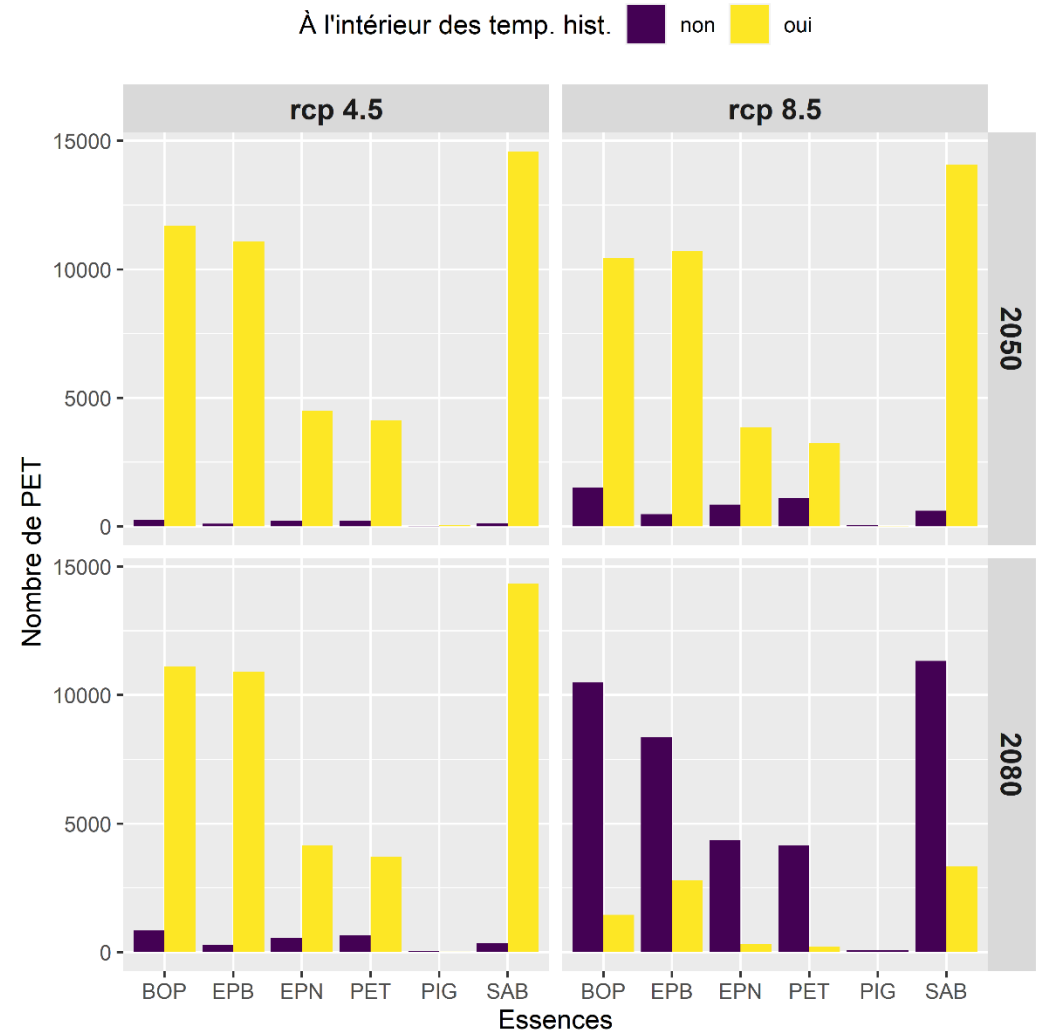
Collaboration avec L. D'Orangeville (UNB)



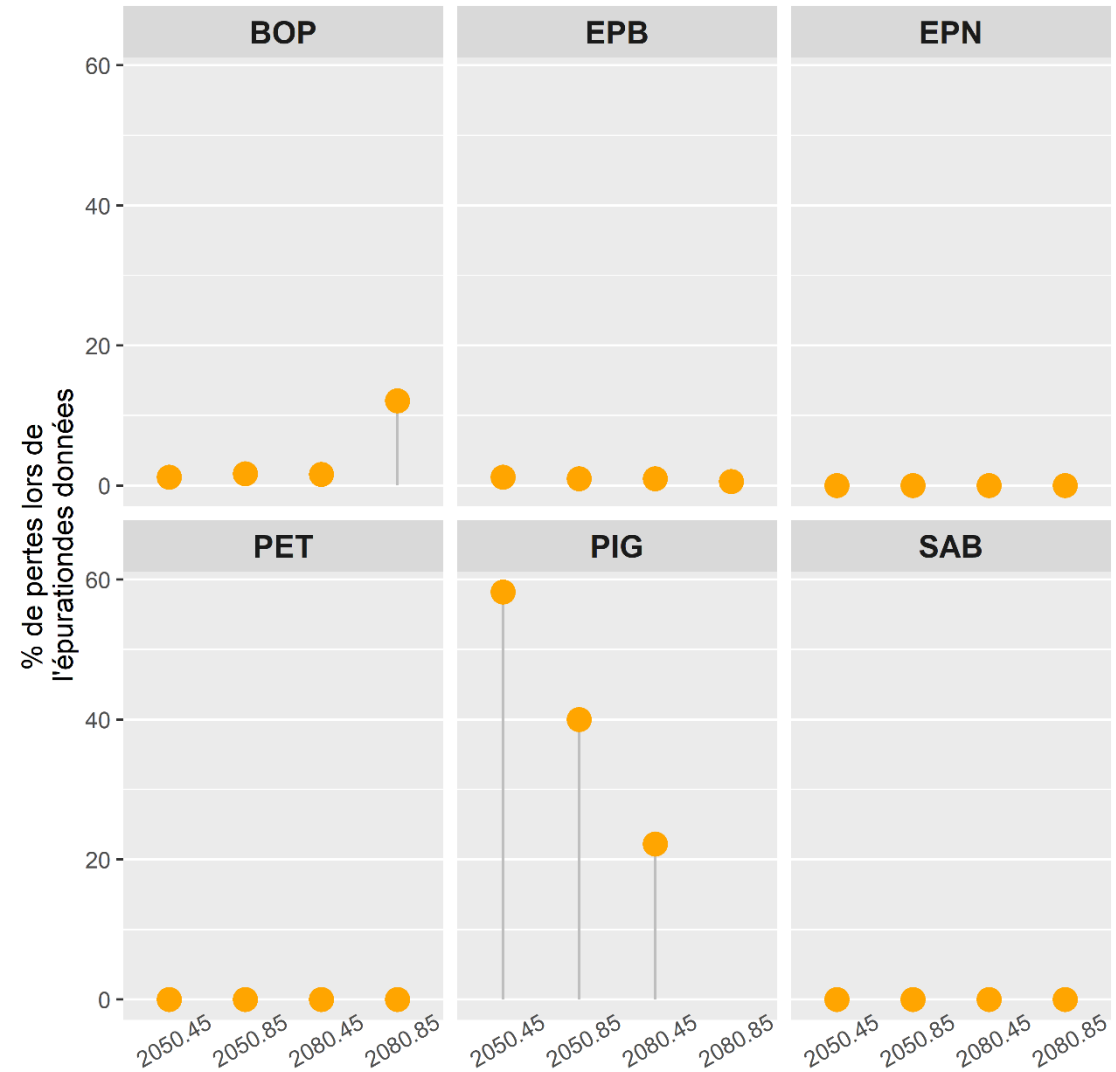
Préparation
des données

1

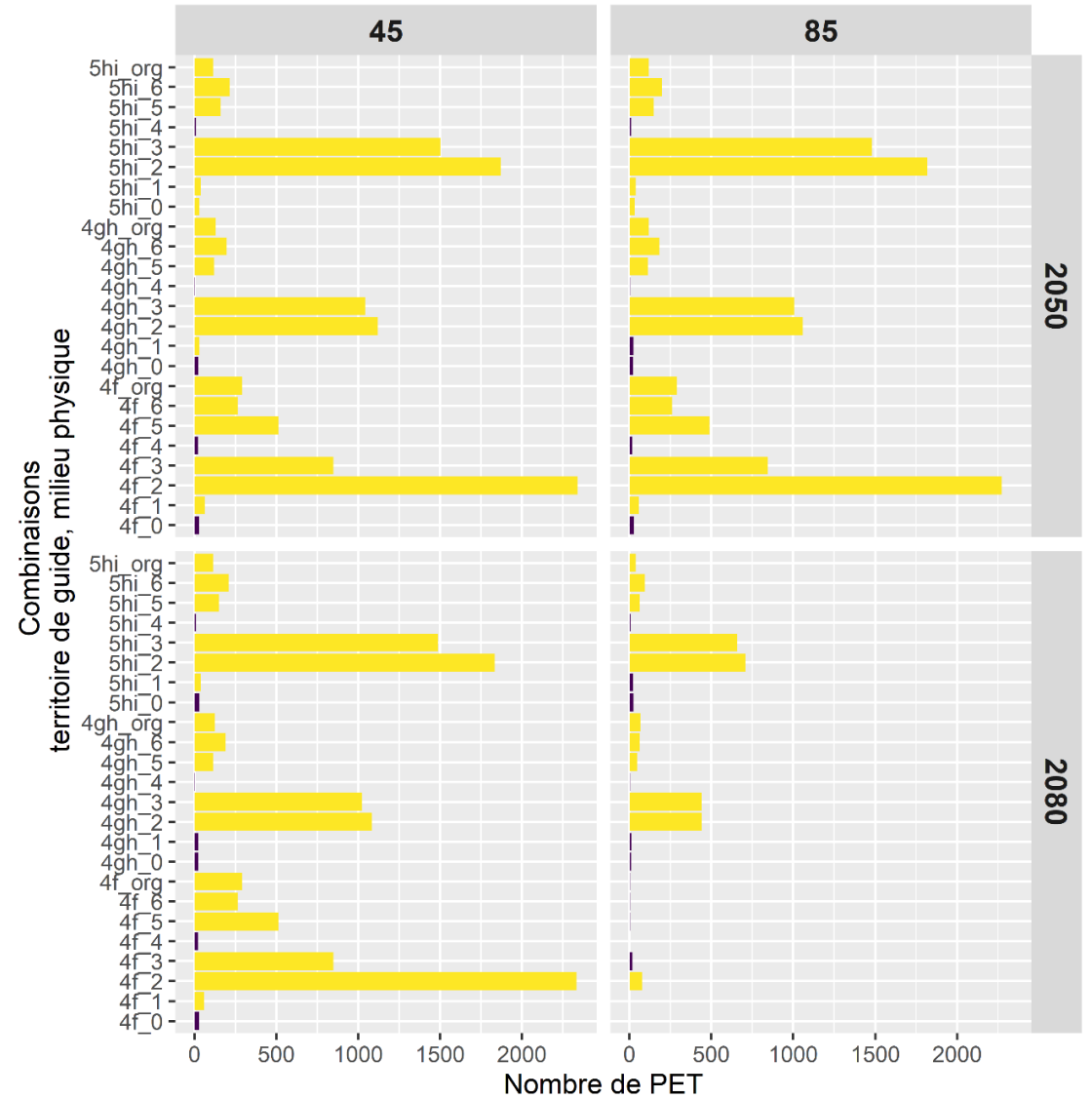
- Pour chaque combinaison ESS-HOR-RCP, exclusion des placettes dont la température future ne fait pas partie de la gamme des températures observées durant la période de référence



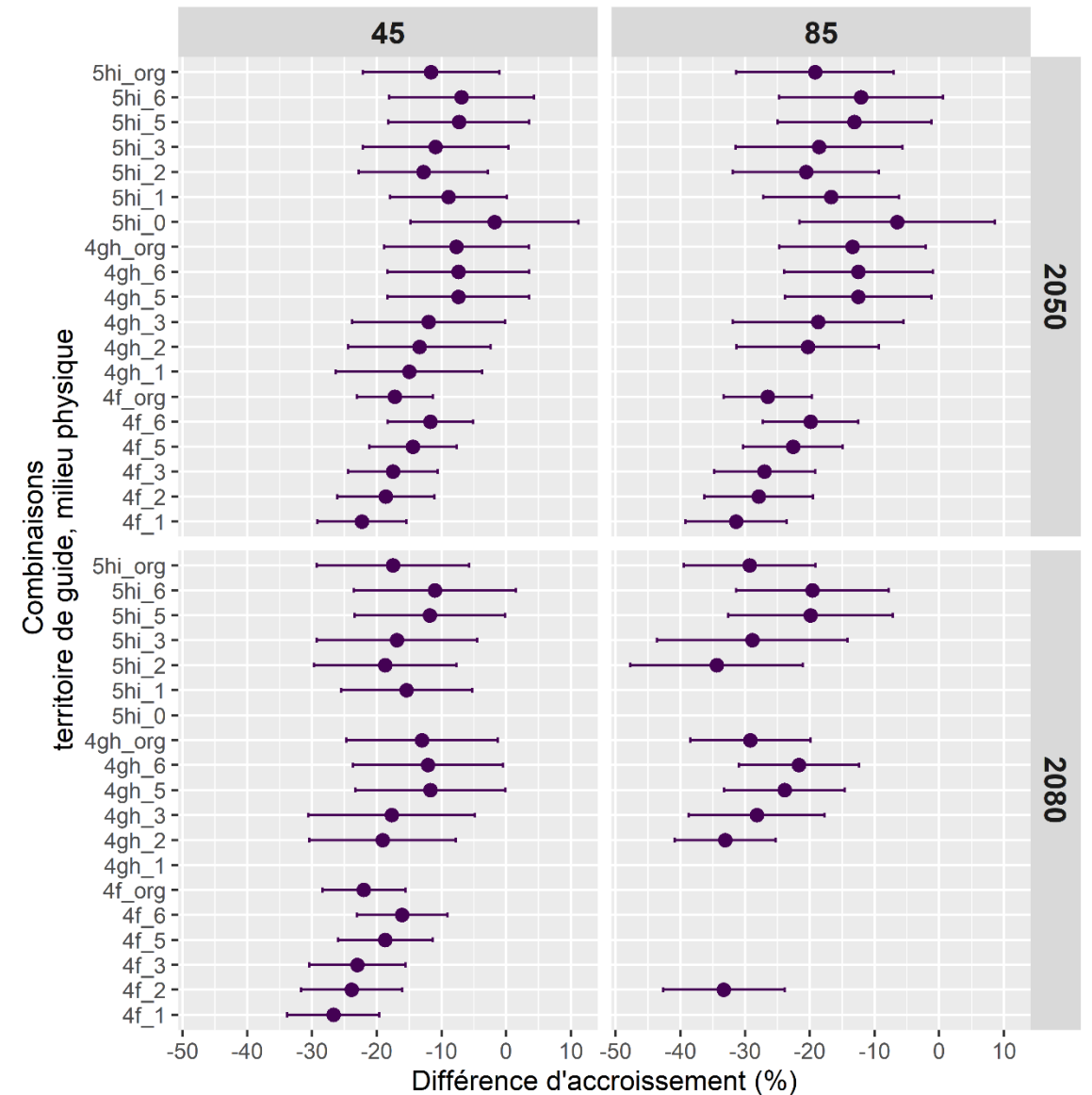
- Pour chaque combinaison ESS-HOR-RCP, exclusion des placettes en raison d'accroissements en surface terrière qui paraissaient aberrants (critère : la distance de Cooks)



- Pour chaque combinaison ESS-HOR-RCP, seules les combinaisons territoire de guide-milieu physique ayant au moins 30 placettes ont été retenues;



- Comparaison de moyennes pour chaque combinaison SOR-ESS-HOR-RCP a été effectuée afin de **grouper ensemble des associations territoire de guide-milieu physique ayant des différences d'accroissement en surface terrière similaires**

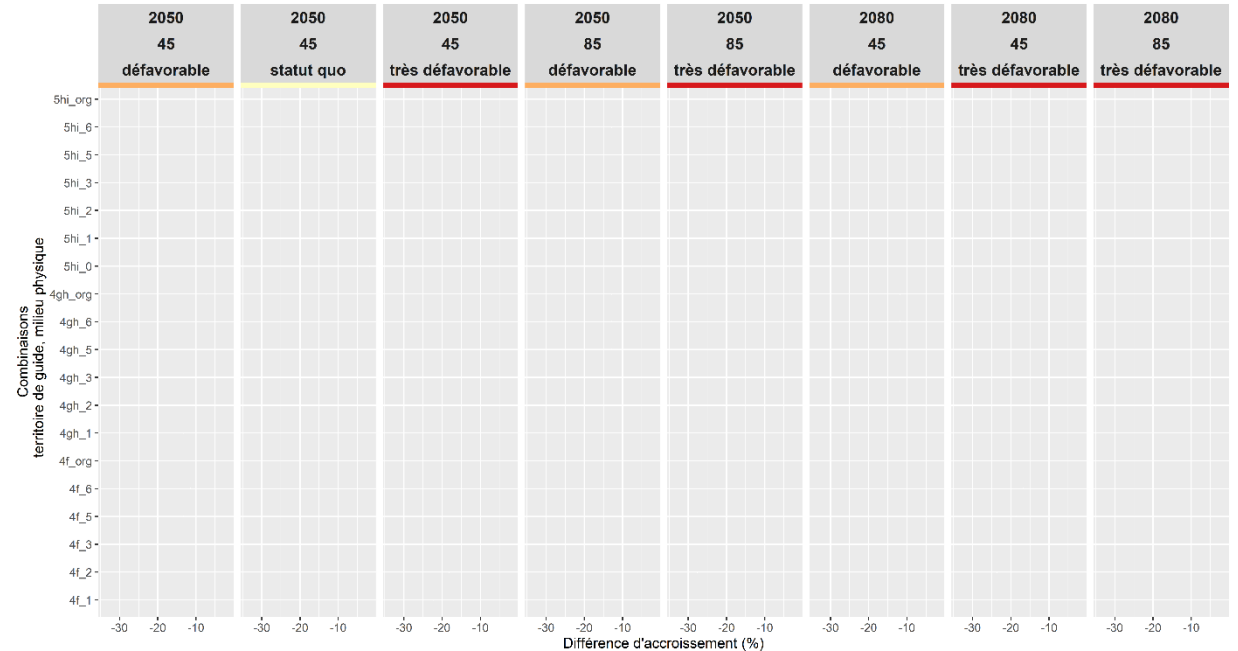


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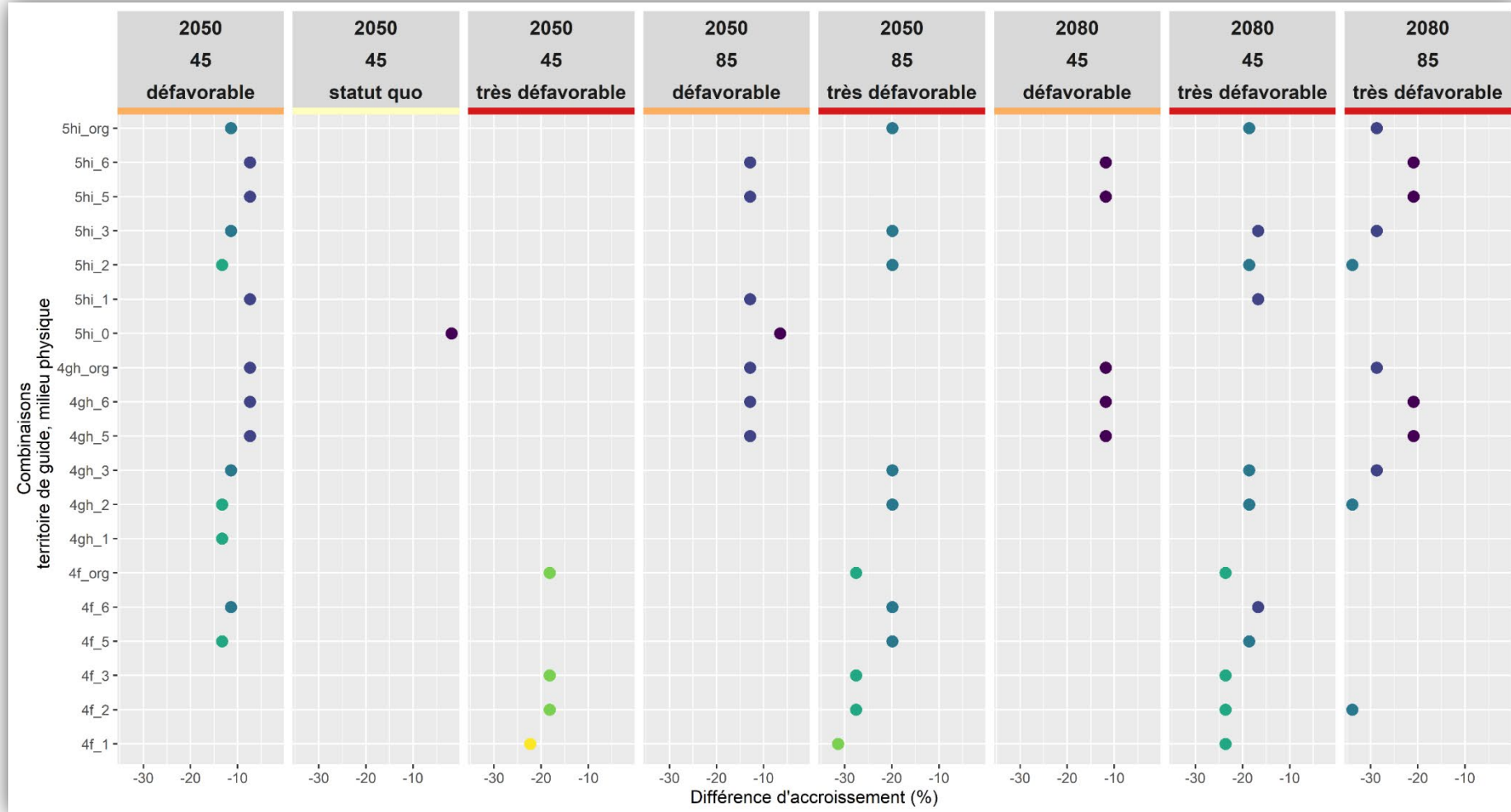
Analyse des données

Pour chaque combinaison SOR-ESS-HOR-RCP, ces groupes ont été qualifiés selon 5 niveaux d'effet des CC sur l'accroissement en surface terrière

- très favorable : $\Delta \geq +15\%$
- favorable : $+3\% \leq \Delta < +15\%$
- statut quo : $-3\% \leq \Delta < +3\%$
- défavorable : $-15\% \leq \Delta < -3\%$
- très défavorable : $\Delta < -15$

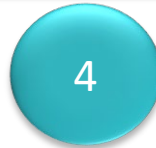


Épinette blanche





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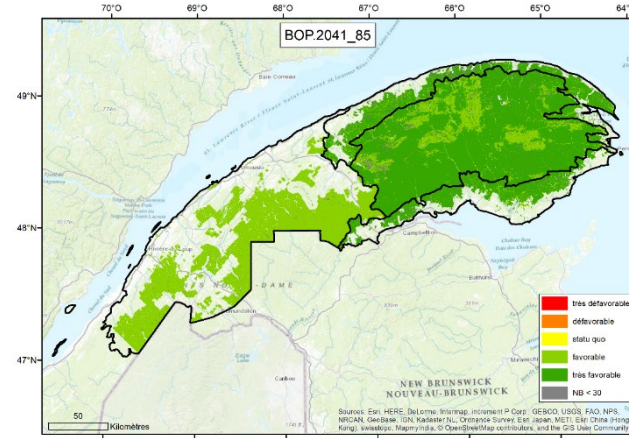
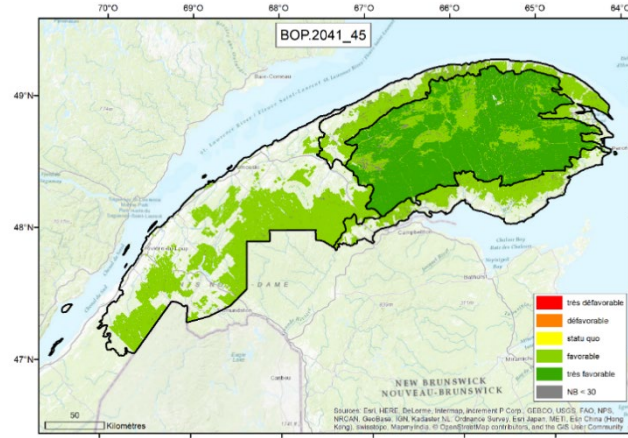


BOP

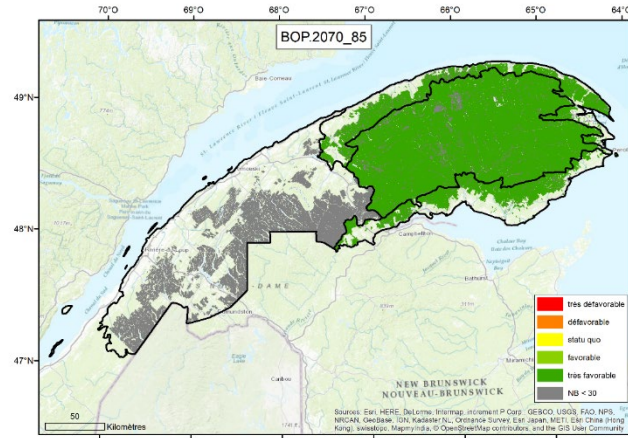
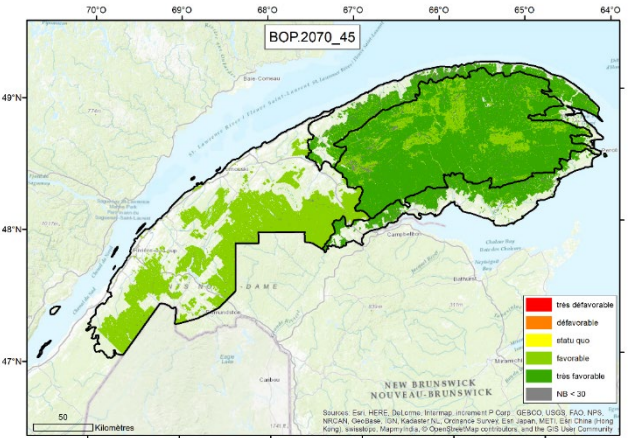
rcp 4,5

rcp 8,5

2050



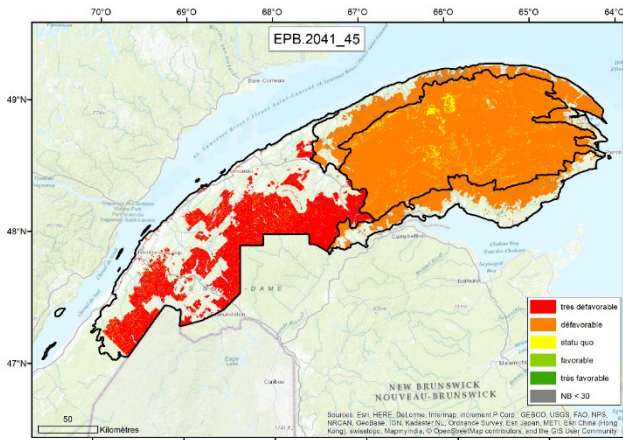
2080



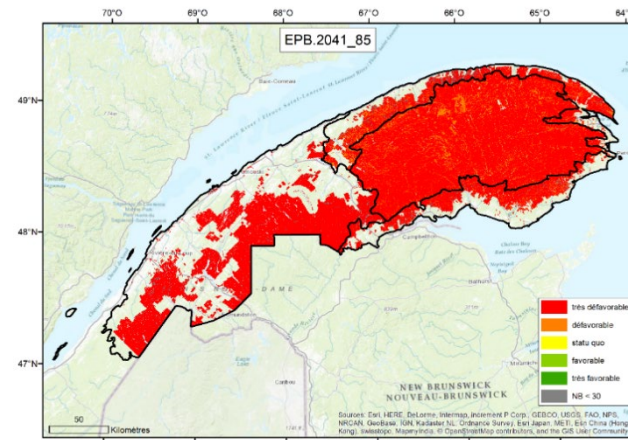


EPB

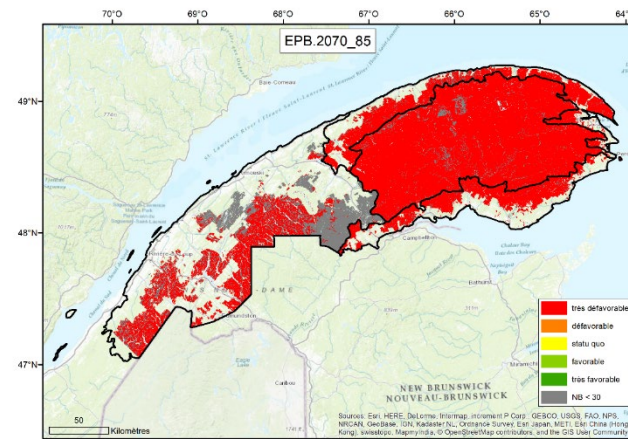
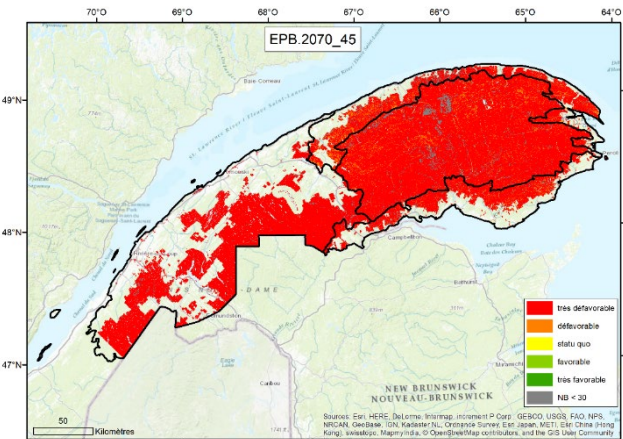
rcp 4,5



rcp 8,5



2050



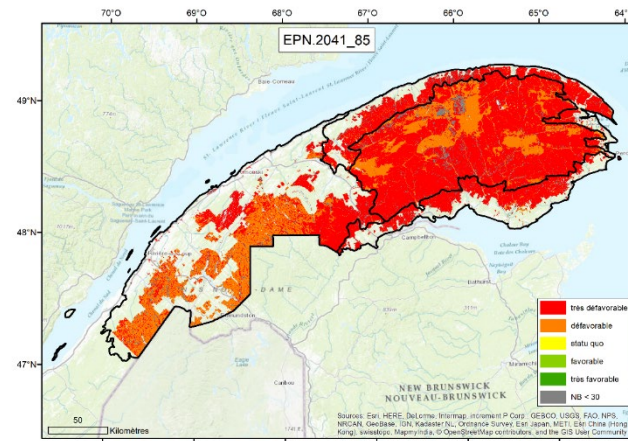
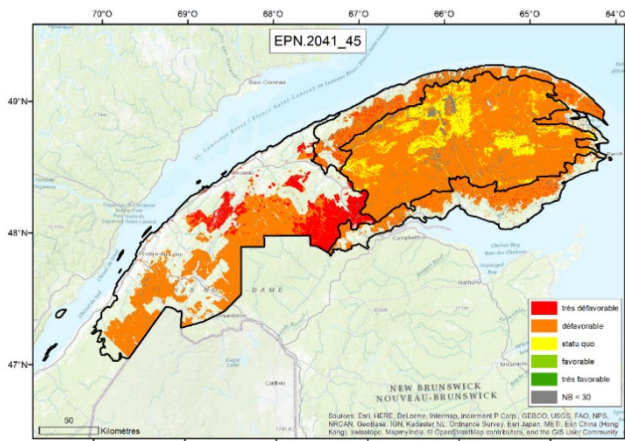
2080



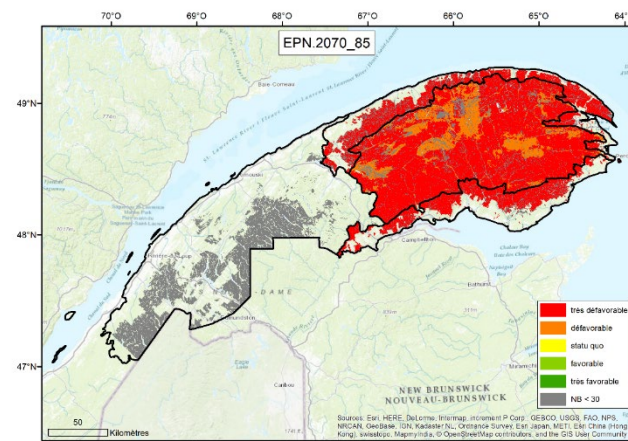
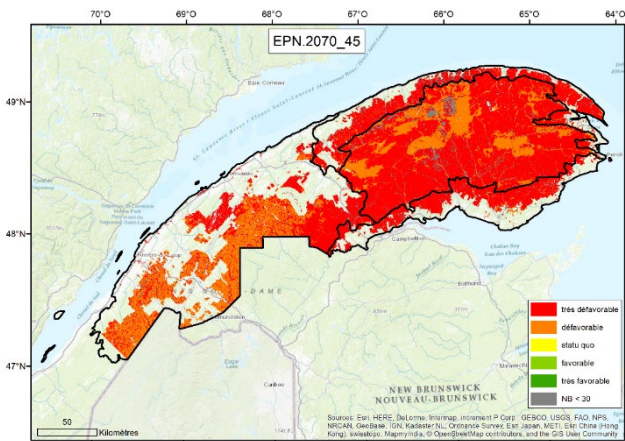
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rcp 8,5

2050



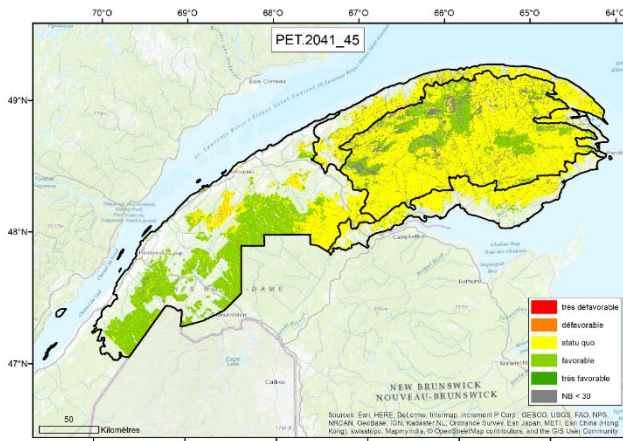
2080





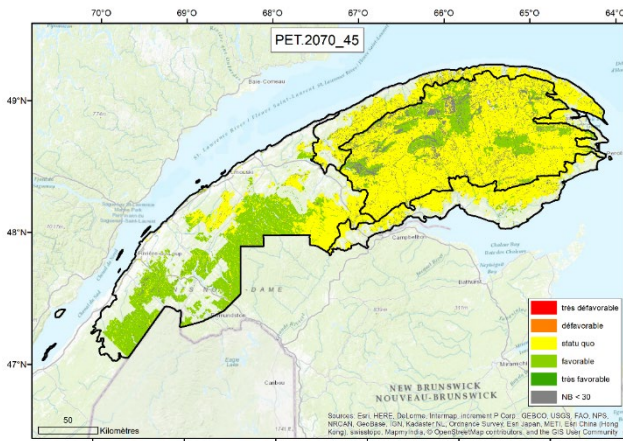
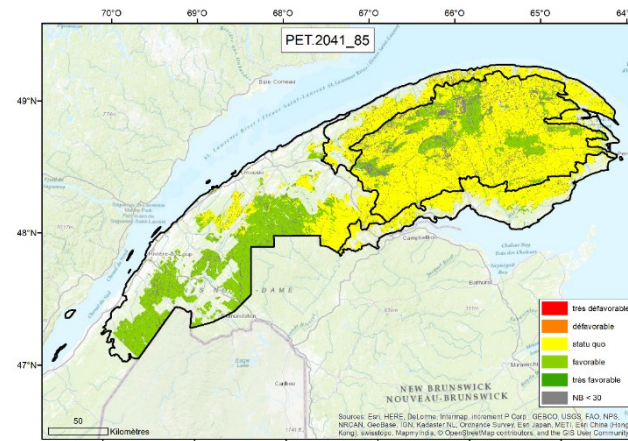
PET

rcp 4,5

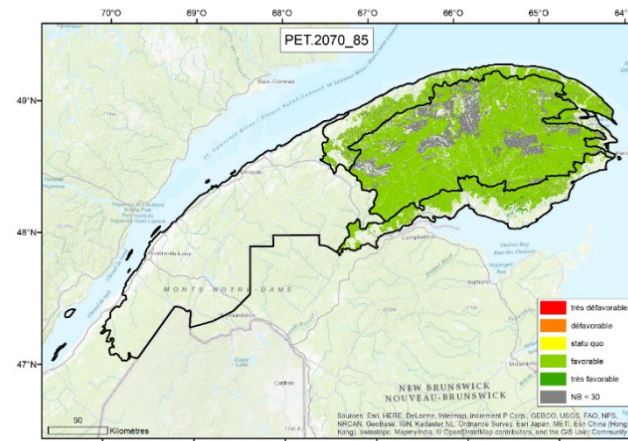


2050

rcp 8,5



2080



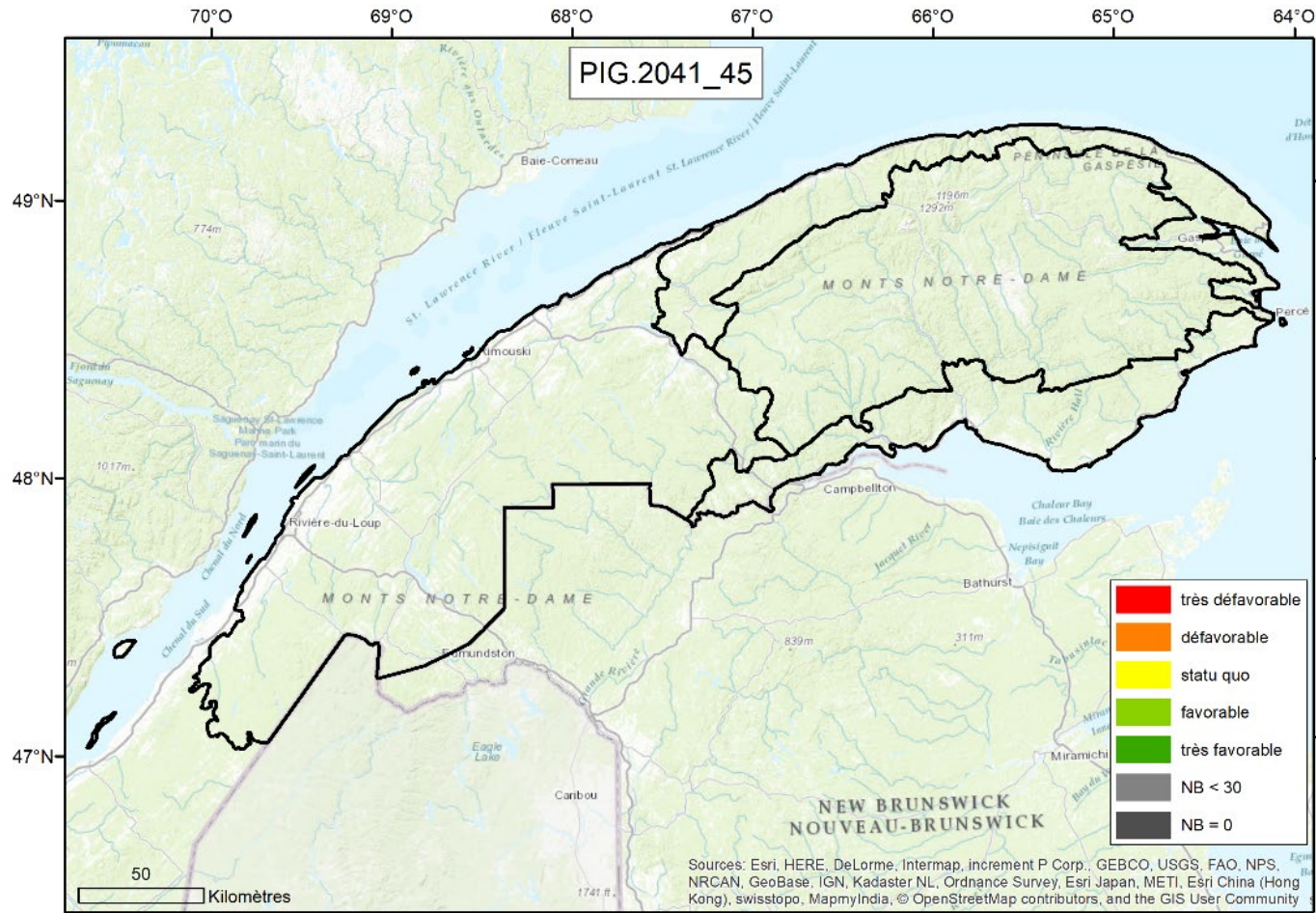


rcp 4,5

rcp 8,5

2050

2080



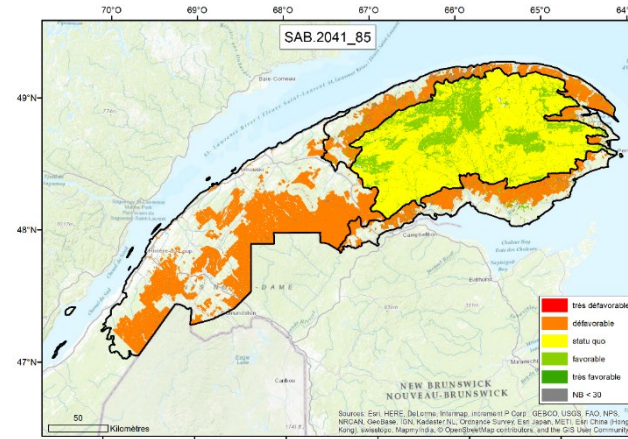
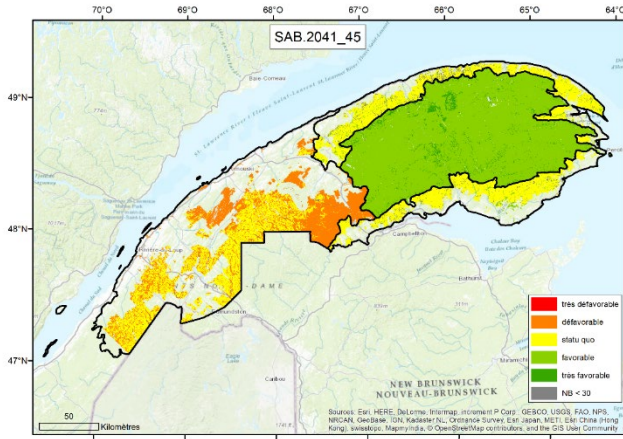


SAB

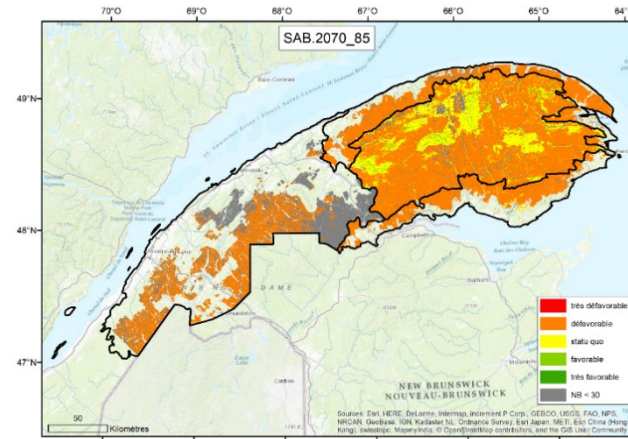
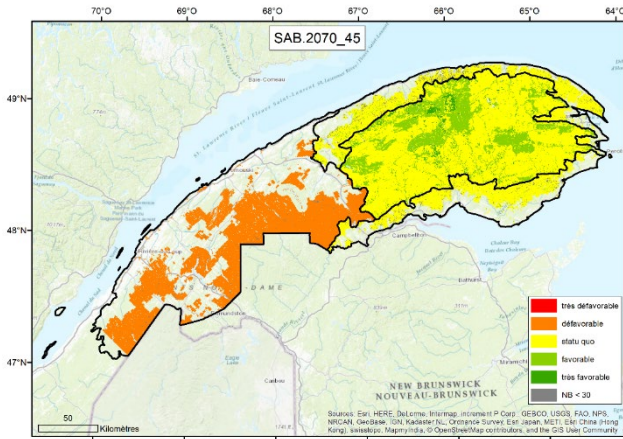
rcp 4,5

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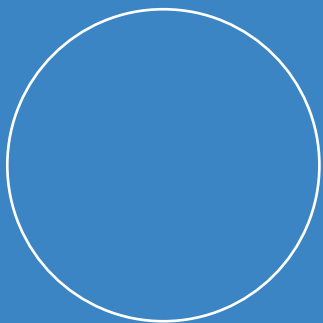
2050



2080



Le menu du jour



Effets anticipés des
changements climatiques
sur l'habitat des essences
en Gaspésie



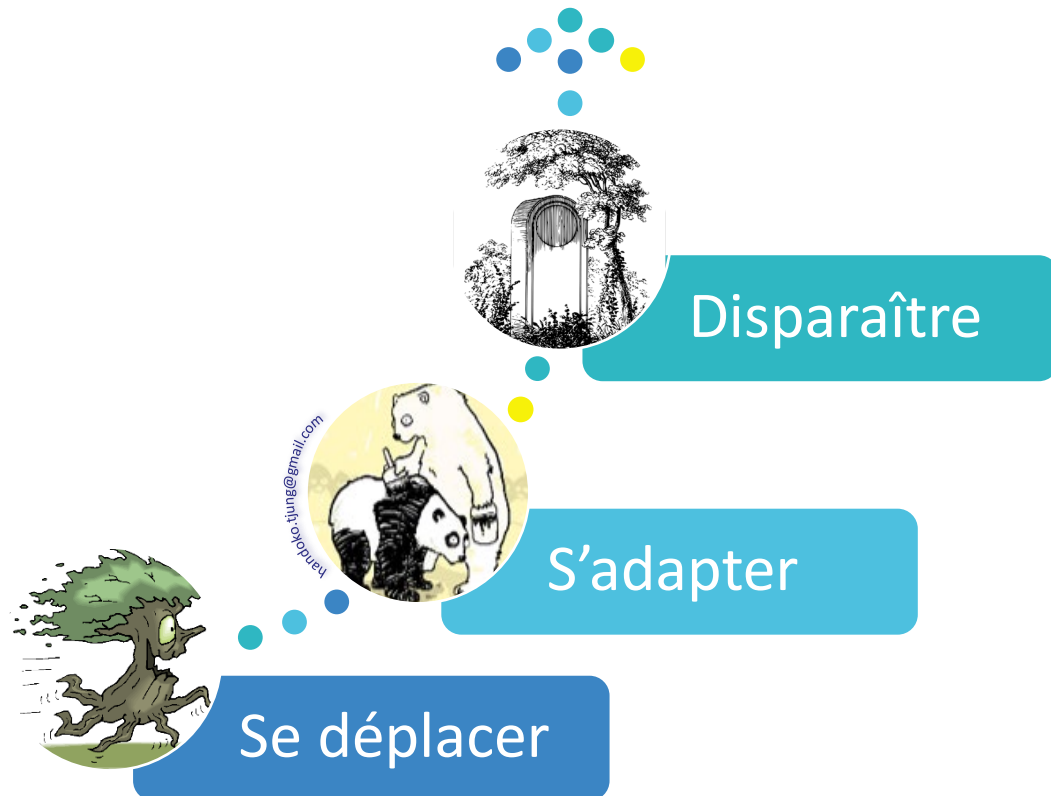
La forêt du futur en
Gaspésie



Effets anticipés des
changements climatiques
sur la composition des
peuplements actuellement
sur pied

Chacun pour soi

- La réponse des espèces est **individuelle**; elle est propre à chacune et dépend notamment du patrimoine génétique de ses différentes populations
- La **rapidité** des changements climatiques peut menacer la survie de certaines populations et même de certaine espèces



Une course perdue d'avance!

- Les espèces les plus rapides (EPN, PIG) ont migré de **19 à 25 km/siècle** durant la période post-glaciaire (Payette et al. 2022);
- Avec un réchauffement de +2 °C, les arbres devront migrer vers le nord à une vitesse de **320 km/siècle** pour suivre les conditions climatiques favorables à leur croissance.



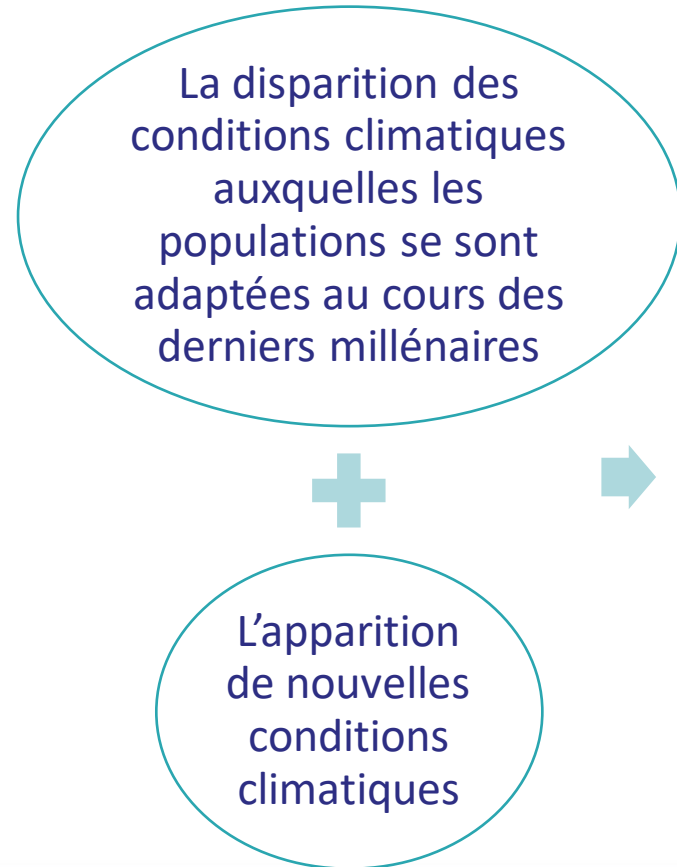
Course perdue d'avance : **facteur 10**

Sauf si
intervention



Migration
assistée

S'adapter aux nouvelles conditions climatiques ou...disparaître



Les climats futurs ne sont pas très éloignés des tolérances climatiques des populations existantes.

Les climats futurs sont très éloignés des tolérances climatiques des populations existantes.

Adaptation/acclimatation

Apparition de nouvelles associations **génotype/climat**



Extirpation

- Maladaptation des individus
- Extirpation des populations
- Disparition d'espèces



ARTICLES
<https://doi.org/10.1038/441558-020-00968-6>

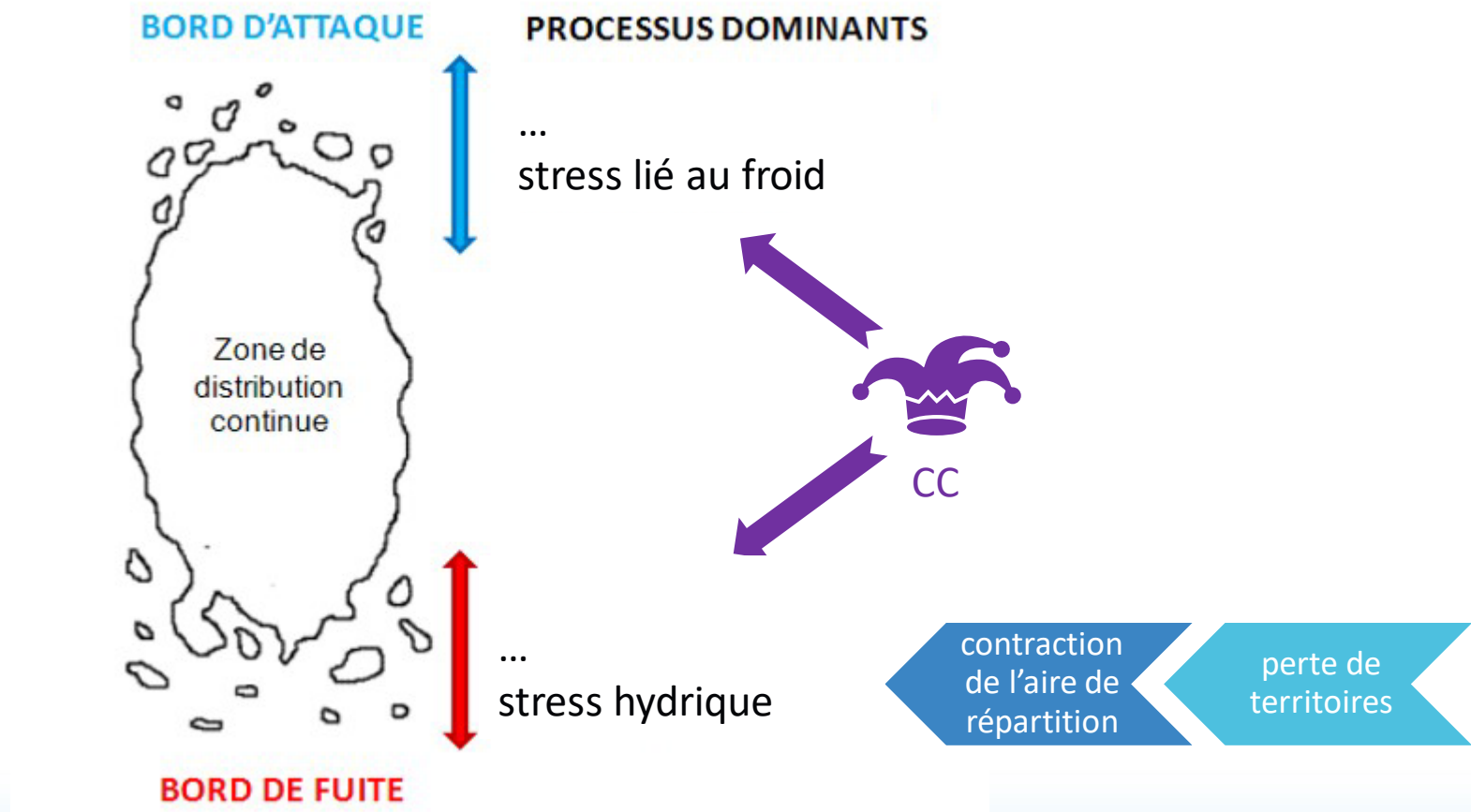
nature climate change

Check for updates

Maladaptation, migration and extirpation fuel climate change risk in a forest tree species

Andrew V. Gougherty^{1,2}, Stephen R. Keller² and Matthew C. Fitzpatrick¹

L'aire de répartition d'une espèce



Effets anticipés des CC sur l'habitat des espèces arborescentes

127 espèces arborescentes

15 prédicteurs

Altitude
Indices climatiques
Classes de dépôt
Classes de drainage

7 modèles statistiques



2 scénarios d'émission de gaz à effet de serre

RCP 4.5
RCP 8.5

23 modèles climatiques globaux

3 horizons temporels

1961-1990 (PR)
2041-2070 (2050)
2071-2100 (2080)

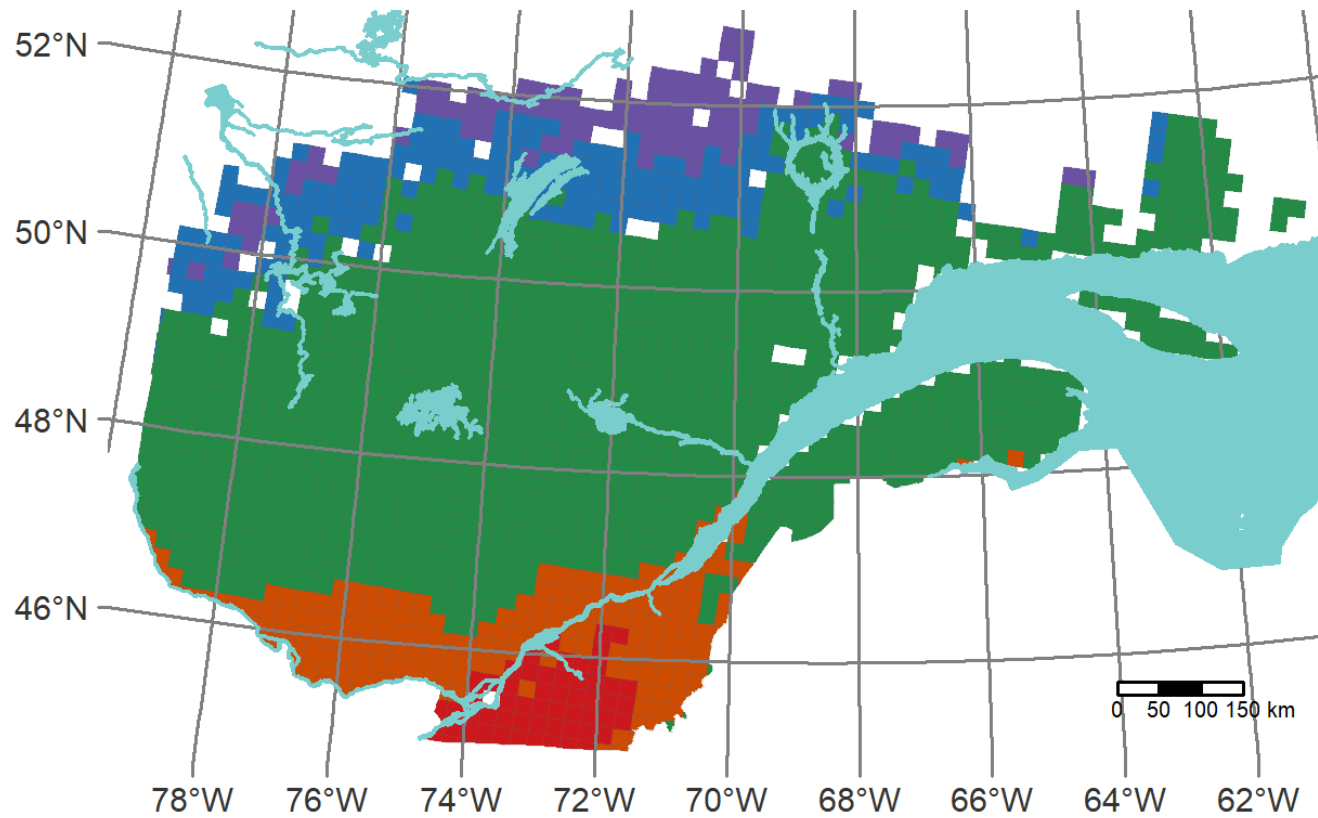
2050-4.5

2080-8.5



ESPECE A

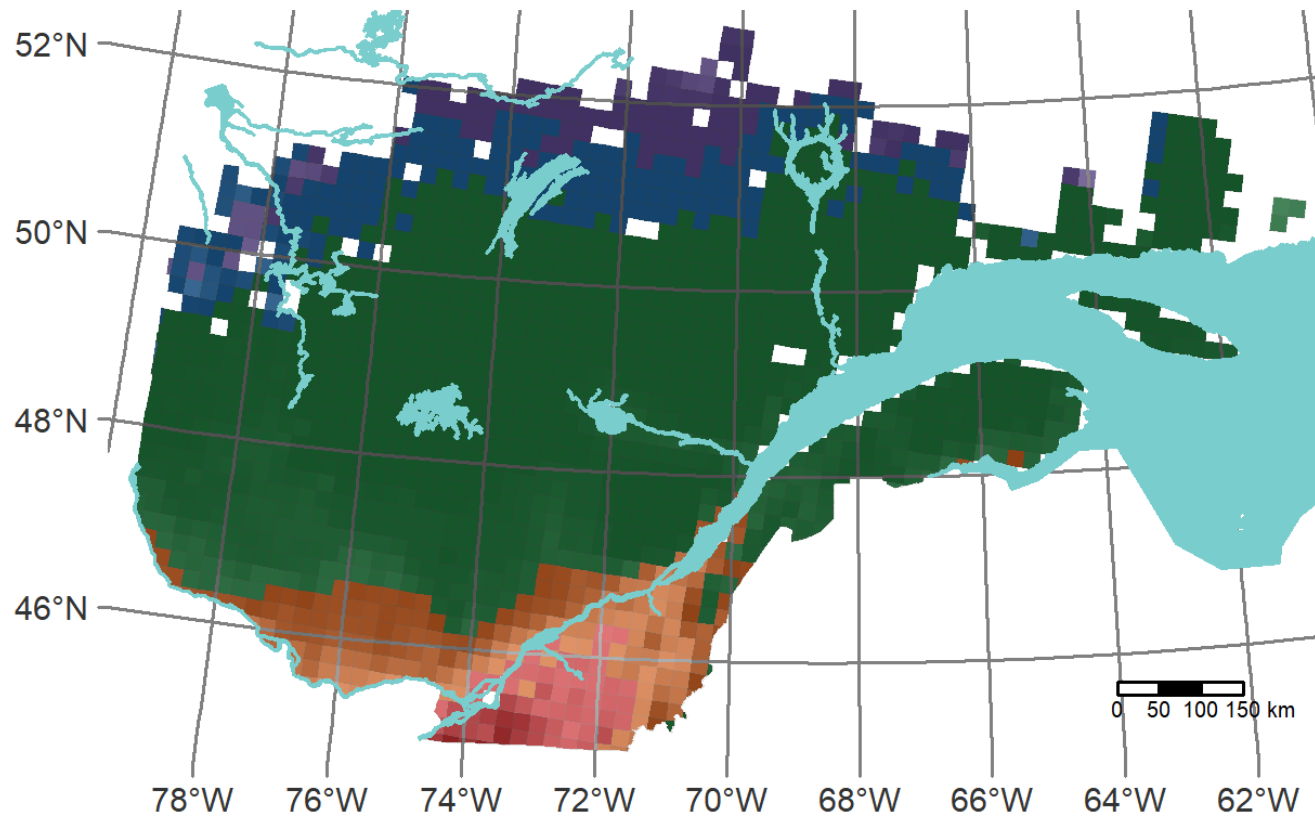
ESPECE B



BOP

2040-45

- hab défav
- hab moins fav
- statut quo
- hab plus fav
- nouvel hab



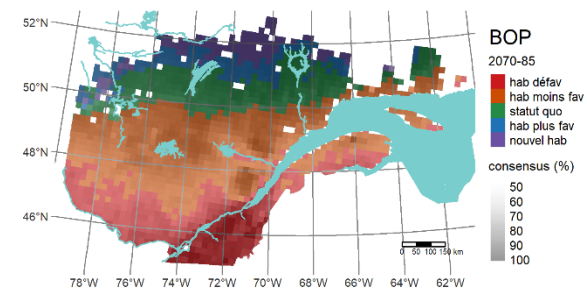
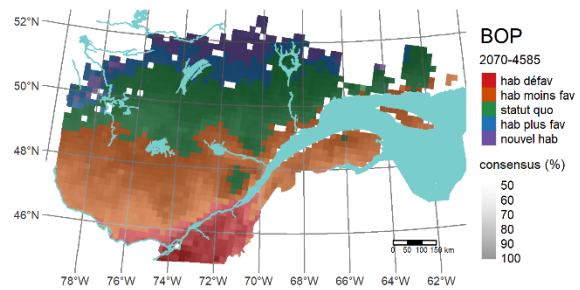
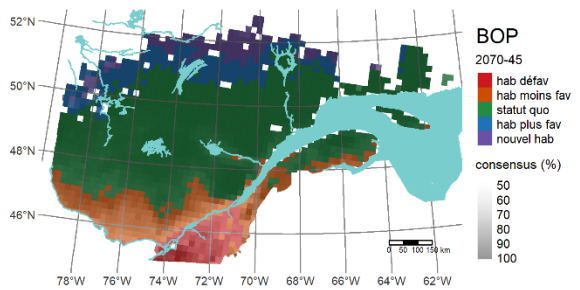
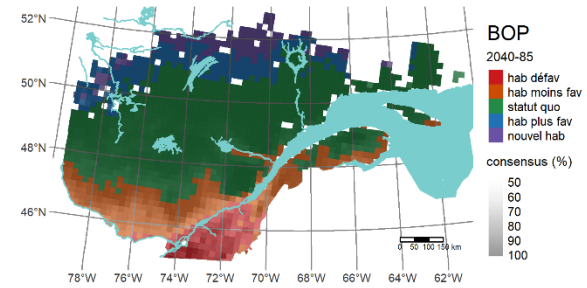
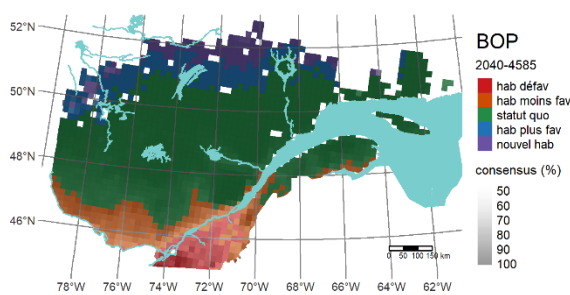
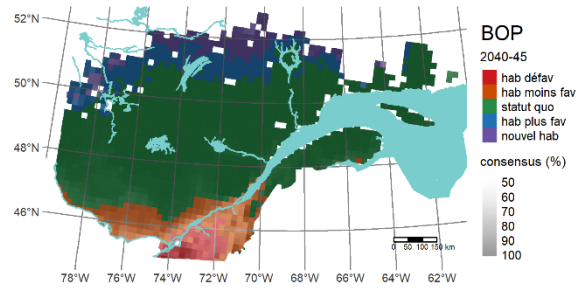
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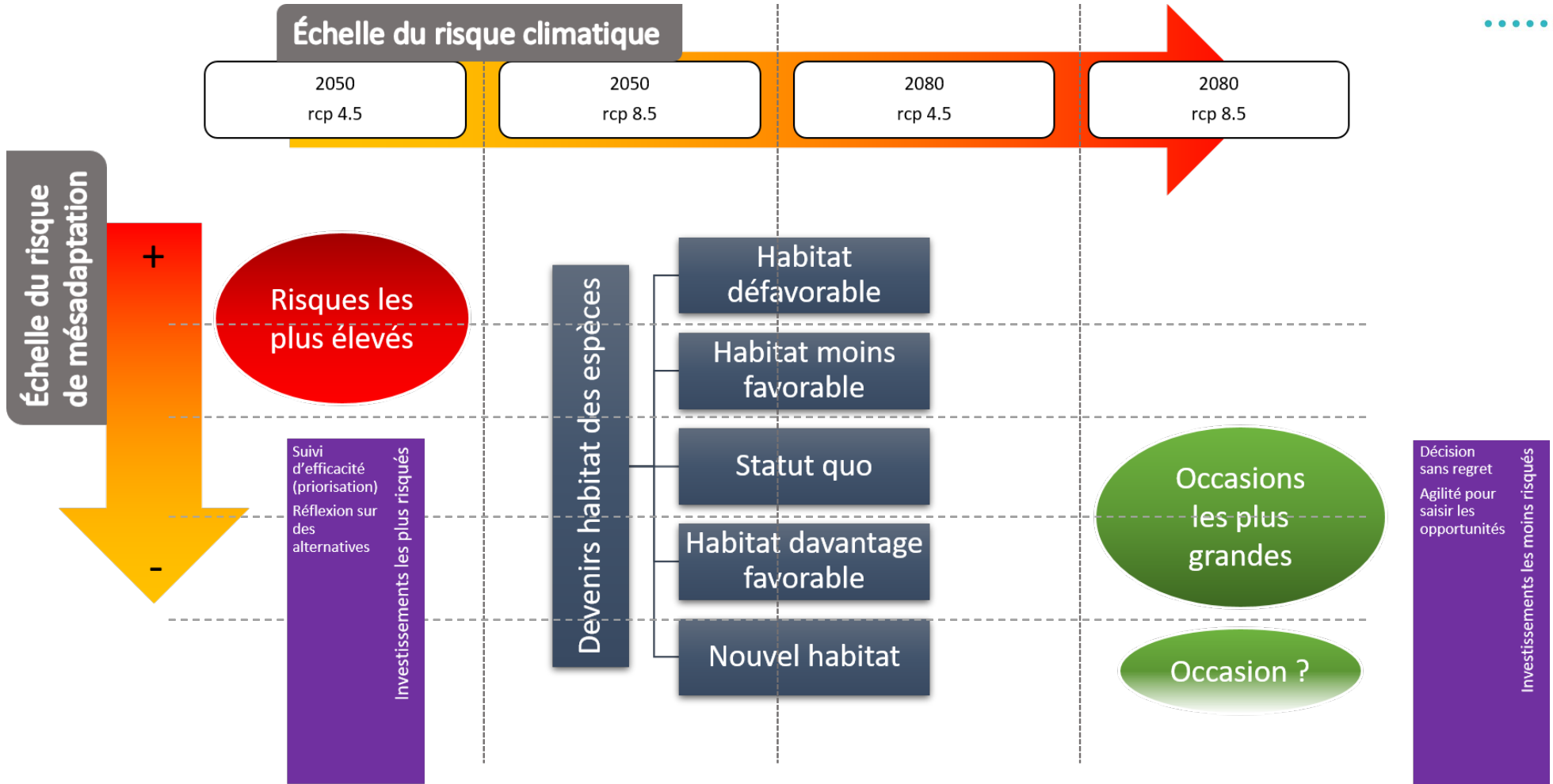
2040-45

- hab défav
- hab moins fav
- statut quo
- hab plus fav
- nouvel hab

consensus (%)

- 50
- 60
- 70
- 80
- 90
- 100







2050-4.5

Quelque part, dans l'aire de répartition de l'espèce on anticipe des conditions climatiques futures moins favorables à sa présence

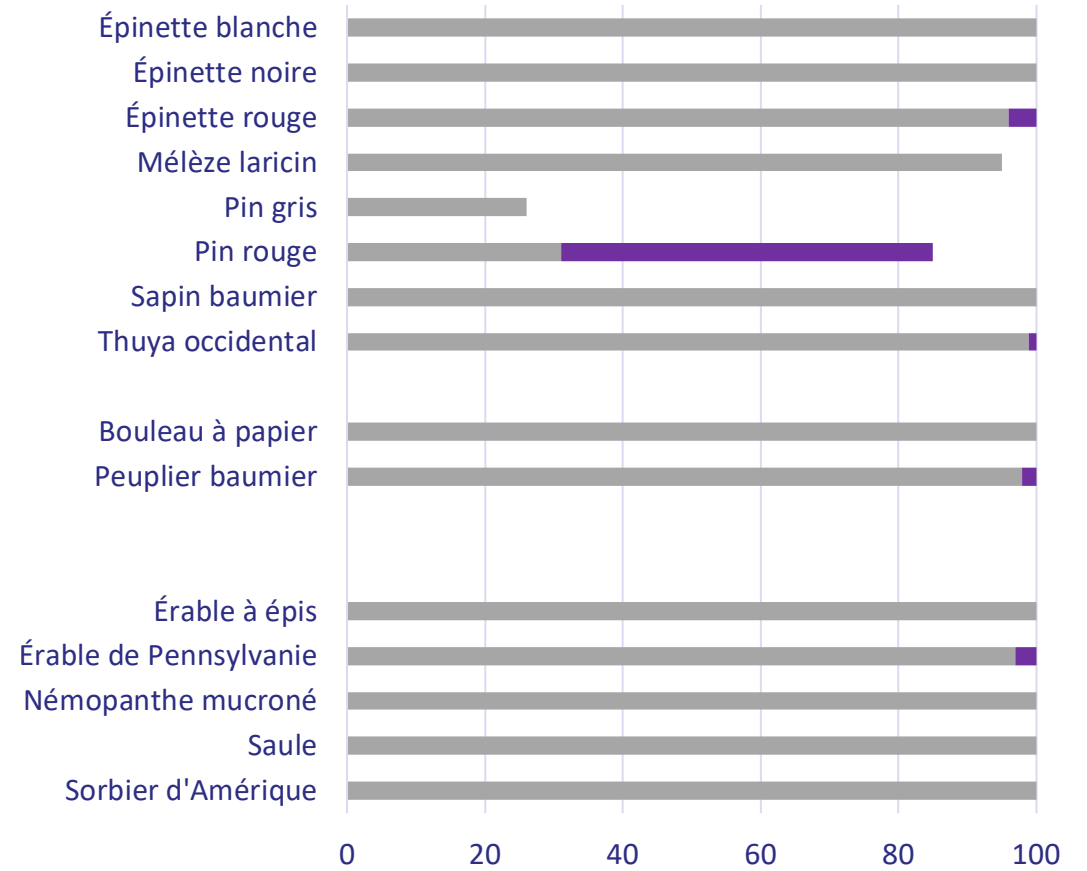
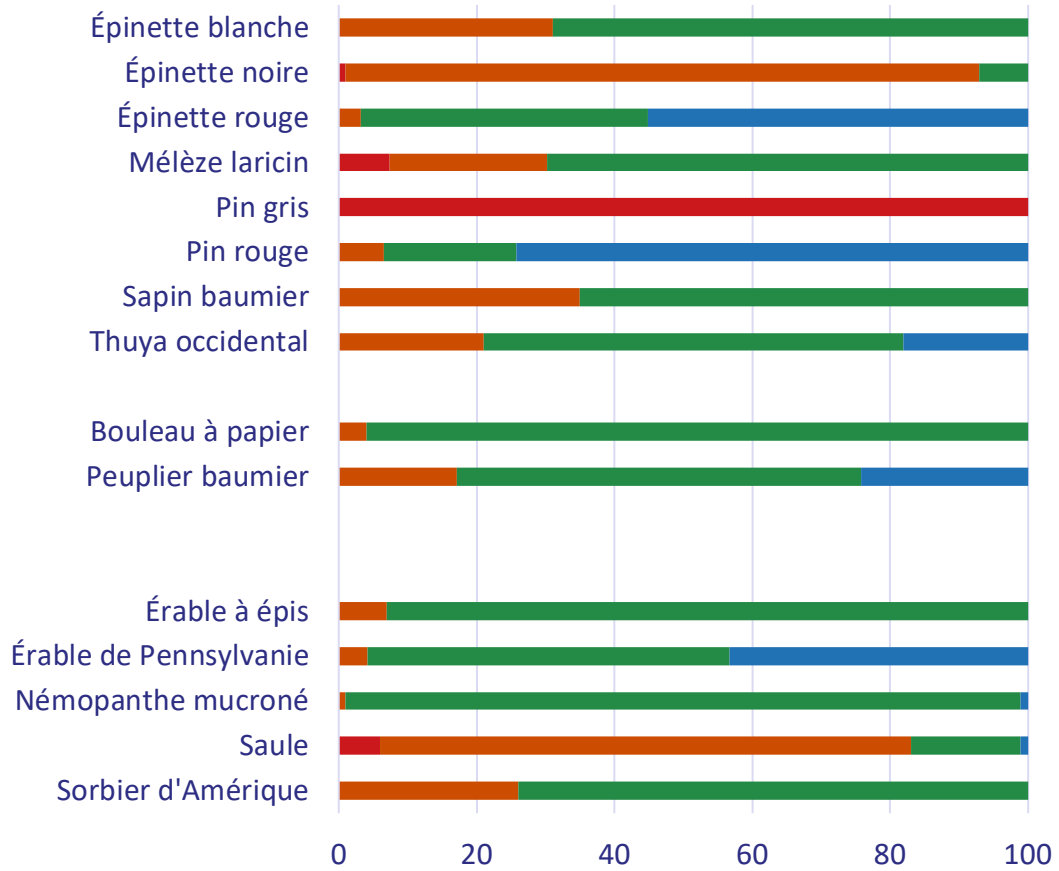
Urgence d'agir

2080-8.5

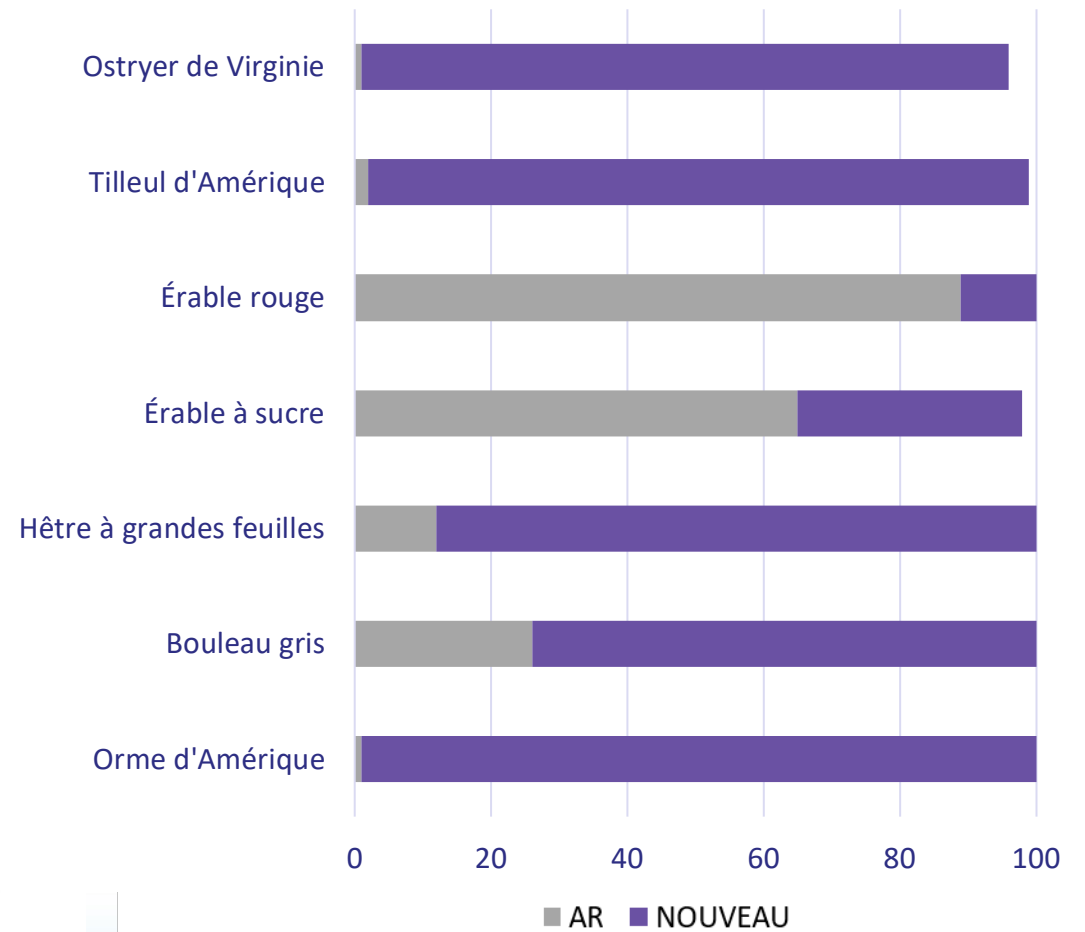
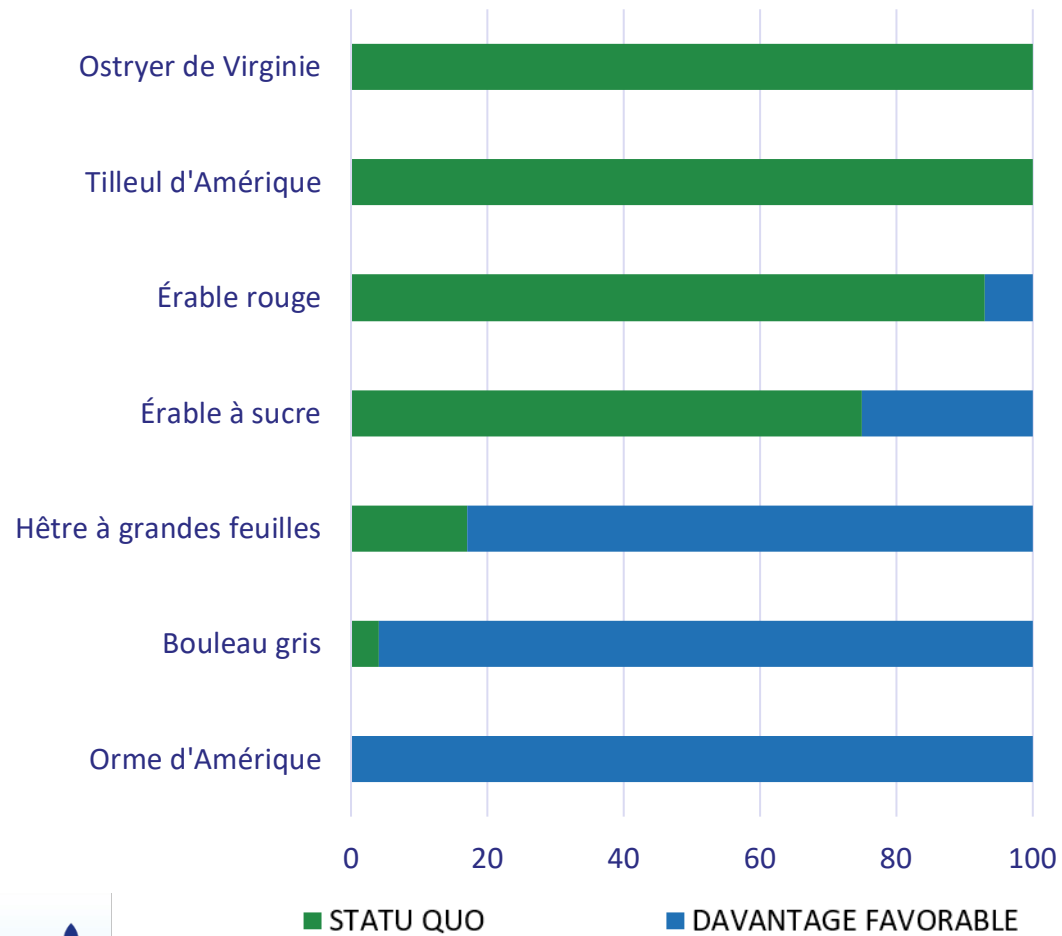
Nulle part, dans l'aire de répartition de l'espèce on anticipe des conditions climatiques futures moins favorables à sa présence

Aucune urgence d'agir

les plus vulnérables en Gaspésie



les moins vulnérables en Gaspésie



Le menu du jour

1


2

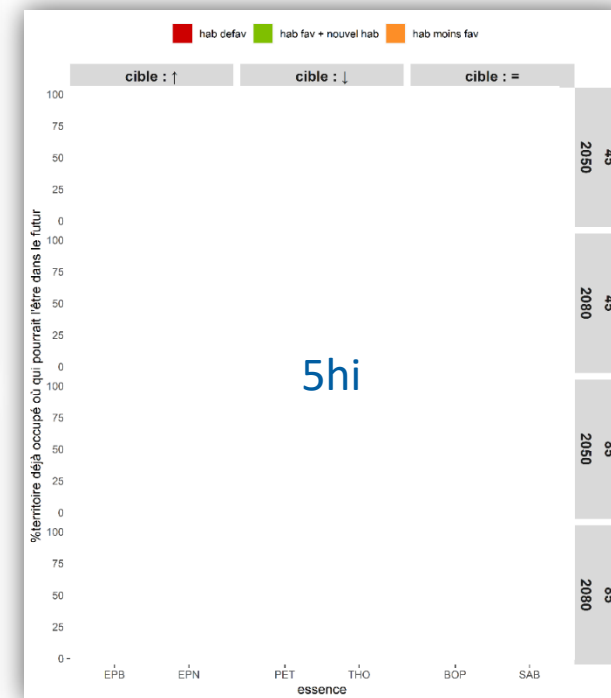
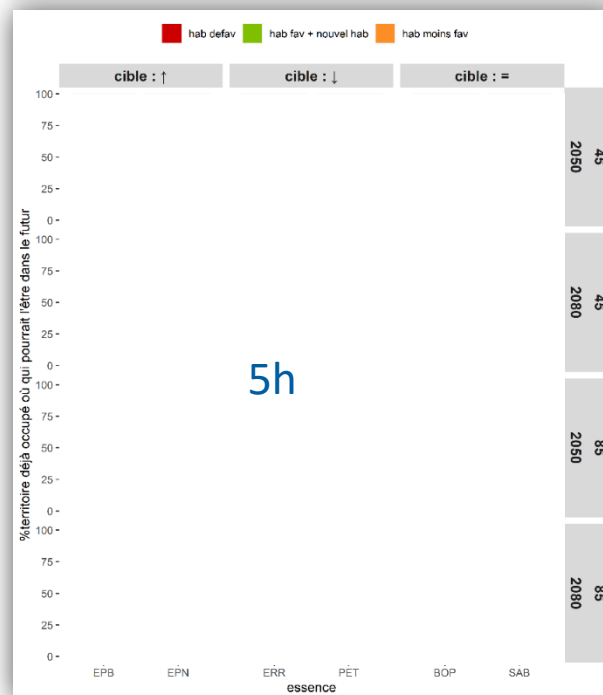
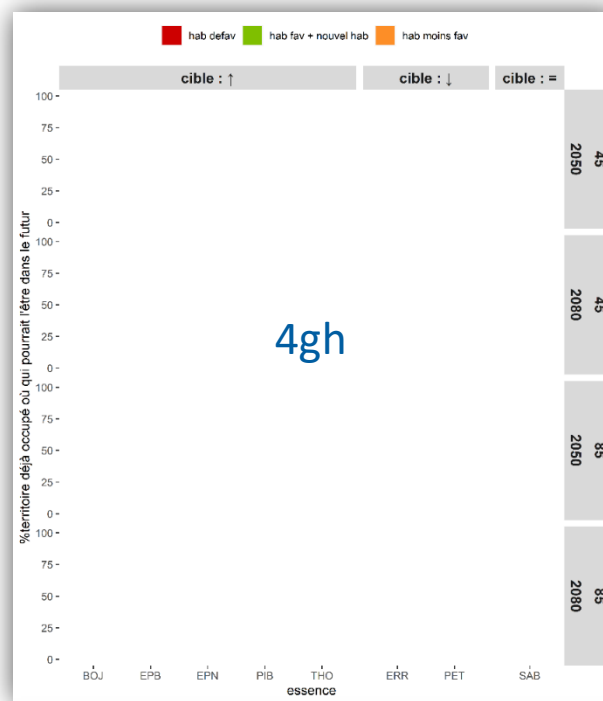
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4

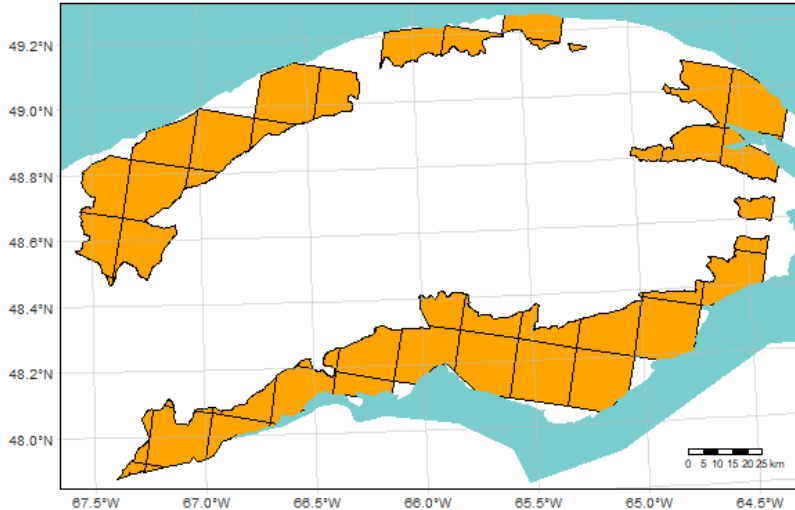
La forêt du futur en
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Effets anticipés des
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	<h2>Fiche ENJEU TGIRT R11</h2>		Date d'approbation	2017-01-13
			N° de la fiche	R11-T-18-04
			Date de la dernière MAJ	2017-07-20



Fréquence des essences – 4gh (source: R11)



Augmentation
ou maintien

BOJ

EPB

EPN

PIB

THO

Contrôle ou
diminution

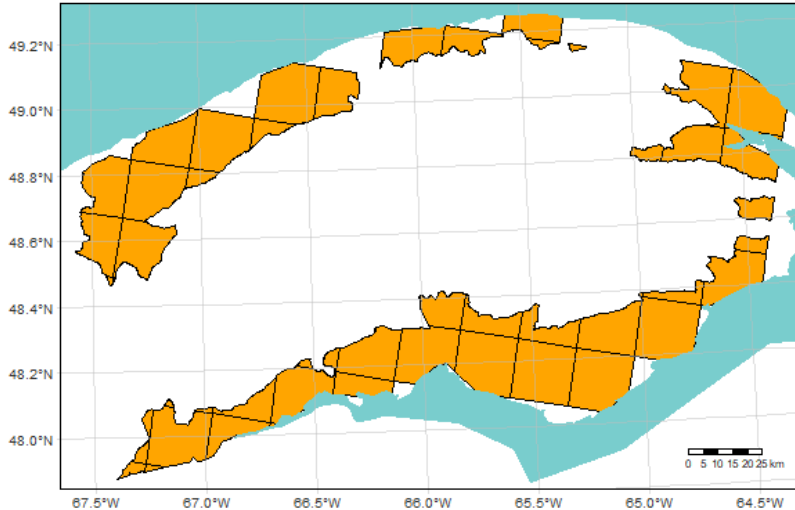
ERR

PET

Maintien

SAB

Fréquence des essences – 4gh (source: R11)



Augmentation
ou maintien

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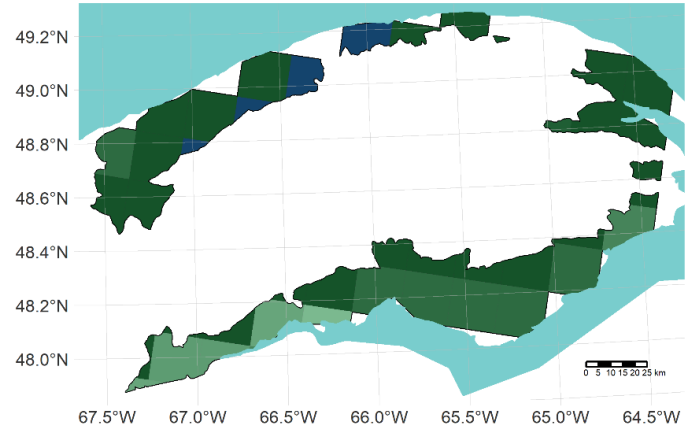
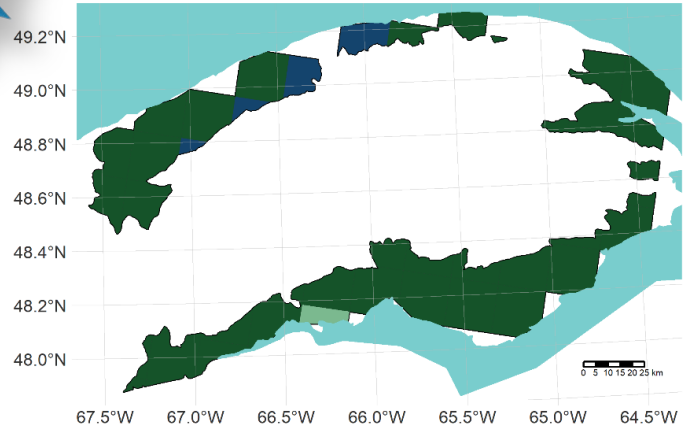
SAB

BOJ

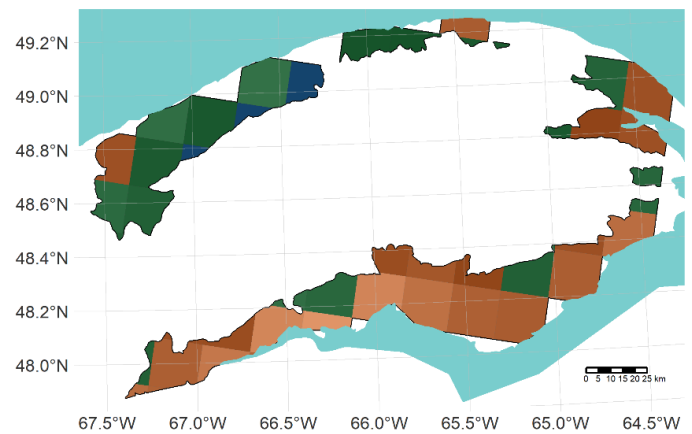
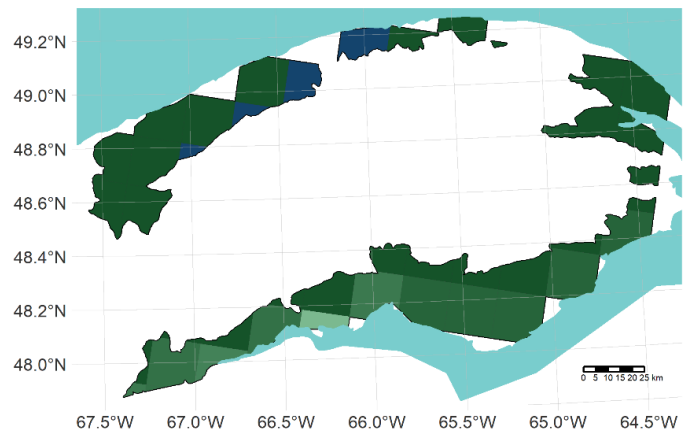
rcp 4.5

rcp 8.5

2050



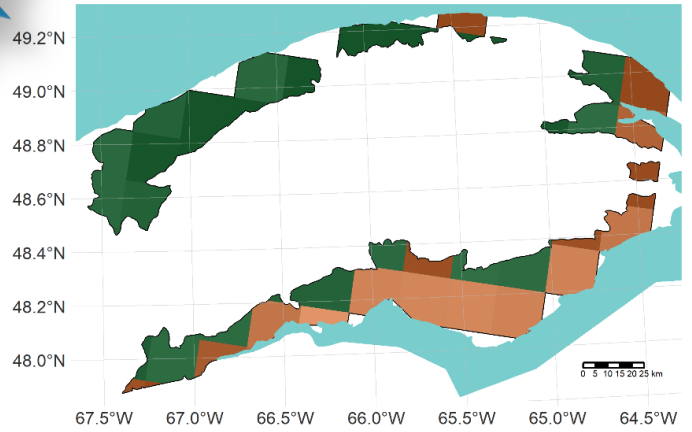
2080



EPB

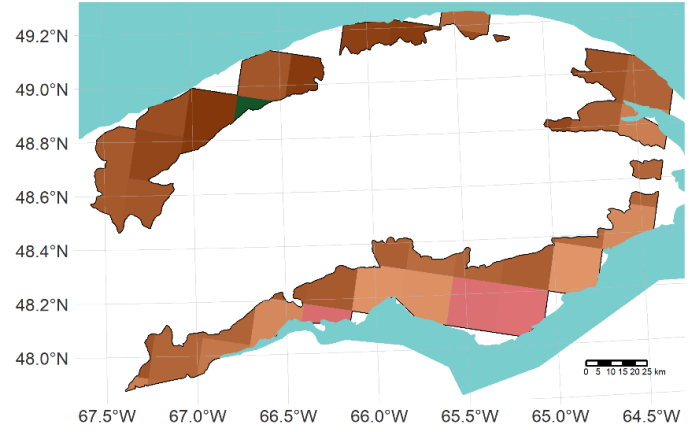
rcp 4.5

2050



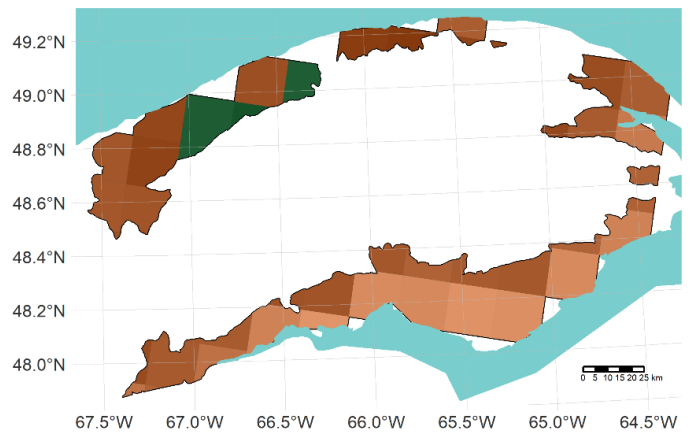
EPB
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rcp 8.5

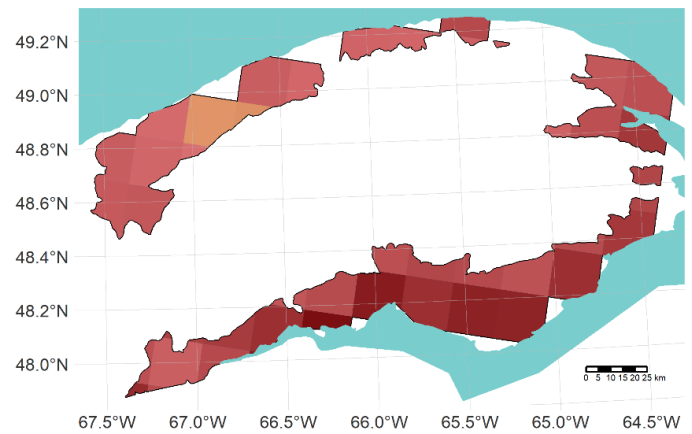


EPB
2040-85
hab défav
hab moins fav
statut quo
consensus (%)
60
70
80
90

2080



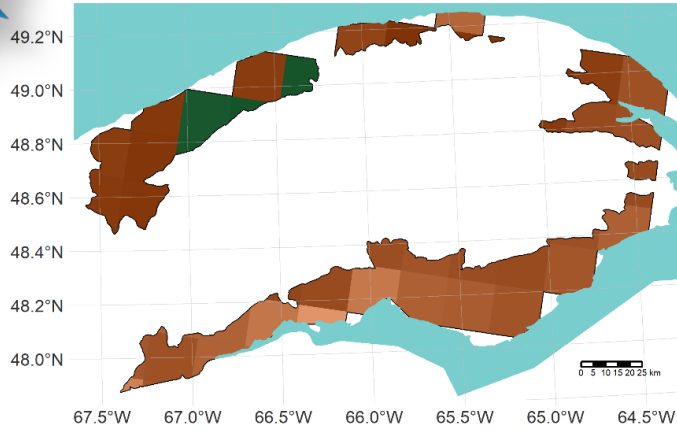
EPB
2070-45
hab moins fav
statut quo
consensus (%)
60
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EPB
2070-85
hab défav
hab moins fav
consensus (%)
50
60
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90

EPN

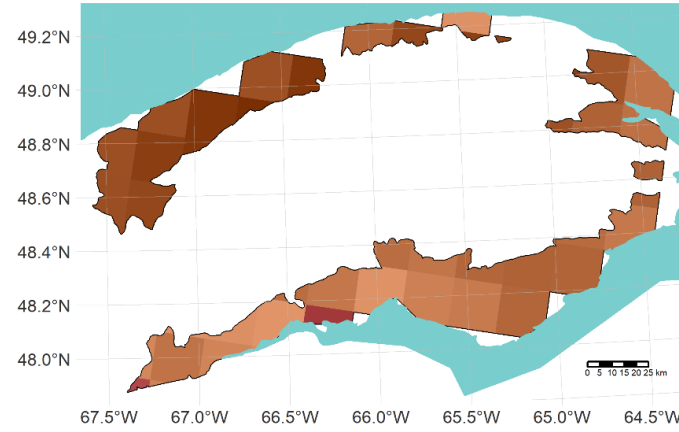
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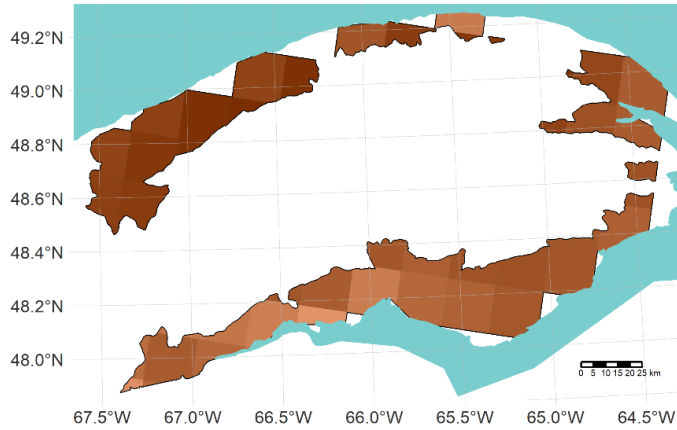
2050

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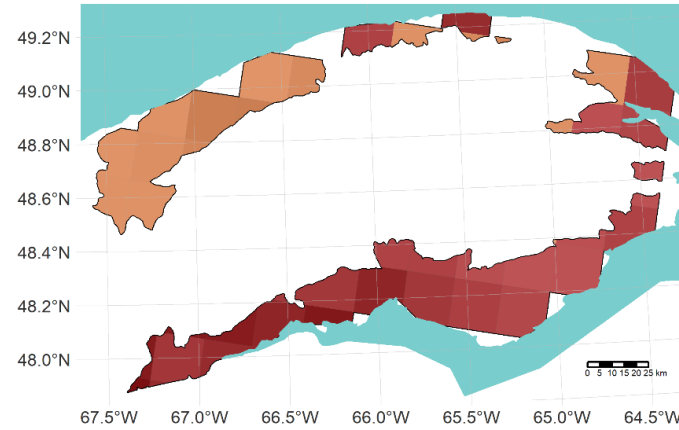


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2080



EPN
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consensus (%)
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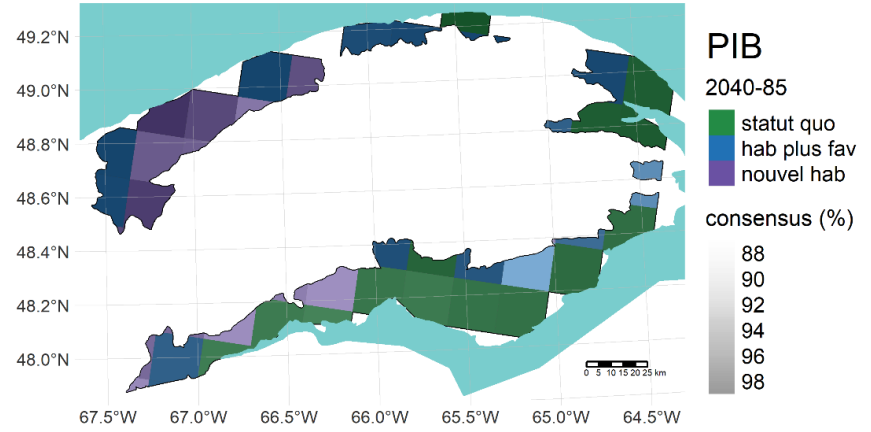
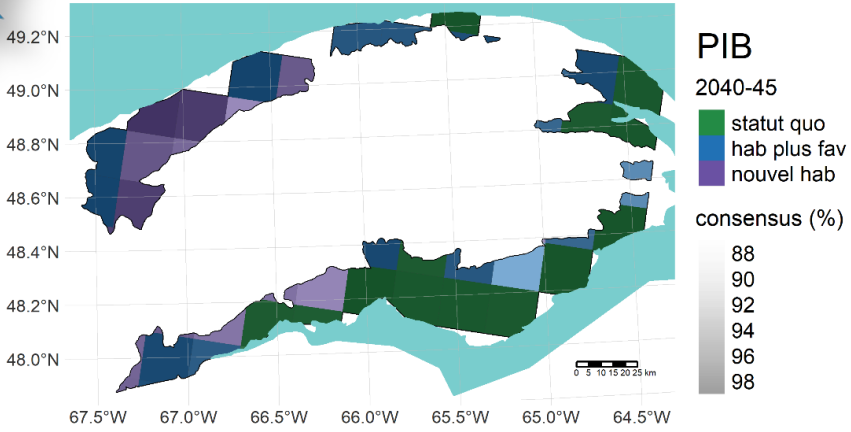
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90

PIB

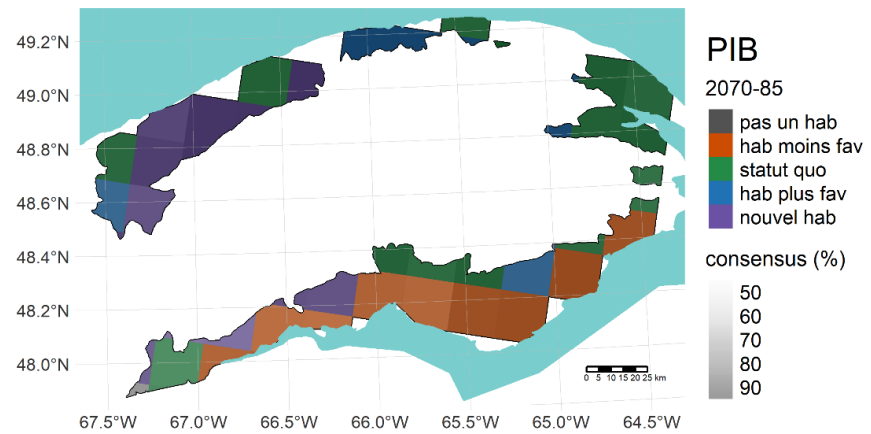
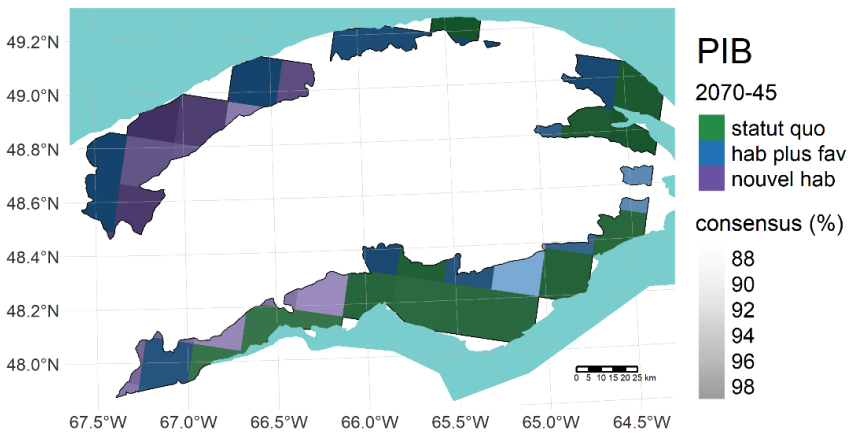
rcp 4.5

rcp 8.5

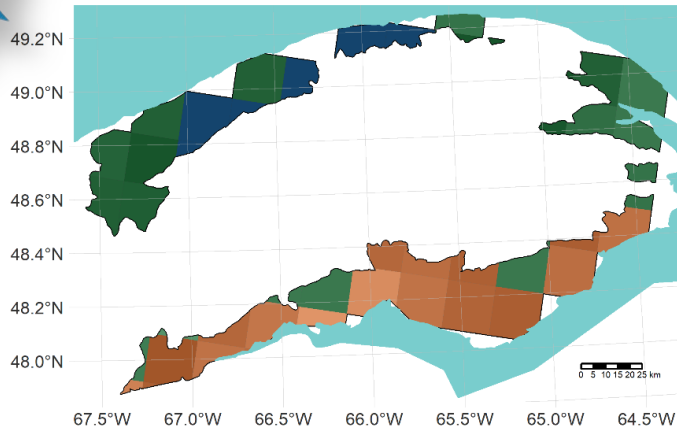
2050



2080



THO

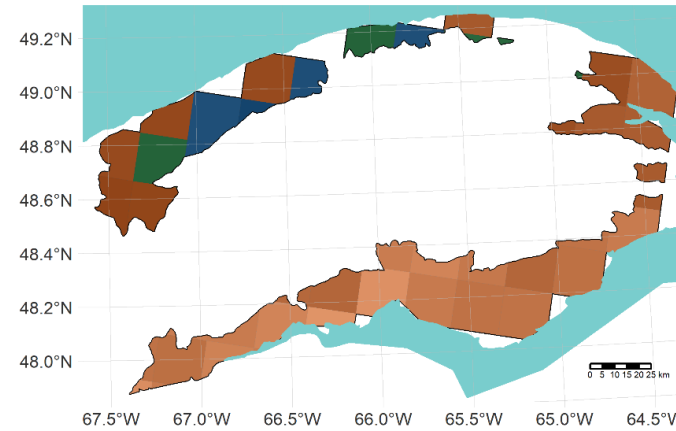
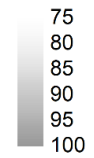


THO

2040-45

- hab moins fav
- statut quo
- hab plus fav

consensus (%)

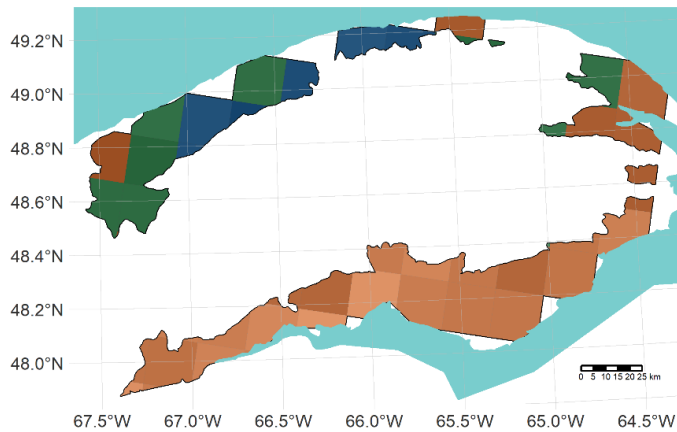
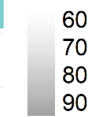


THO

2040-85

- hab moins fav
- statut quo
- hab plus fav

consensus (%)

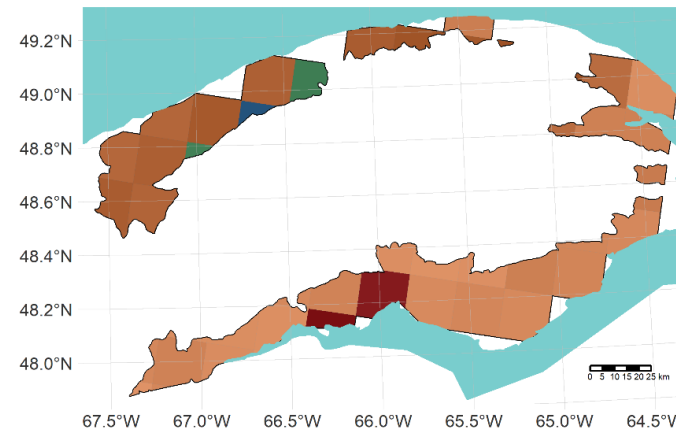


THO

2070-45

- hab moins fav
- statut quo
- hab plus fav

consensus (%)

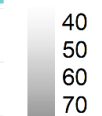


THO

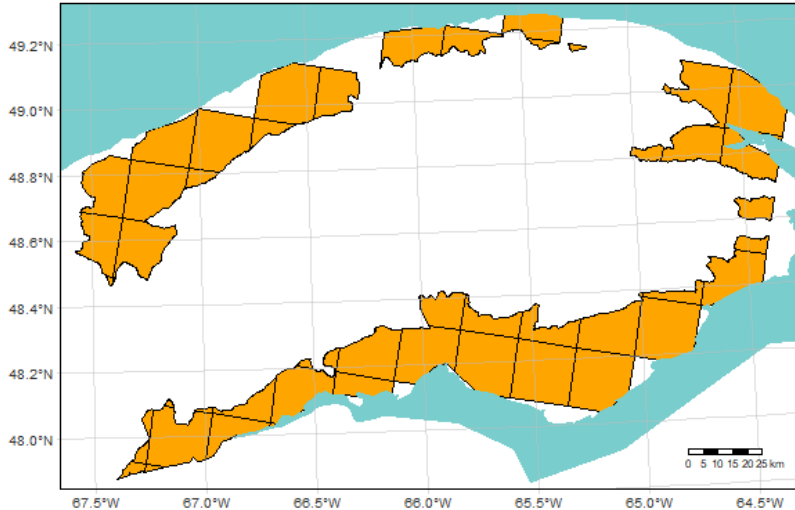
2070-85

- hab défav
- hab moins fav
- statut quo
- hab plus fav

consensus (%)



Fréquence des essences – 4gh (source: R11)



Augmentation
ou maintien

BOJ

EPB

EPN

PIB

THO

Contrôle ou
diminution

ERR

PET

Maintien

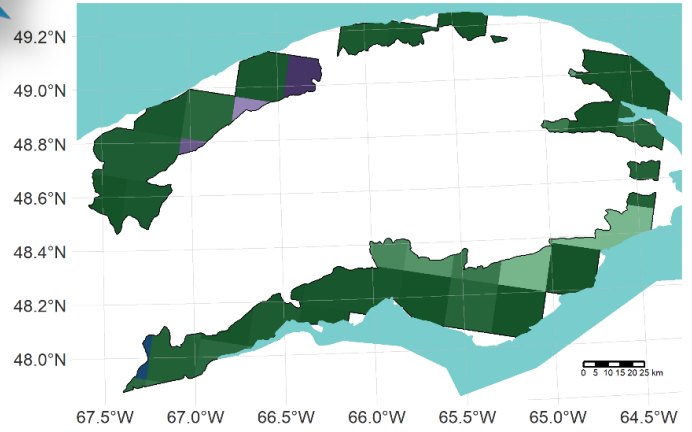
SAB

ERR

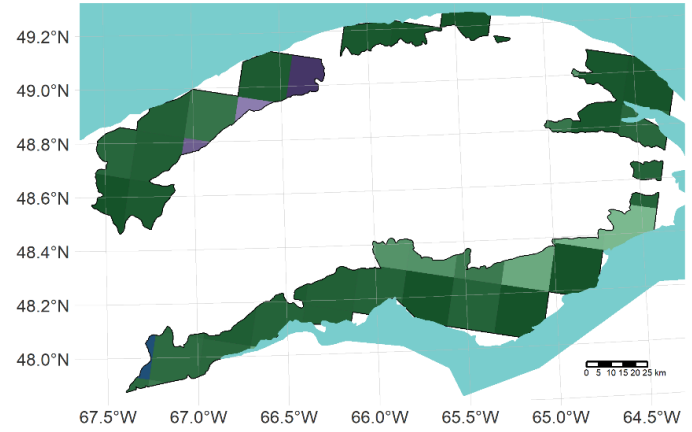
rcp 4.5

rcp 8.5

2050

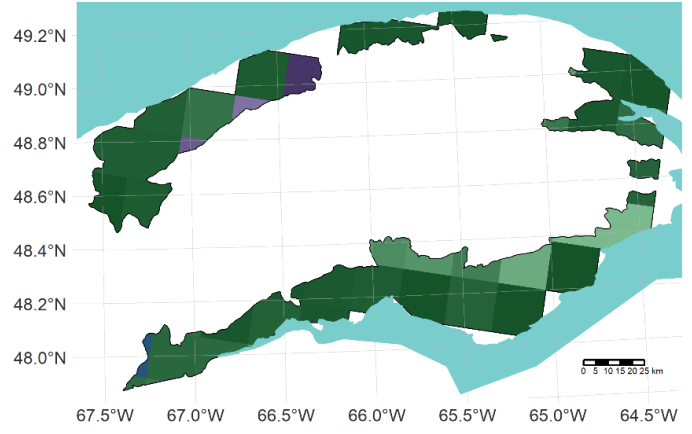


ERR
2040-45
statut quo
hab plus fav
nouvel hab
consensus (%)
95
96
97
98
99
100

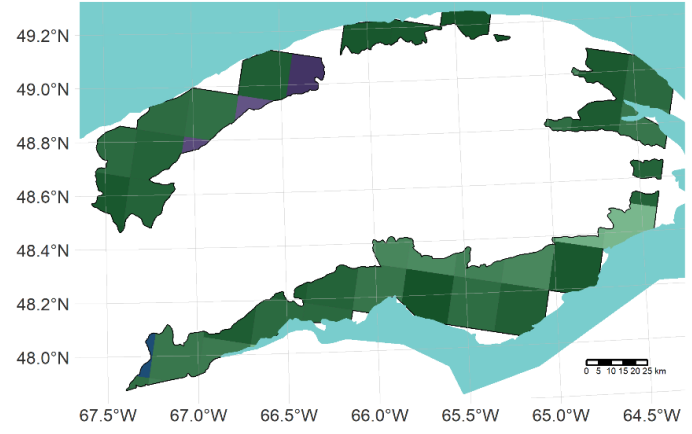


ERR
2040-85
statut quo
hab plus fav
nouvel hab
consensus (%)
95
96
97
98
99
100

2080



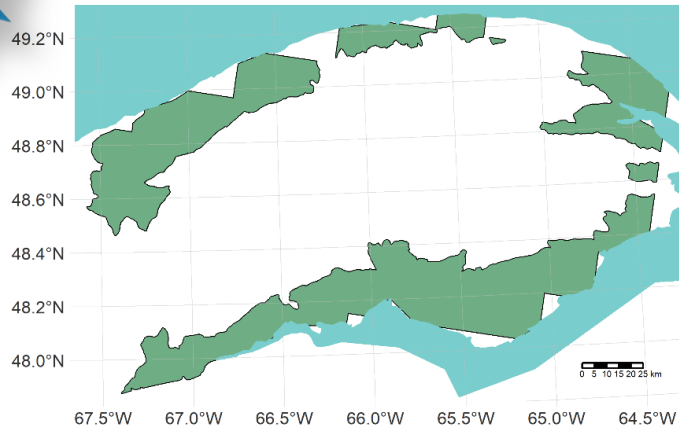
ERR
2070-45
statut quo
hab plus fav
nouvel hab
consensus (%)
95
96
97
98
99
100



ERR
2070-85
statut quo
hab plus fav
nouvel hab
consensus (%)
94
96
98
100

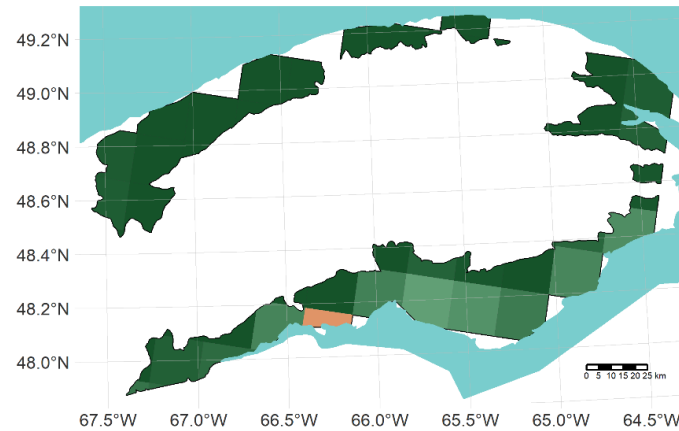
PET

rcp 4.5



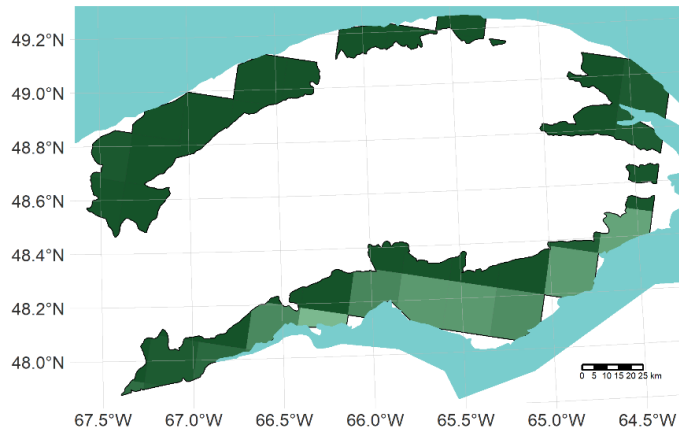
PET
2040-45
■ statut quo
consensus (%)
■ 100

rcp 8.5



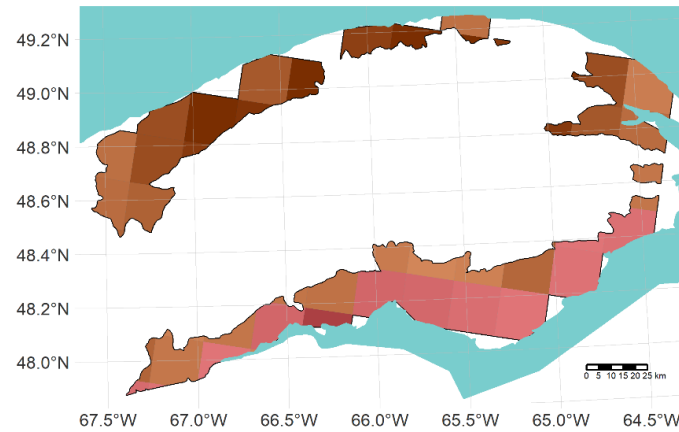
PET
2040-85
■ hab moins fav
■ statut quo
consensus (%)
■ 94
■ 95
■ 96
■ 97
■ 98
■ 99
■ 100

2050



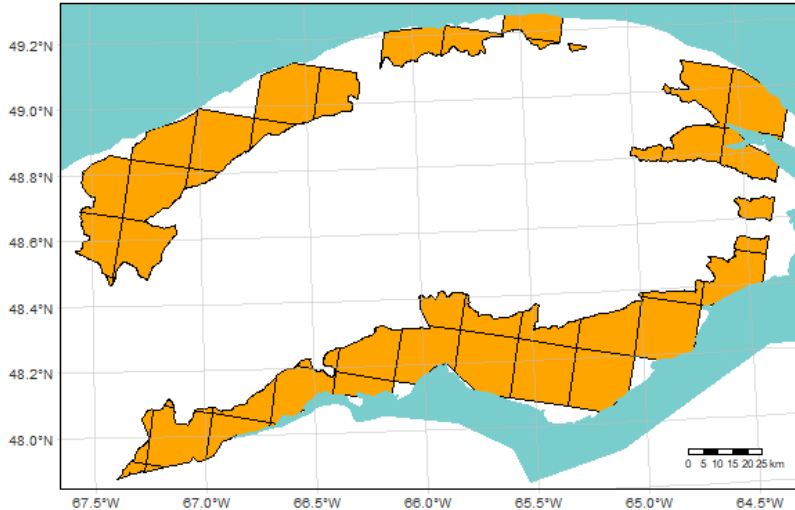
PET
2070-45
■ statut quo
consensus (%)
■ 97.0
■ 97.5
■ 98.0
■ 98.5
■ 99.0
■ 99.5
■ 100.0

2080



PET
2070-85
■ hab défav
■ hab moins fav
consensus (%)
■ 50
■ 60
■ 70
■ 80

Fréquence des essences – 4gh (source: R11)



Augmentation
ou maintien

BOJ

EPB

EPN

PIB

THO

Contrôle ou
diminution

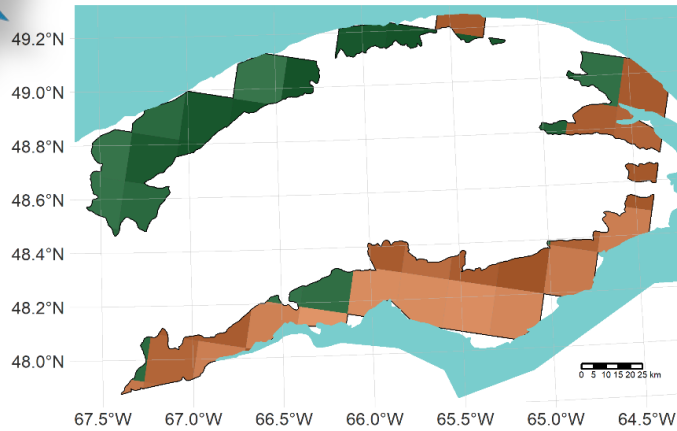
ERR

PET

Maintien

SAB

SAB



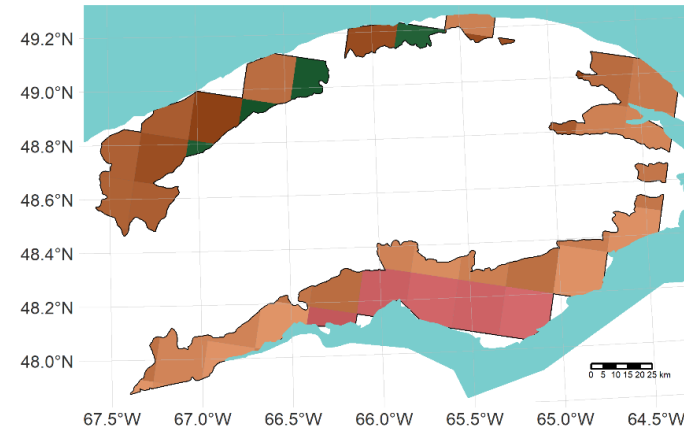
SAB

2040-45

hab moins fav
statut quo

consensus (%)

70
80
90
100



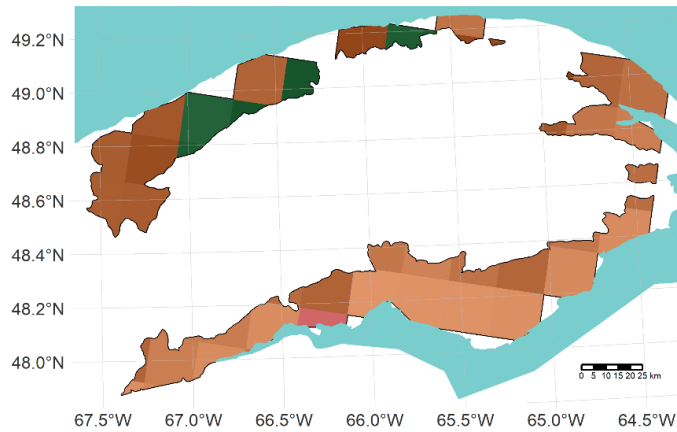
SAB

2040-85

hab défav
hab moins fav
statut quo

consensus (%)

50
60
70
80
90



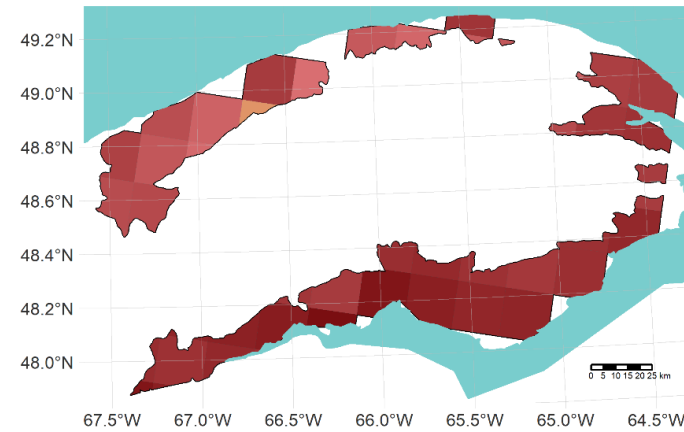
SAB

2070-45

hab défav
hab moins fav
statut quo

consensus (%)

50
60
70
80
90



SAB

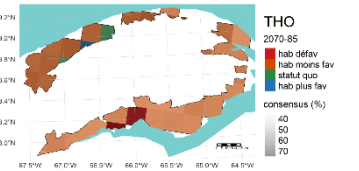
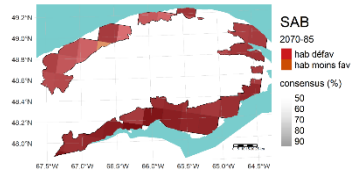
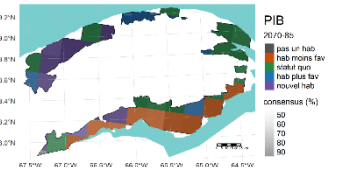
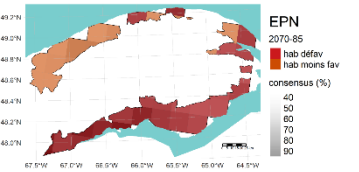
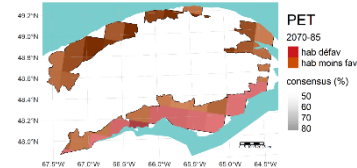
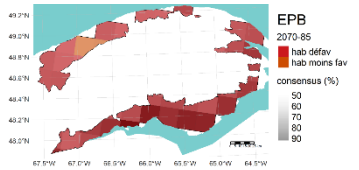
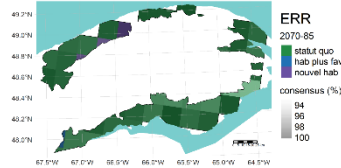
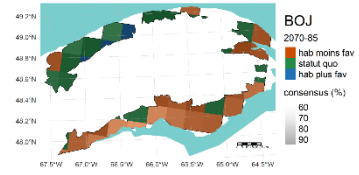
2070-85

hab défav
hab moins fav

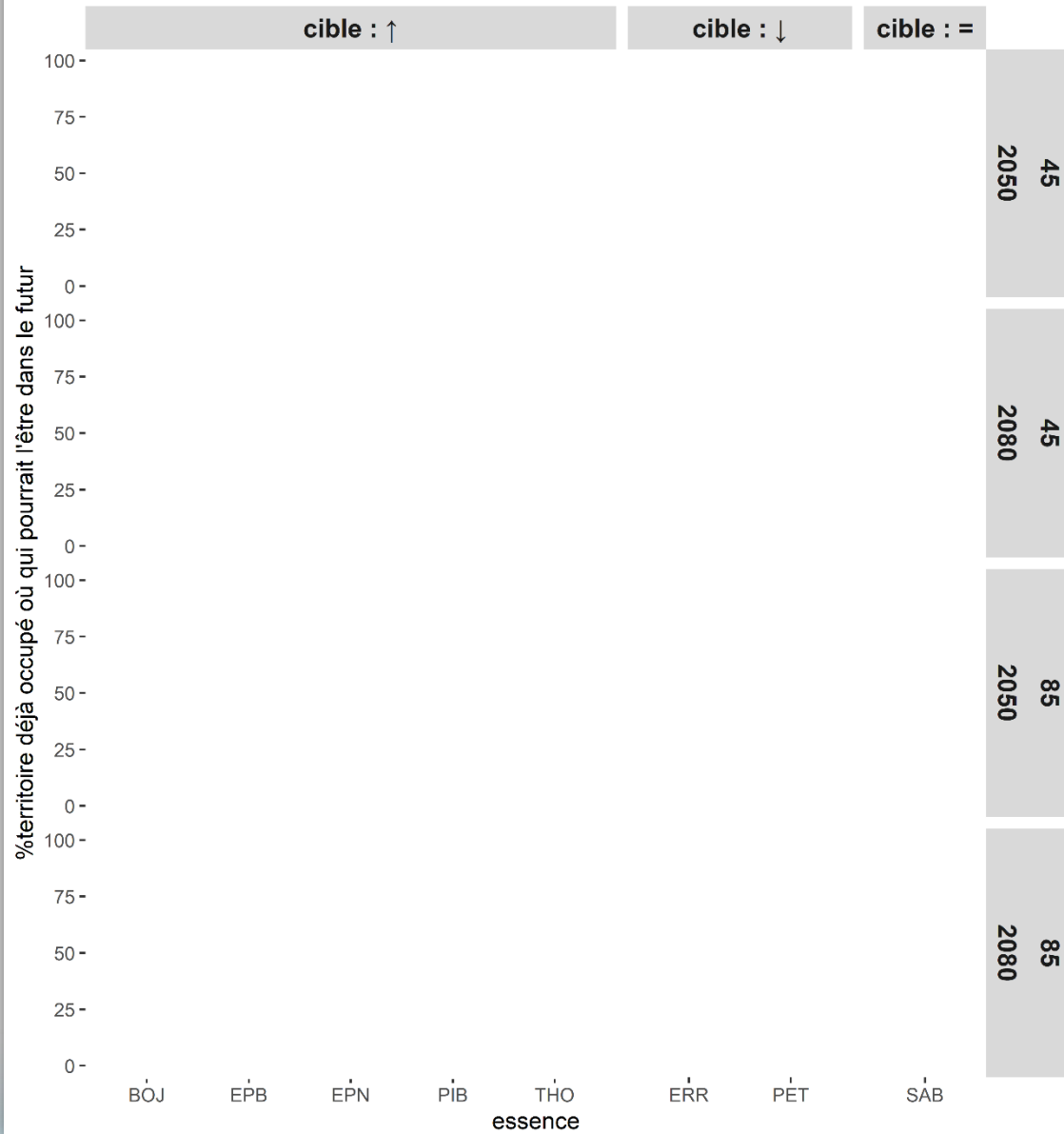
consensus (%)

50
60
70
80
90

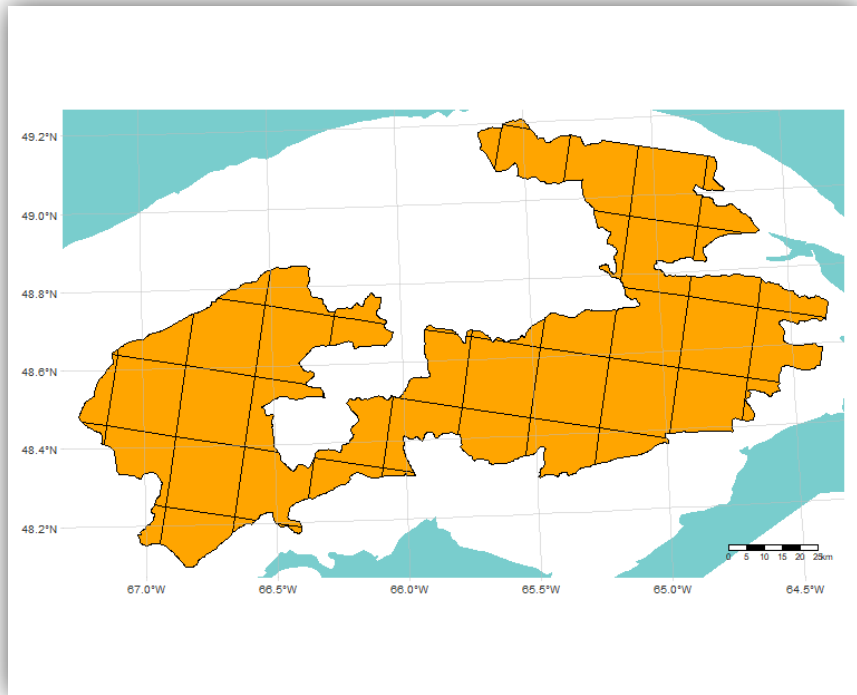
Bilan – 4gh



■ hab defav
 ■ hab fav + nouvel hab
 ■ hab moins fav



Fréquence des essences – 5h (R11)



Augmentation
ou maintien

EPB

EPN

Contrôle ou
diminution

ERR

PET

Maintien

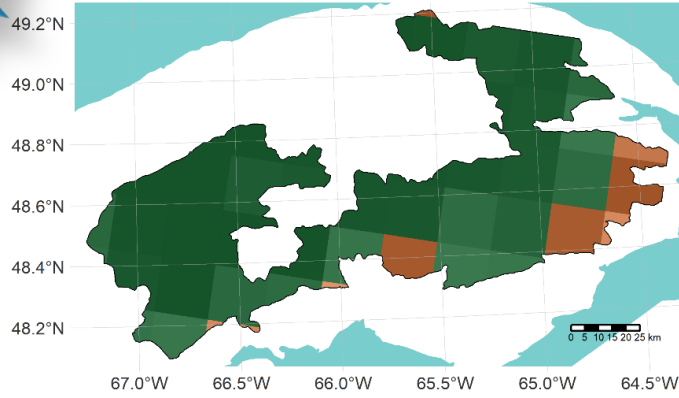
BOP

SAB

EPB

rcp 4.5

2050



EPB

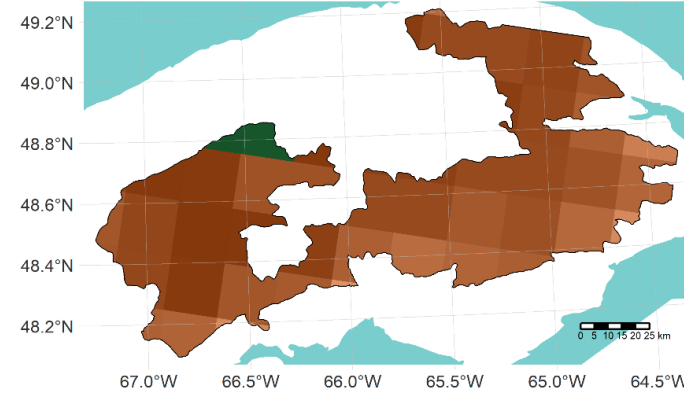
2040-45

- hab moins fav
- statut quo

consensus (%)

- 80
- 85
- 90
- 95
- 100

rcp 8.5



EPB

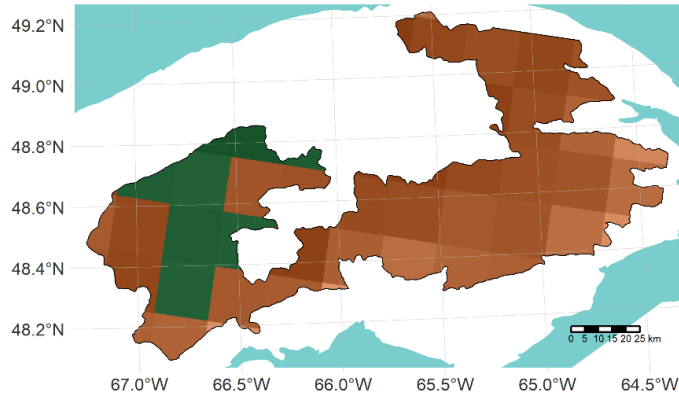
2040-85

- hab moins fav
- statut quo

consensus (%)

- 60
- 70
- 80
- 90

2080



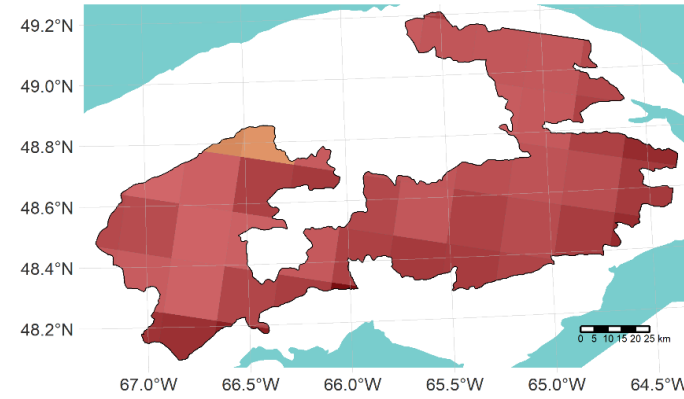
EPB

2070-45

- hab moins fav
- statut quo

consensus (%)

- 60
- 70
- 80
- 90



EPB

2070-85

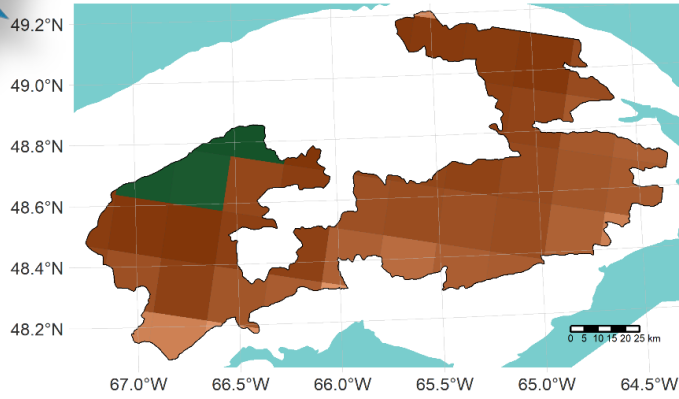
- hab défav
- hab moins fav

consensus (%)

- 50
- 60
- 70
- 80

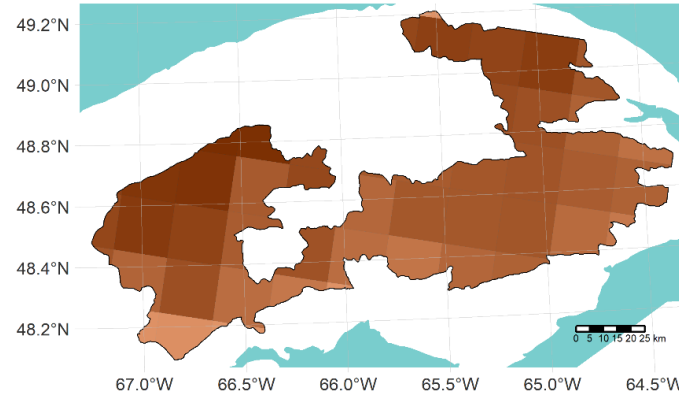
EPN

rcp 4.5



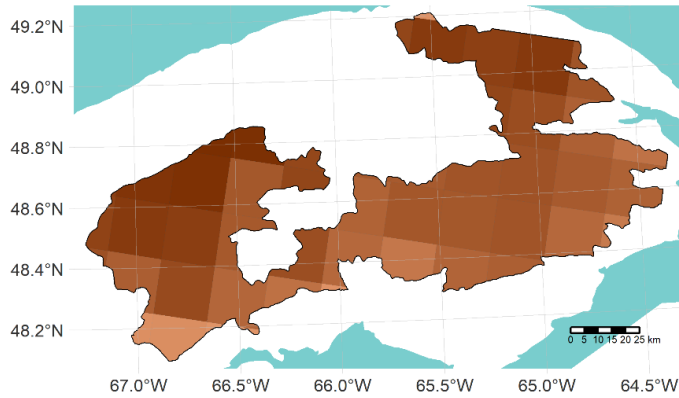
EPN
2040-45
hab moins fav
statut quo
consensus (%)
70
75
80
85
90
95

rcp 8.5



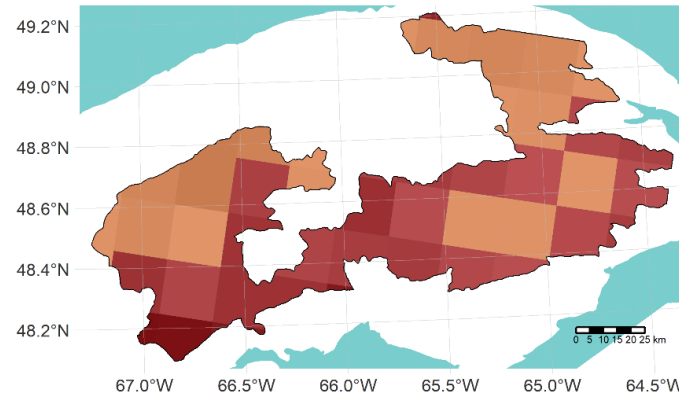
EPN
2040-85
hab moins fav
consensus (%)
50
60
70
80
90

2050



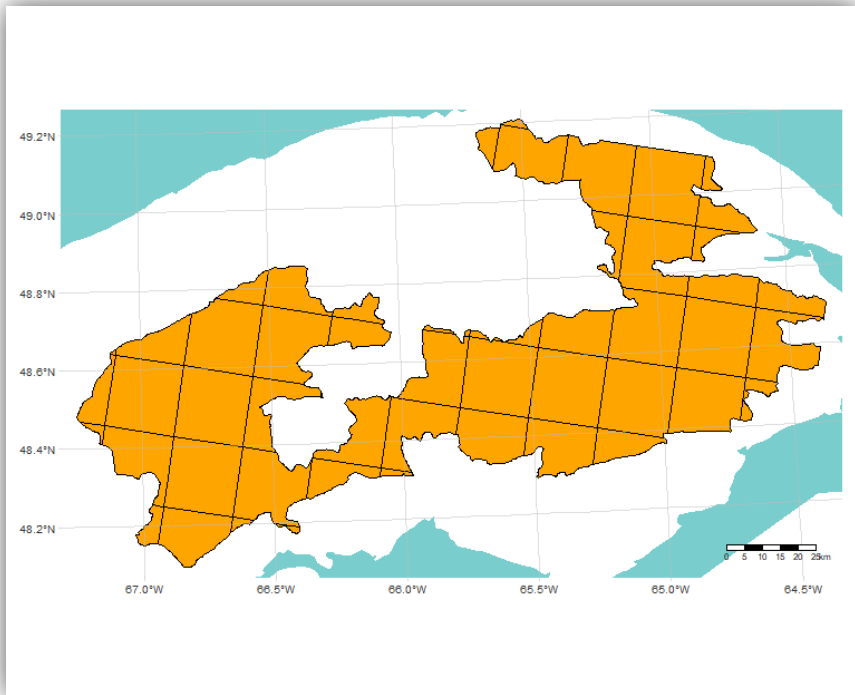
EPN
2070-45
hab moins fav
consensus (%)
60
70
80
90

2080



EPN
2070-85
hab défav
hab moins fav
consensus (%)
40
50
60
70
80
90

Fréquence des essences – 5h (R11)



Augmentation
ou maintien

EPB

EPN

Contrôle ou
diminution

ERR

PET

Maintien

BOP

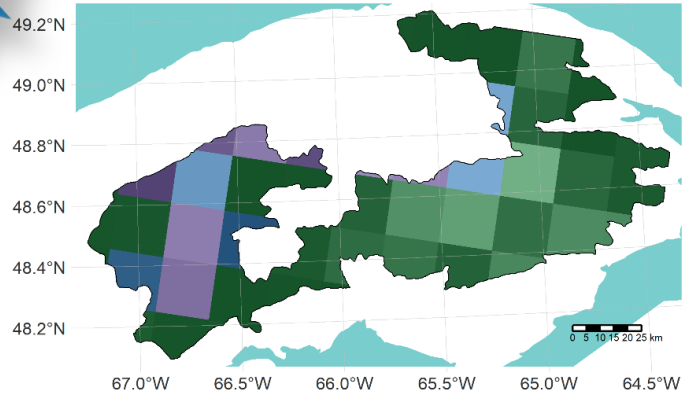
SAB

ERR

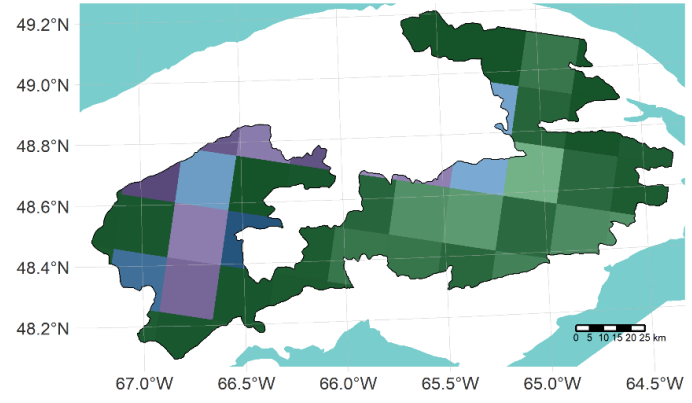
rcp 4.5

rcp 8.5

2050

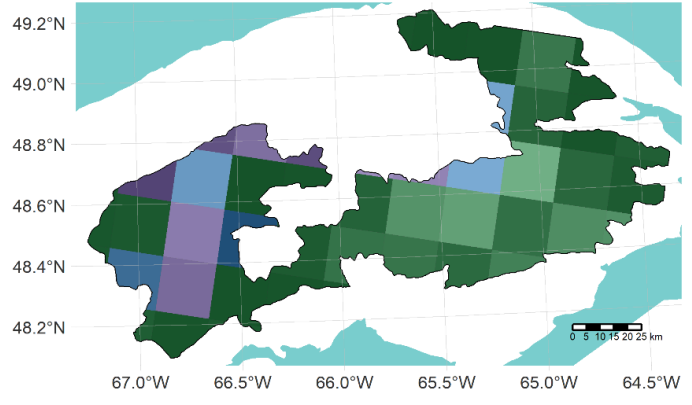


ERR
2040-45
statut quo
hab plus fav
nouvel hab
consensus (%)
90
92
94
96
98
100

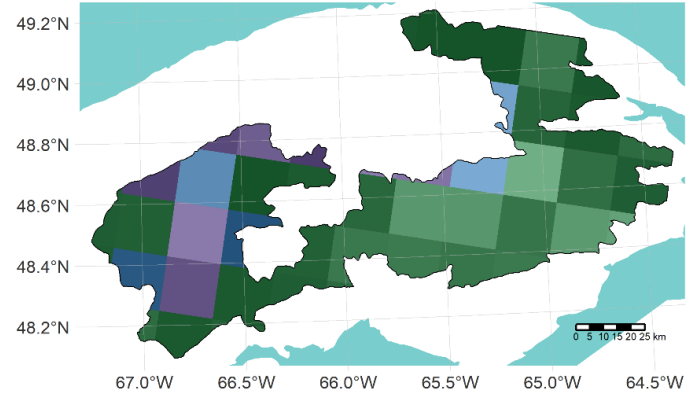


ERR
2040-85
statut quo
hab plus fav
nouvel hab
consensus (%)
90
92
94
96
98
100

2080



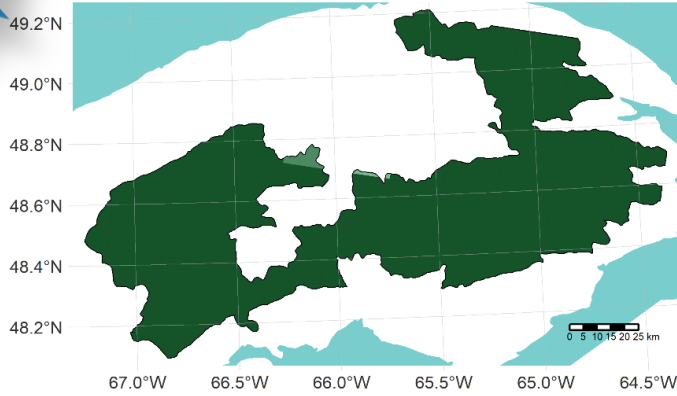
ERR
2070-45
statut quo
hab plus fav
nouvel hab
consensus (%)
90
92
94
96
98
100



ERR
2070-85
statut quo
hab plus fav
nouvel hab
consensus (%)
90
92
94
96
98
100

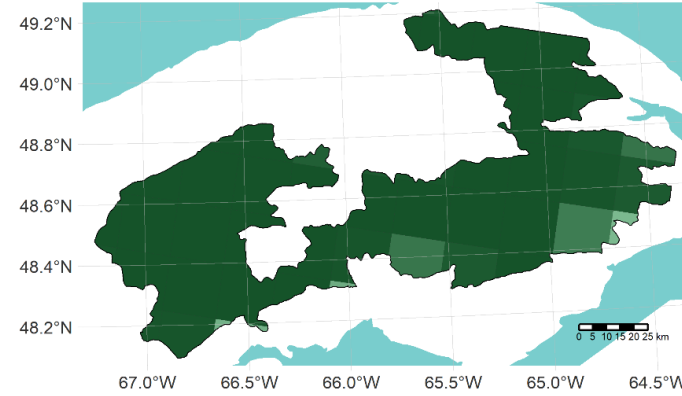
PET

rcp 4.5



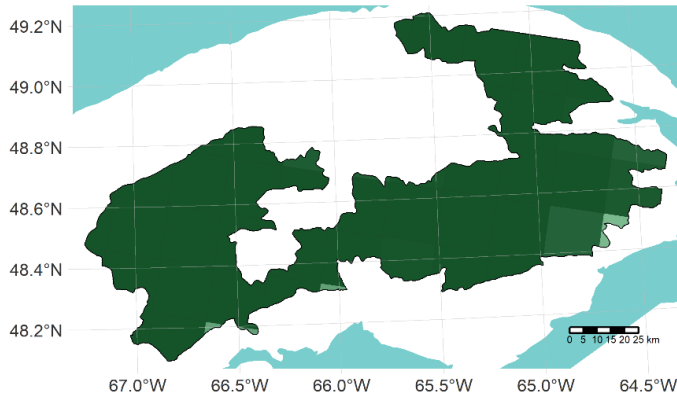
PET
2040-45
■ statut quo
consensus (%)
99.88
99.90
99.92
99.94
99.96
99.98

rcp 8.5



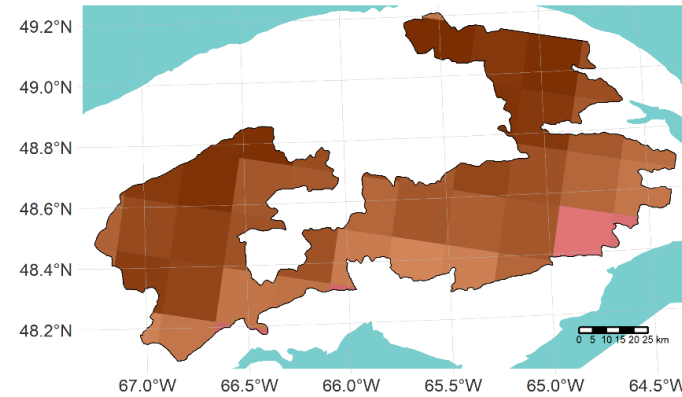
PET
2040-85
■ statut quo
consensus (%)
97.5
98.0
98.5
99.0
99.5
100.0

2050



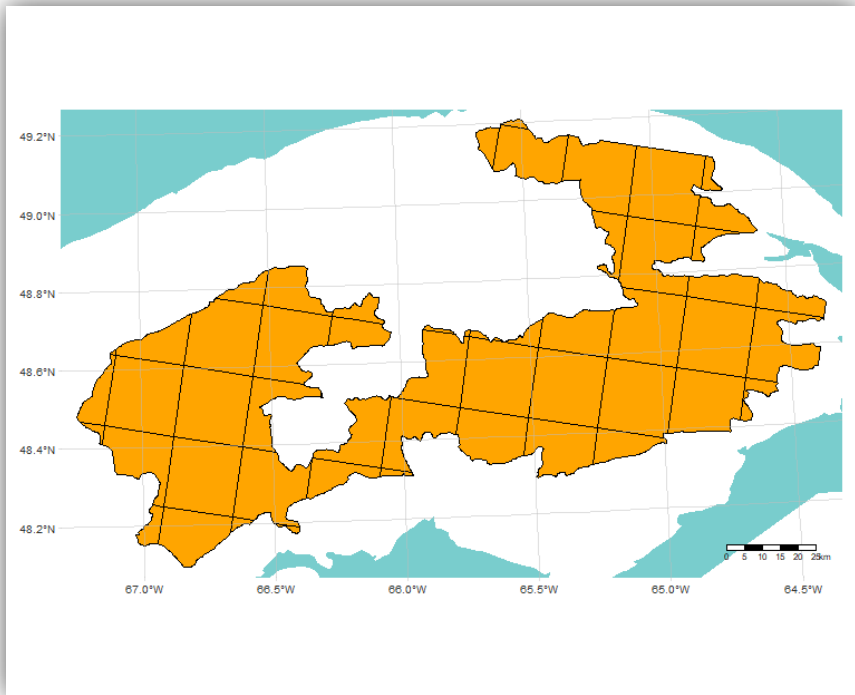
PET
2070-45
■ statut quo
consensus (%)
98.0
98.5
99.0
99.5
100.0

2080



PET
2070-85
■ hab défav
■ hab moins fav
consensus (%)
50
55
60
65
70
75
80

Fréquence des essences – 5h (R11)



Augmentation
ou maintien

EPB

EPN

Contrôle ou
diminution

ERR

PET

Maintien

BOP

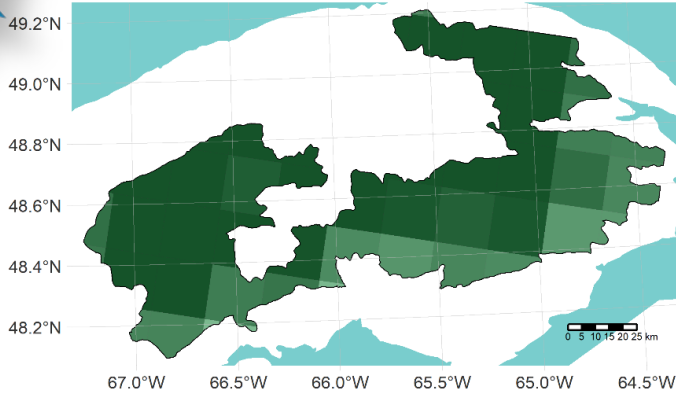
SAB

BOP

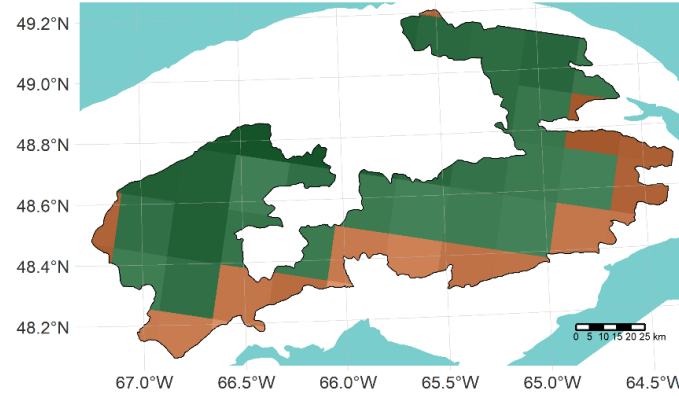
rcp 4.5

rcp 8.5

2050

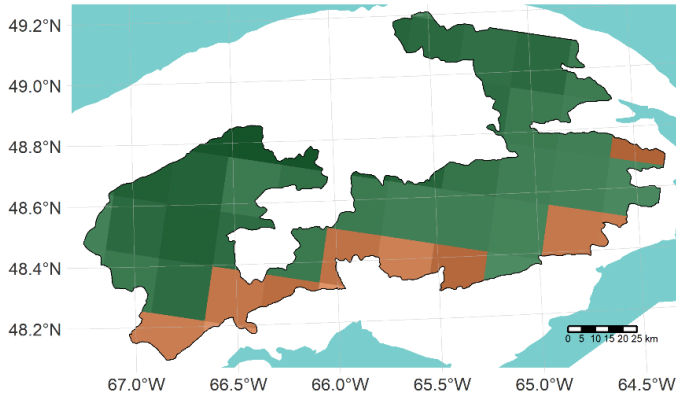


BOP
2040-45
statut quo
consensus (%)
92
94
96
98
100

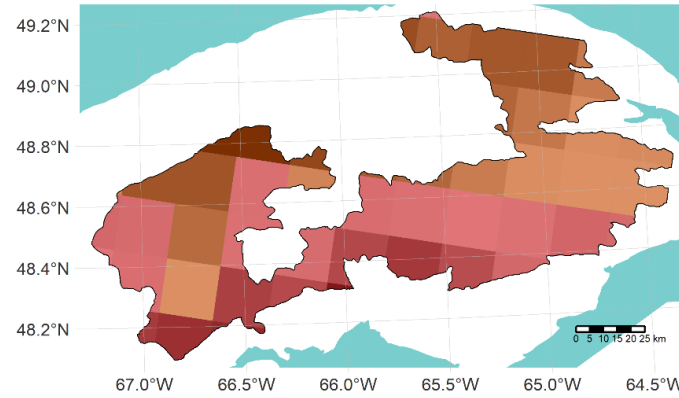


BOP
2040-85
hab moins fav
statut quo
consensus (%)
80
85
90
95

2080



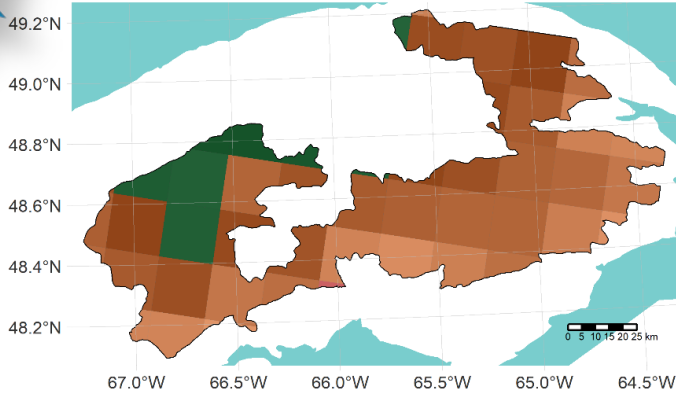
BOP
2070-45
hab moins fav
statut quo
consensus (%)
80
85
90
95



BOP
2070-85
hab défav
hab moins fav
consensus (%)
50
55
60
65

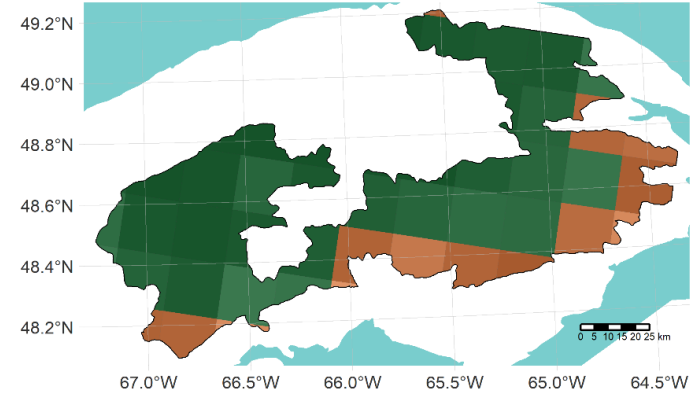
SAB

rcp 4.5



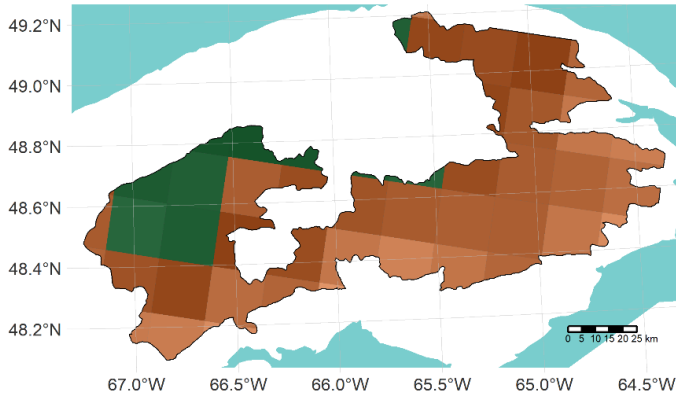
SAB
2040-85
hab défav
hab moins fav
statut quo
consensus (%)
50
60
70
80
90

rcp 8.5



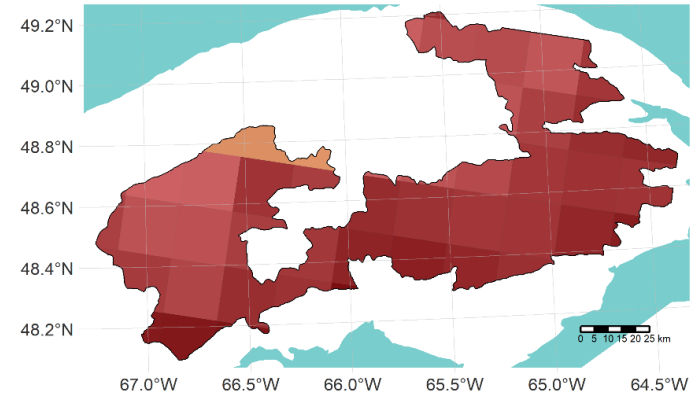
SAB
2040-45
hab moins fav
statut quo
consensus (%)
70
75
80
85
90
95
100

2050



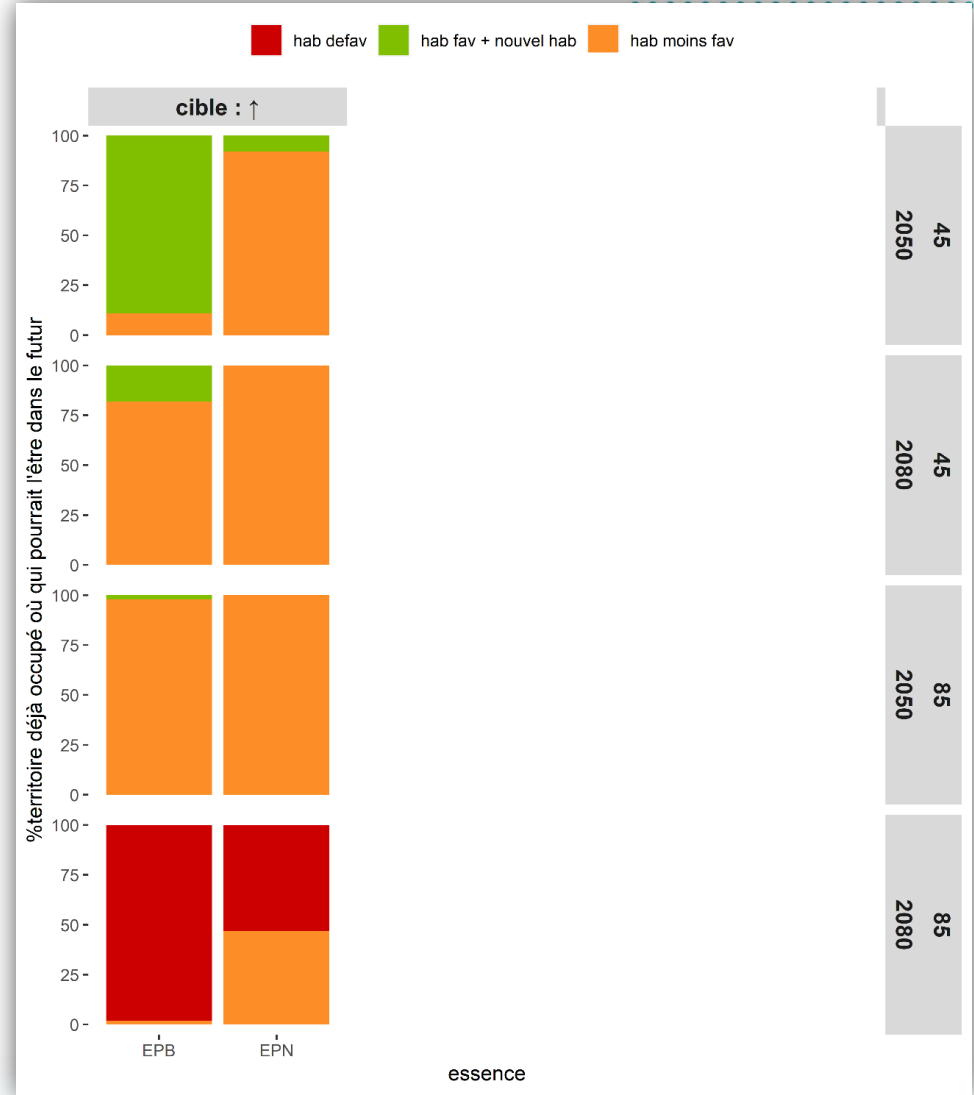
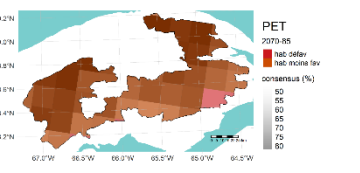
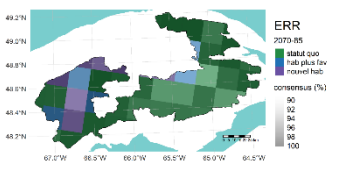
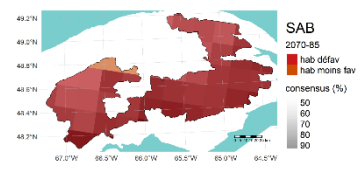
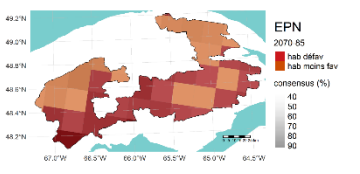
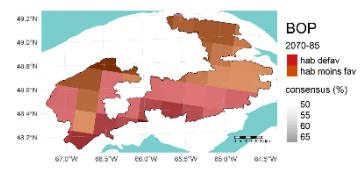
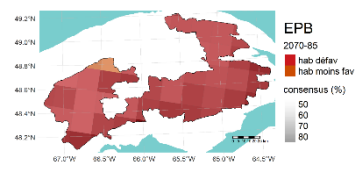
SAB
2070-45
hab moins fav
statut quo
consensus (%)
50
60
70
80
90

2080

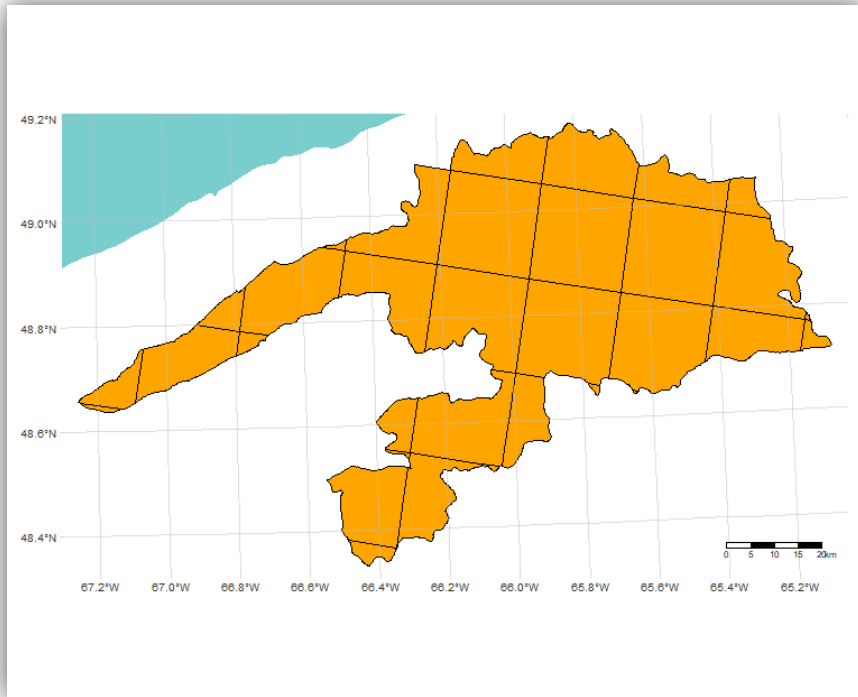


SAB
2070-85
hab défav
hab moins fav
consensus (%)
50
60
70
80
90

Bilan – 5h



Fréquence des essences – 5i (source: R11)



Augmentation
ou maintien

EPB

EPN

Contrôle ou
diminution

PET

THO

Maintien

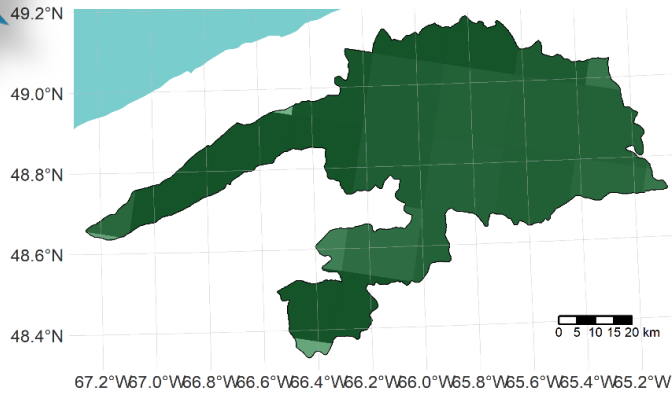
BOP

SAB

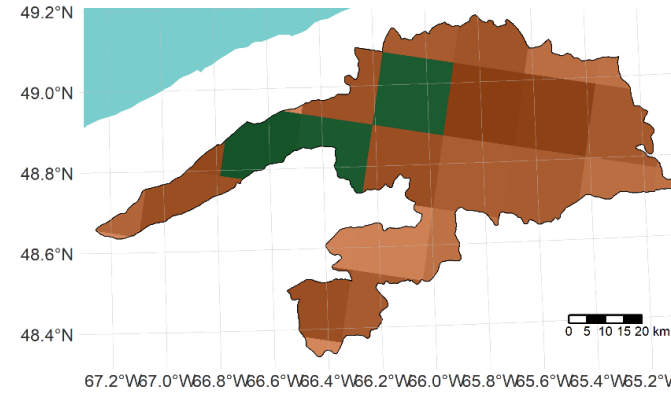
EPB

rcp 4.5

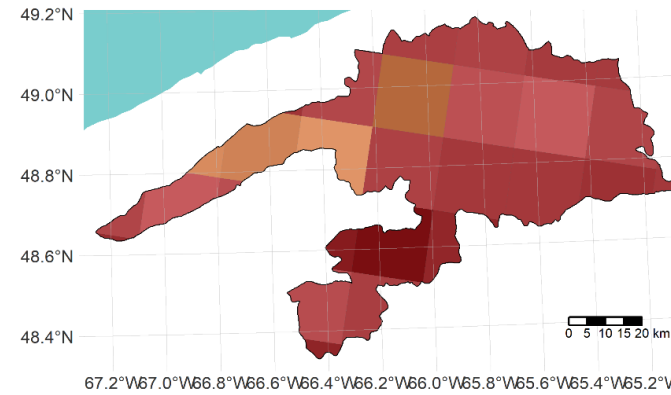
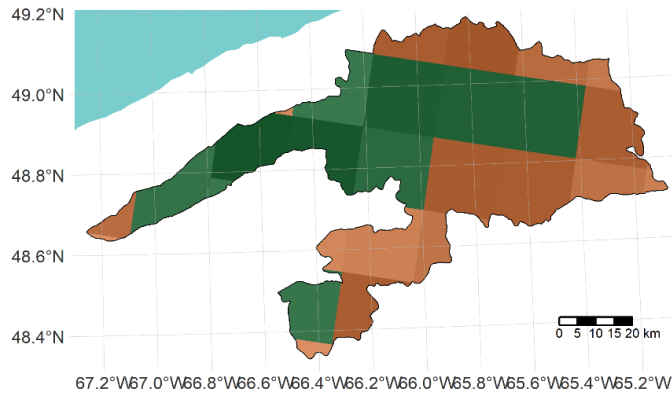
2050



rcp 8.5



2080

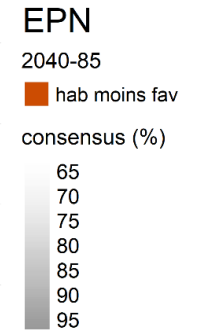
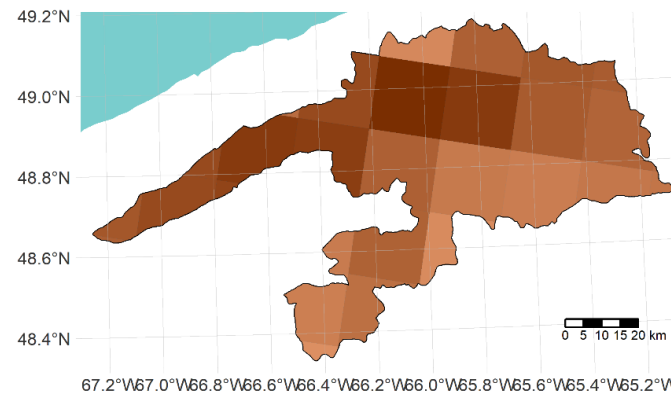
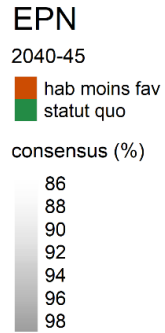
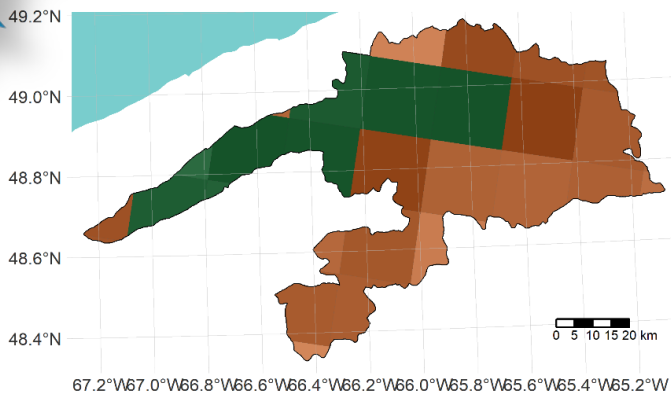


EPN

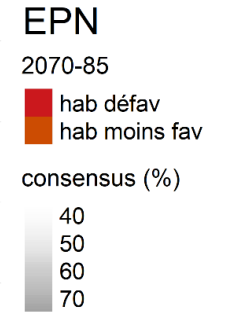
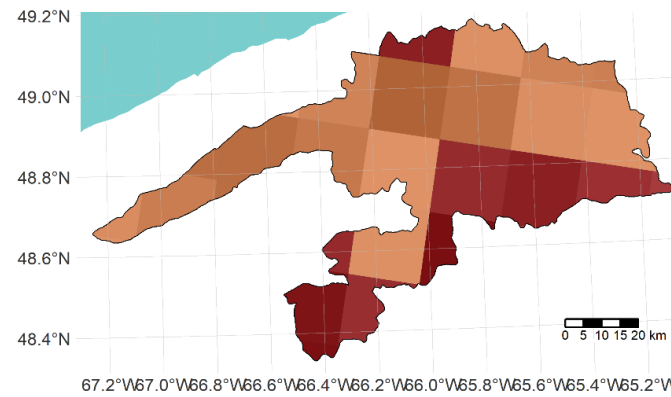
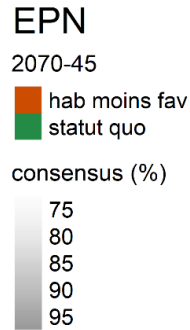
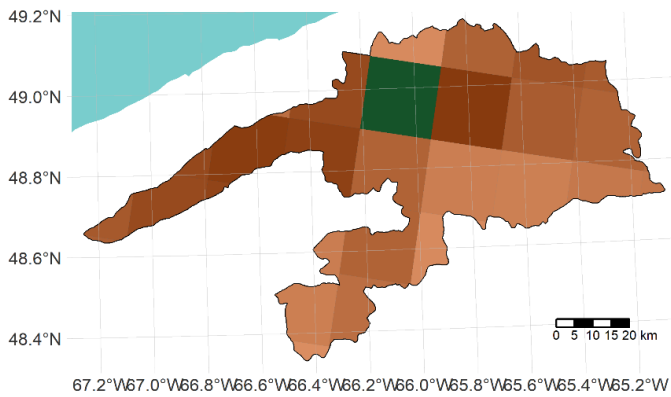
rcp 4.5

rcp 8.5

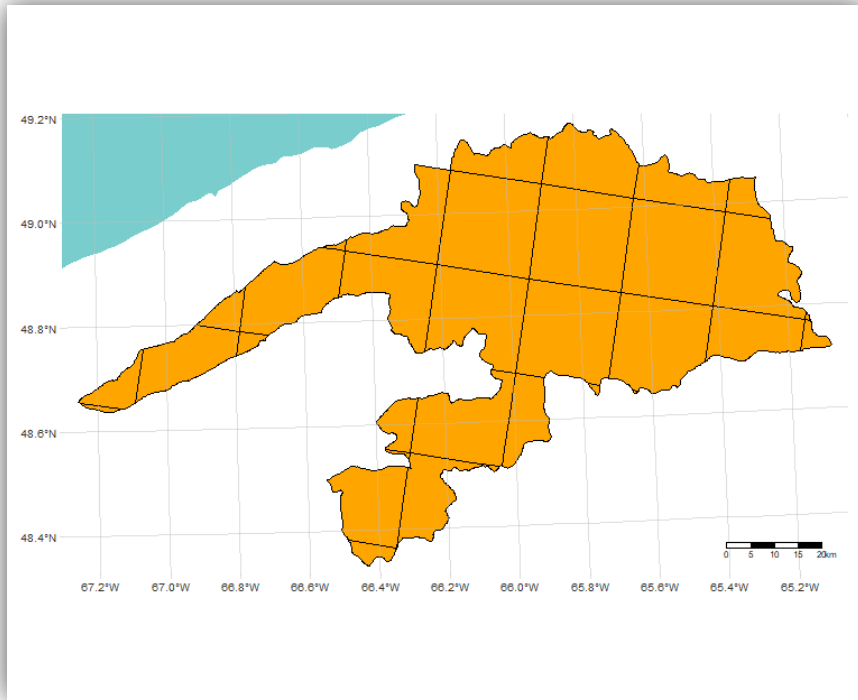
2050



2080



Fréquence des essences – 5i (source: R11)



Augmentation
ou maintien

EPB

EPN

Contrôle ou
diminution

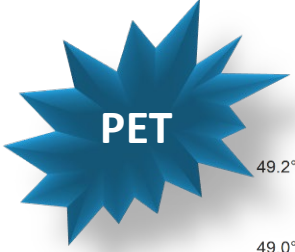
PET

THO

Maintien

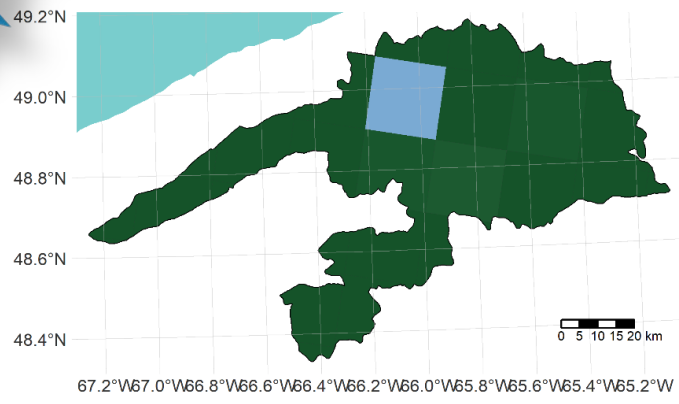
BOP

SAB

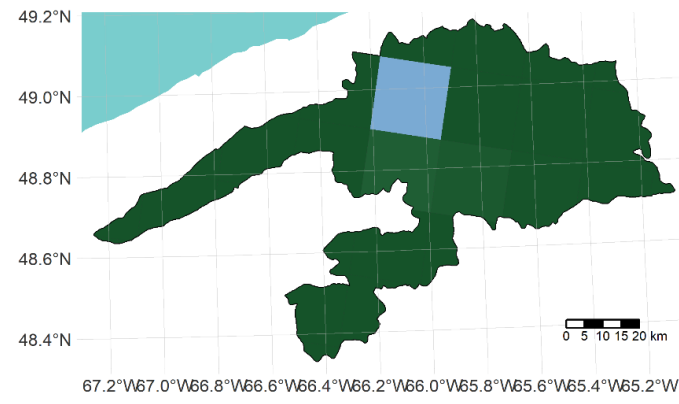


2050

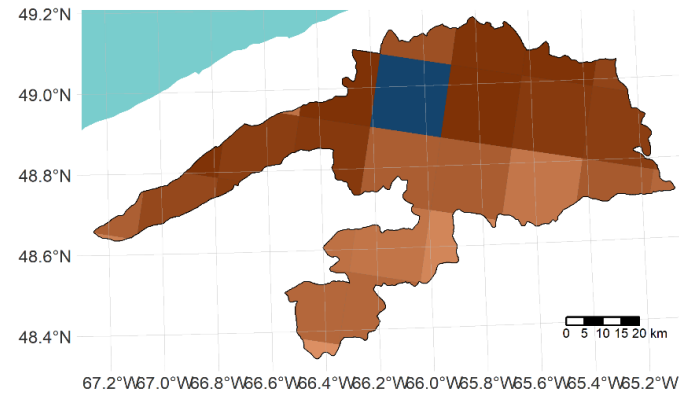
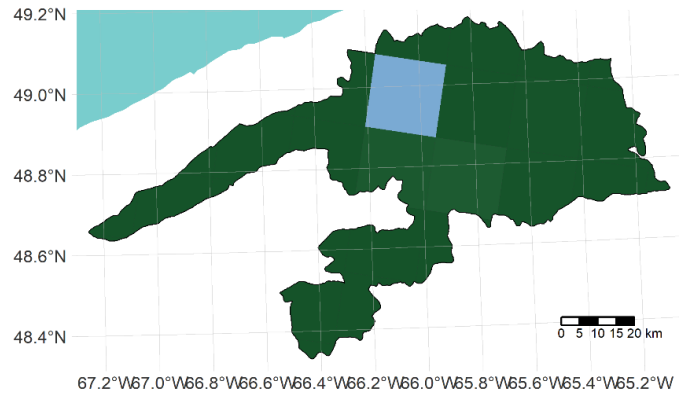
rcp 4.5



rcp 8.5



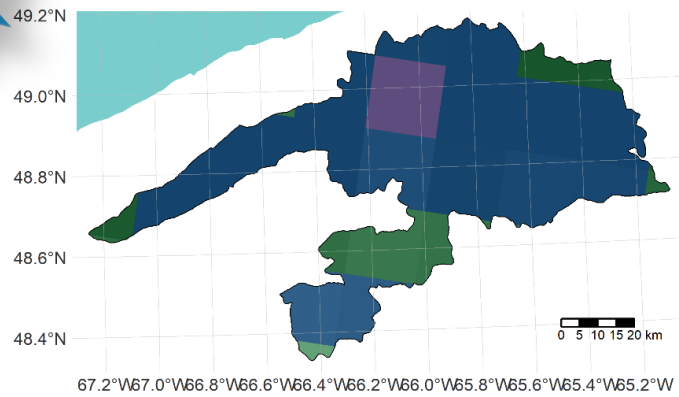
2080





2050

rcp 4.5



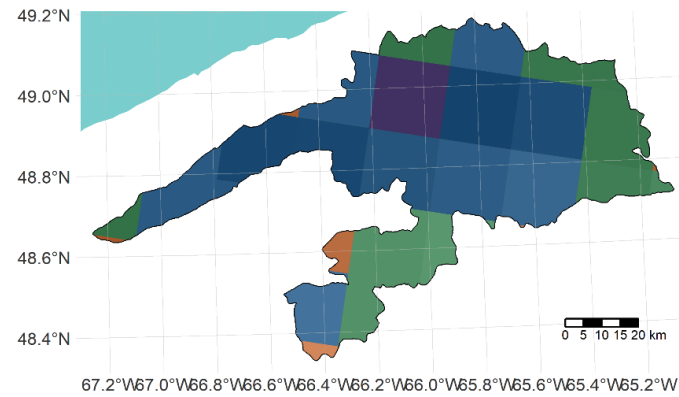
THO
2040-45

- hab moins fav
- statut quo
- hab plus fav
- nouvel hab

consensus (%)

- 88
- 90
- 92
- 94
- 96
- 98
- 100

rcp 8.5



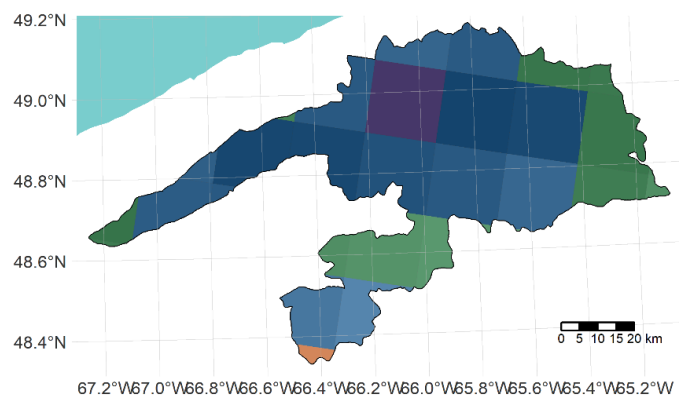
THO
2040-85

- hab moins fav
- statut quo
- hab plus fav
- nouvel hab

consensus (%)

- 75
- 80
- 85
- 90
- 95

2080

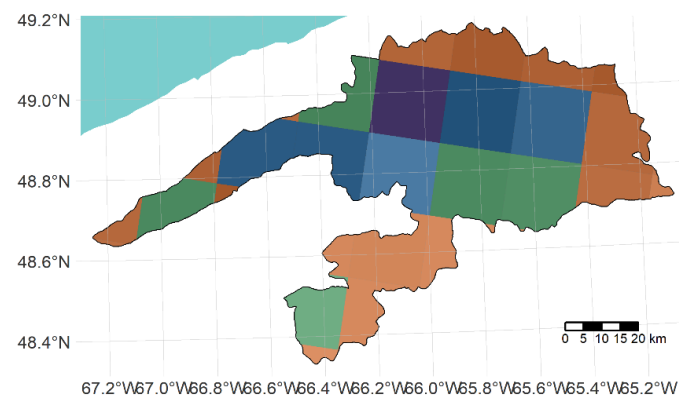


THO
2070-45

- hab moins fav
- statut quo
- hab plus fav
- nouvel hab

consensus (%)

- 80
- 85
- 90
- 95



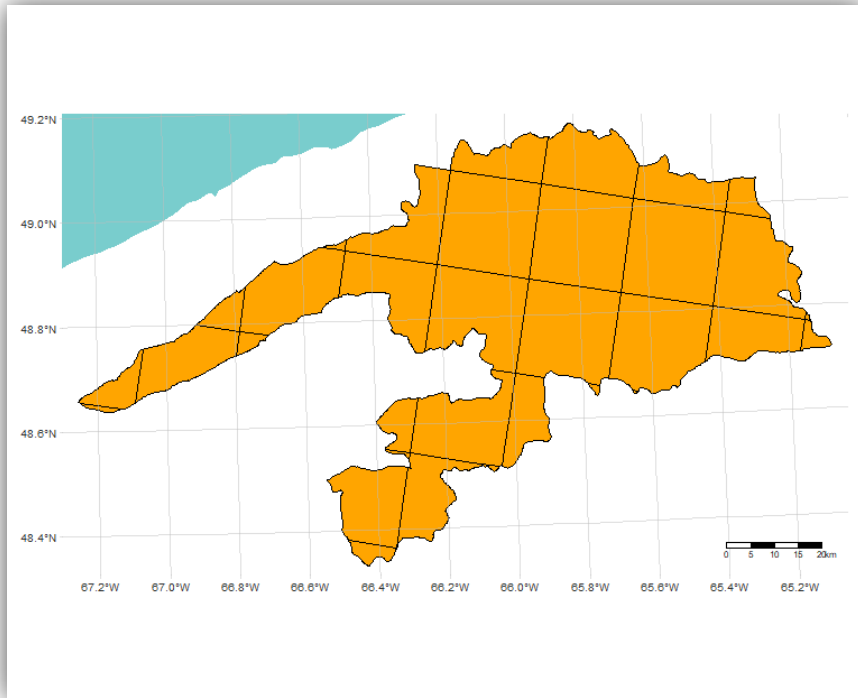
THO
2070-85

- hab moins fav
- statut quo
- hab plus fav
- nouvel hab

consensus (%)

- 40
- 50
- 60
- 70

Fréquence des essences – 5i (source: R11)



Augmentation
ou maintien

EPB

EPN

Contrôle ou
diminution

PET

THO

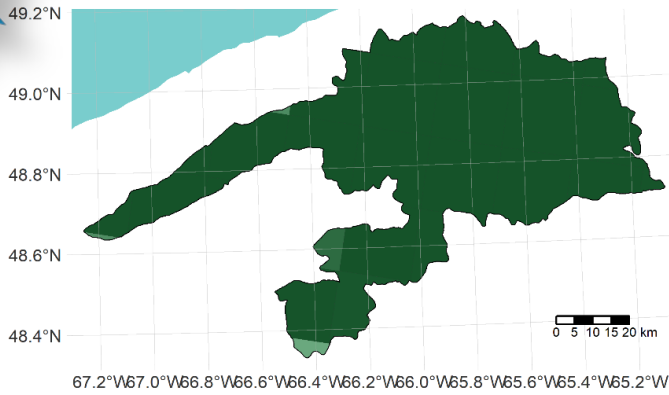
Maintien

BOP

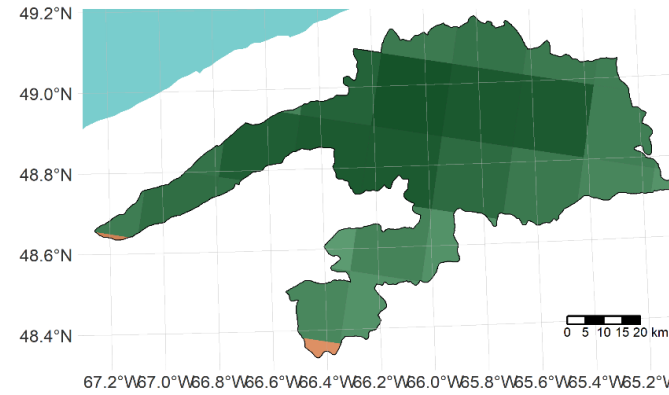
SAB

BOP

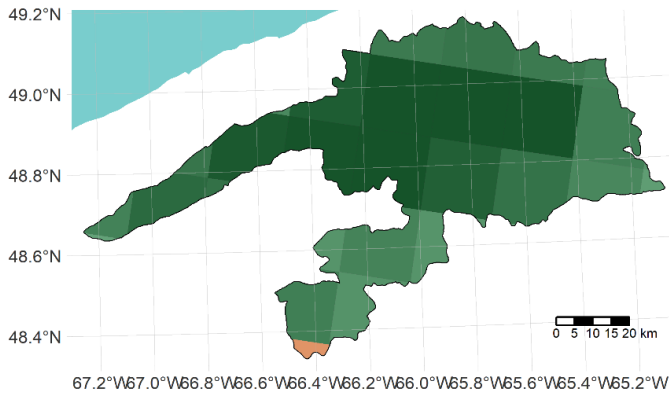
rcp 4.5



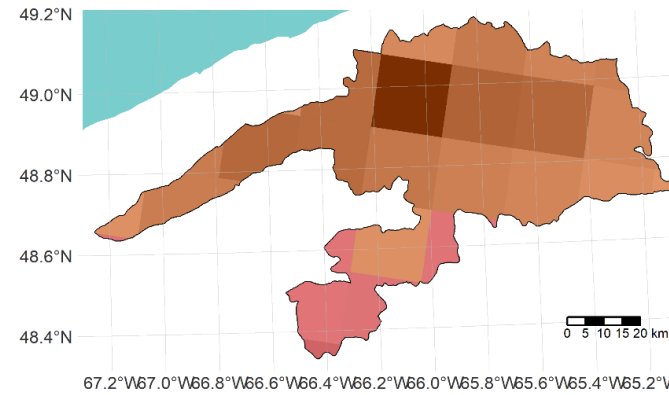
rcp 8.5



2050



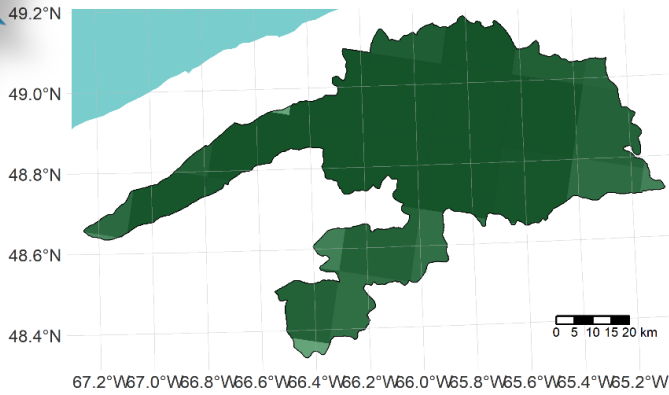
2080



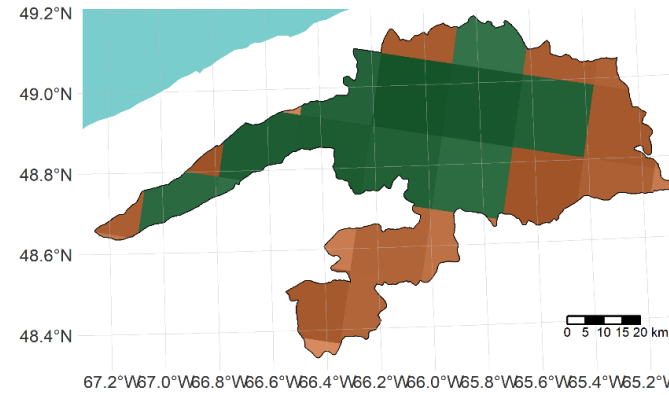
SAB

rcp 4.5

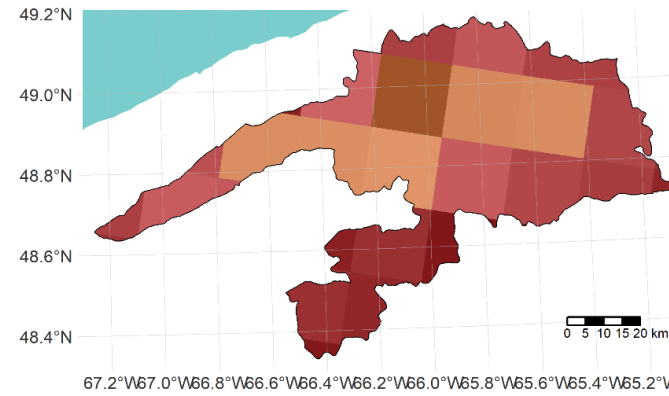
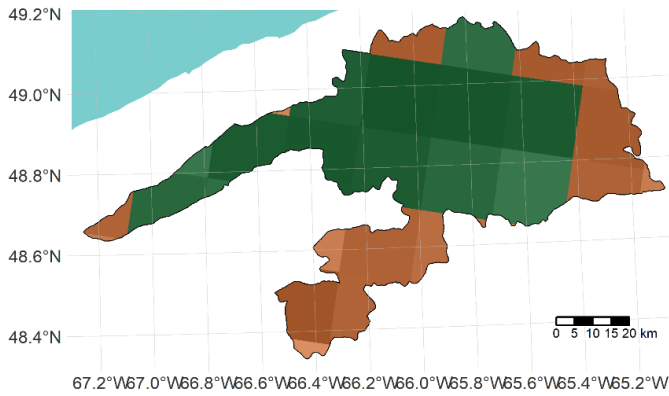
2050



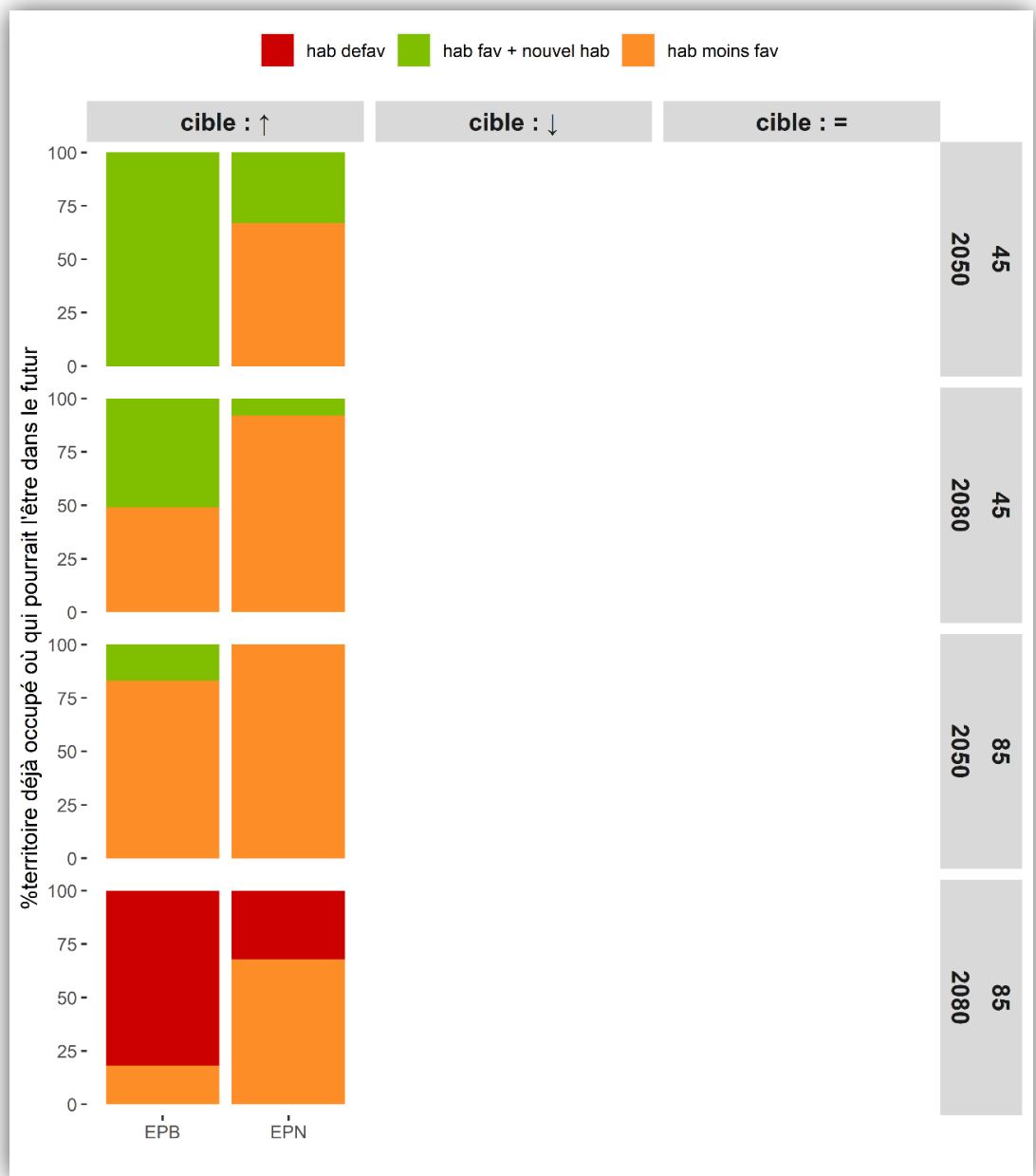
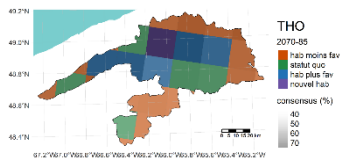
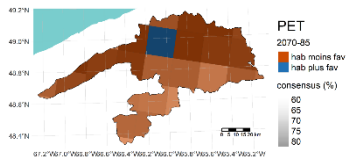
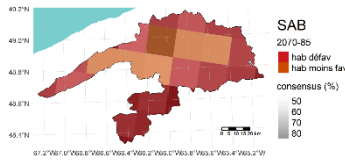
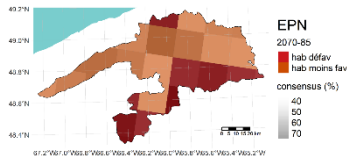
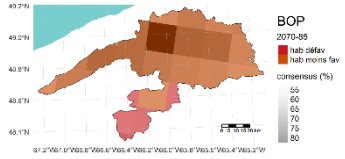
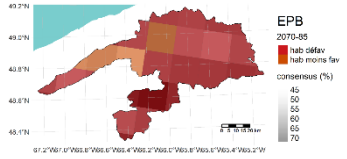
rcp 8.5



2080



Bilan – 5i



Le menu du jour

1

2

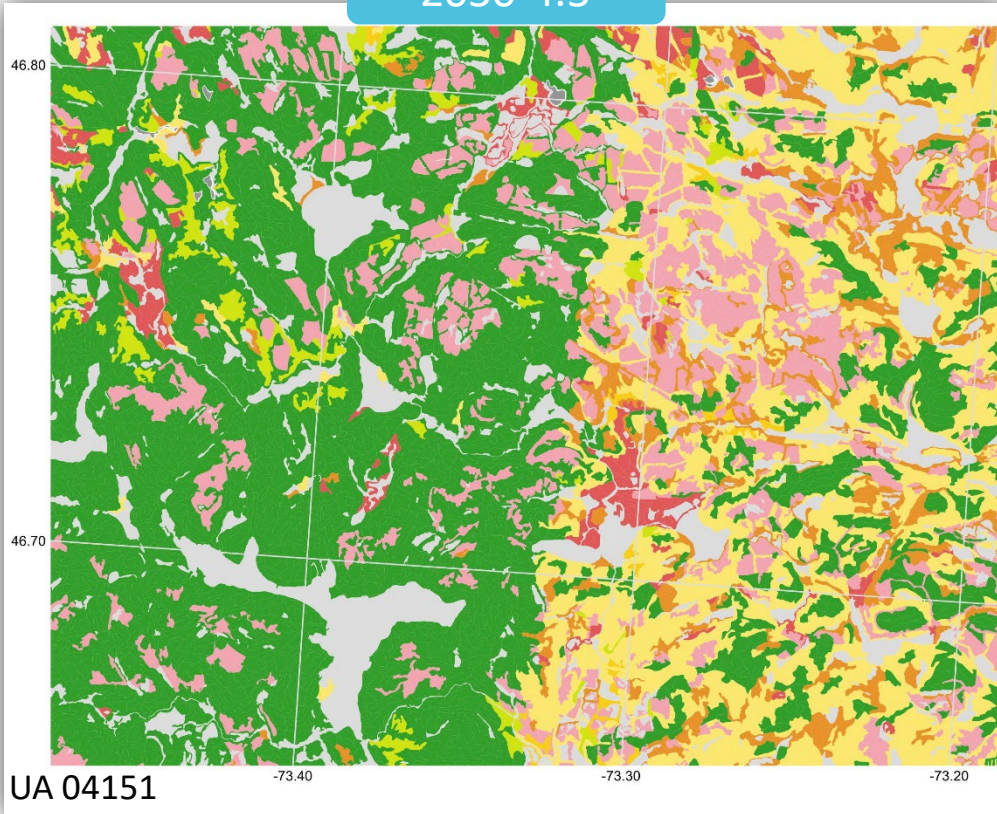
3

4

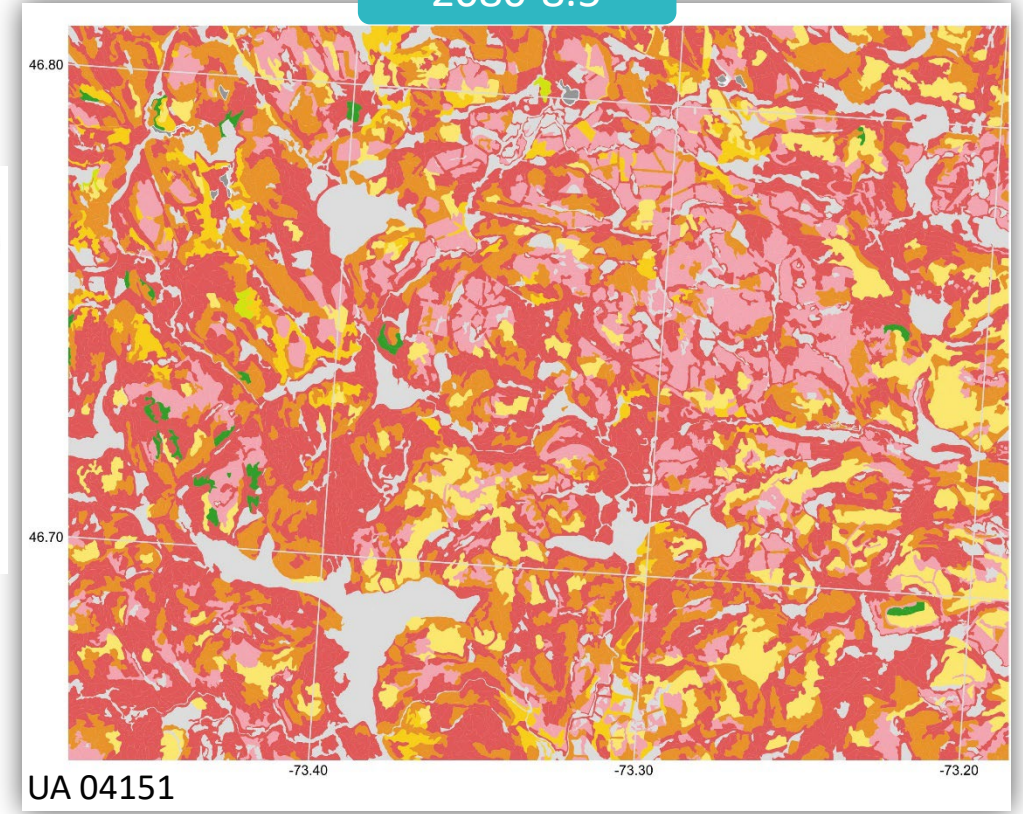
Effets anticipés des
changements climatiques
sur la composition des
peuplements actuellement
sur pied

Effets des CC sur la composition des peuplements sur pied

2050-4.5



2080-8.5



En conclusion,

