Project Steering Group Meeting
April 16, 2025

Peatland restoration for greenhouse gas emission reduction and carbon sequestration in the Baltic Sea region (LIFE PeatCarbon)

Greenhouse gas monitoring update in Latvia

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Monitoring sites of GHG fluxes and environmental variables, Latvia

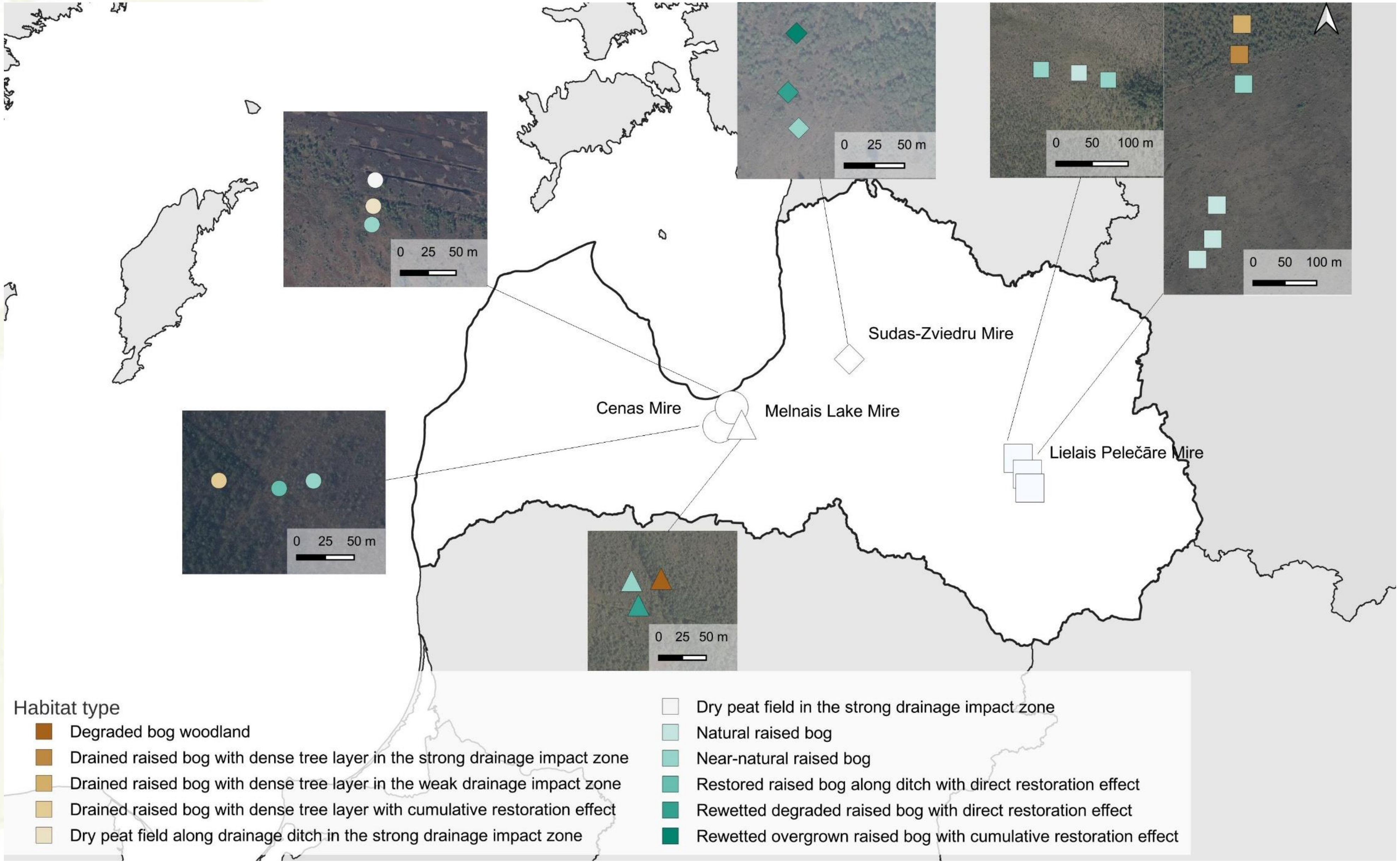

Figure: Monitoring sites in Latvia. Three plots representing different habitats in each study site (in total 21 plots, 7 study sites, 4 mires).

Monitoring of GHG fluxes

- Monitored **GHG fluxes include** (since June 2023):
  - CO_2 fluxes reflecting ecosystem respiration (R_{eco});
  - CO_2 fluxes reflecting soil heterotrophic respiration (R_{het});
  - CH_4 and N_2O fluxes.
- R_{eco}, CH_4 and N_2O fluxes were measured using the **closed chamber method** for gas sampling (four consecutive gas samples were taken in 10-minute intervals) and **gas chromatography method** for determination of CO_2, CH_4 and N_2O concentration in gas samples.
- R_{het} fluxes were measured using a **portable CO_2 gas analyser** (EGM-5).

Monitoring of environmental variables and carbon input into soil through vegetation litter

- Simultaneously with GHG measurements, **environmental variables** (factors potentially affecting ecosystem GHG exchange) were monitored:
  - Groundwater level;
  - Groundwater variables: temperature, dissolved oxygen (DO), electrical conductivity (EC), pH and oxidation-reduction potential (ORP), concentration of nitrates (NH_3^-) and ammonium ions (NH_4^+) as well as other parameters tested in the laboratory;
  - Air and soil temperature;
  - Soil electrical conductivity and soil moisture content;
  - Other.
- Three collectors of **tree litter and moss increment** were installed at each study plot (9 collectors at each study site) to monitor carbon input into the soil through vegetation litter.

Total soil and ground vegetation respiration: habitat approach by types

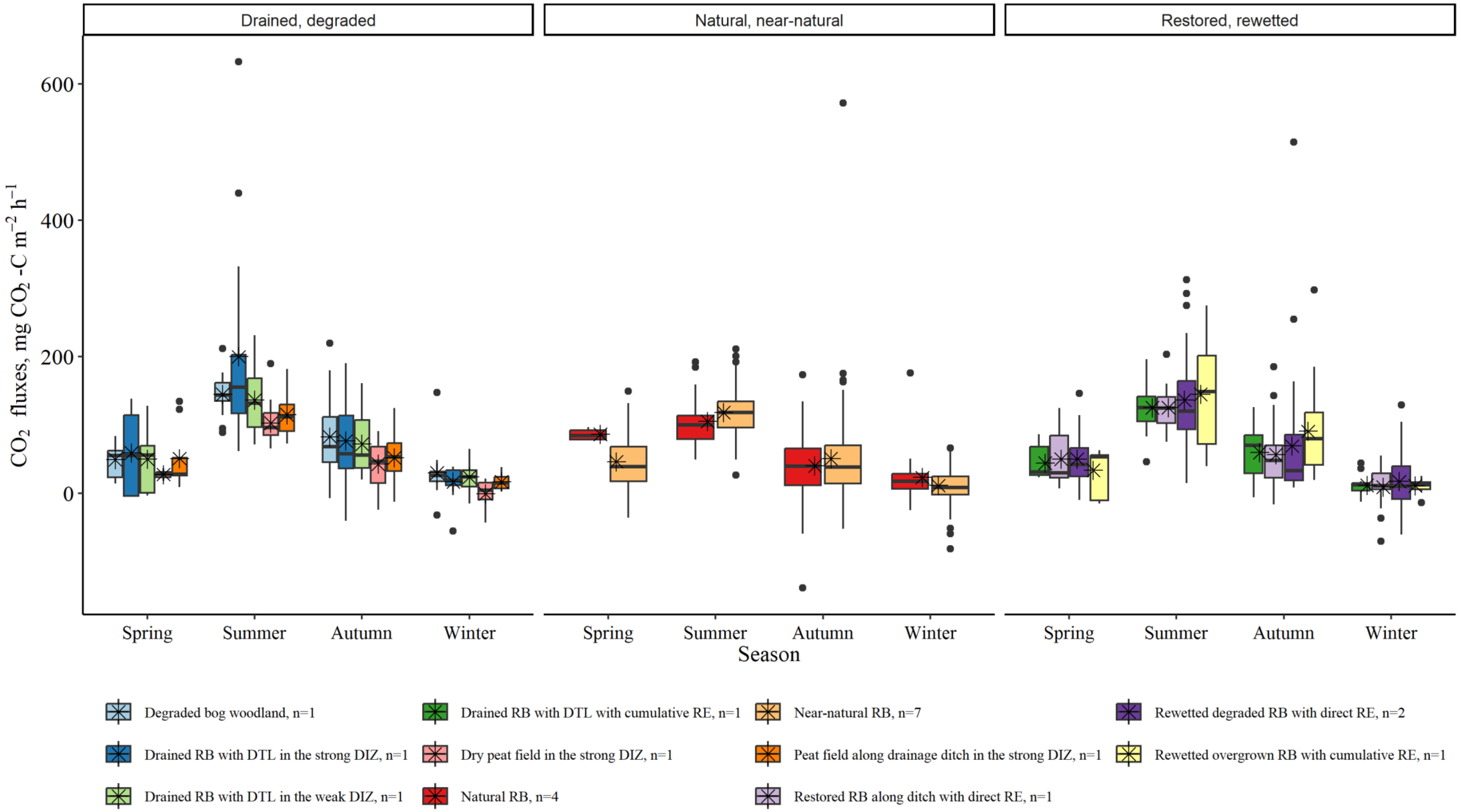

Figure: Variation in total soil and ground vegetation respiration by different types of habitat and seasons.

n – number of plots in the habitat

DTL – dense tree layer;
RB – raised bog;
DIZ – drainage impact zone;
RE – restoration effect.

Spring – March, April, May
Summer – June, July, August
Autumn – September, October, November
Winter – December, January, February

Difference in annual total soil and ground vegetation respiration compared to natural and near-natural RB: habitat approach

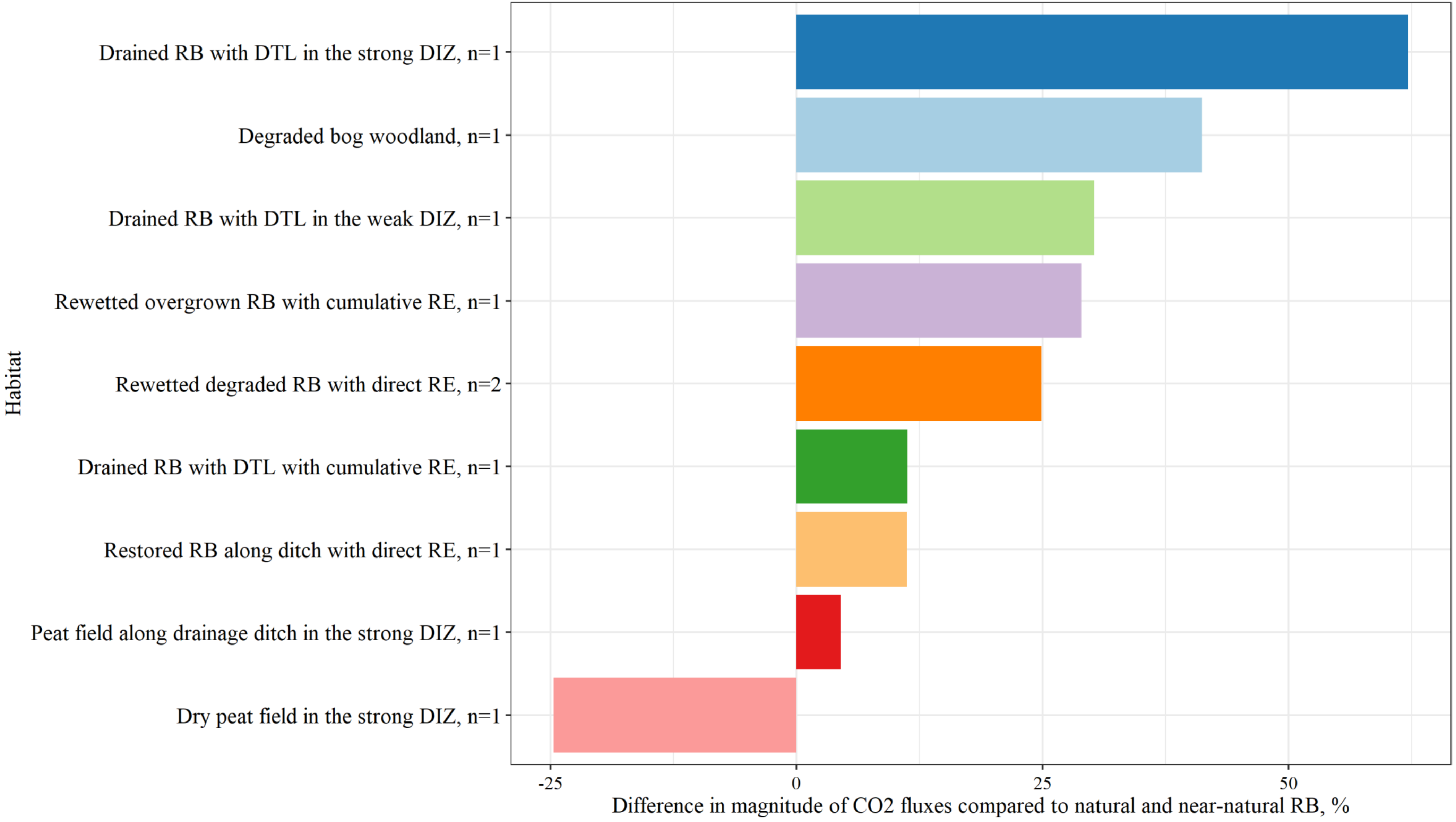

Figure: Difference in annual total soil and ground vegetation respiration compared to natural and near-natural raised bog

n – number of plots in the habitat

DTL – dense tree layer;
RB – raised bog;
DIZ – drainage impact zone;
RE – restoration effect.

CH_4 fluxes: habitat approach by type

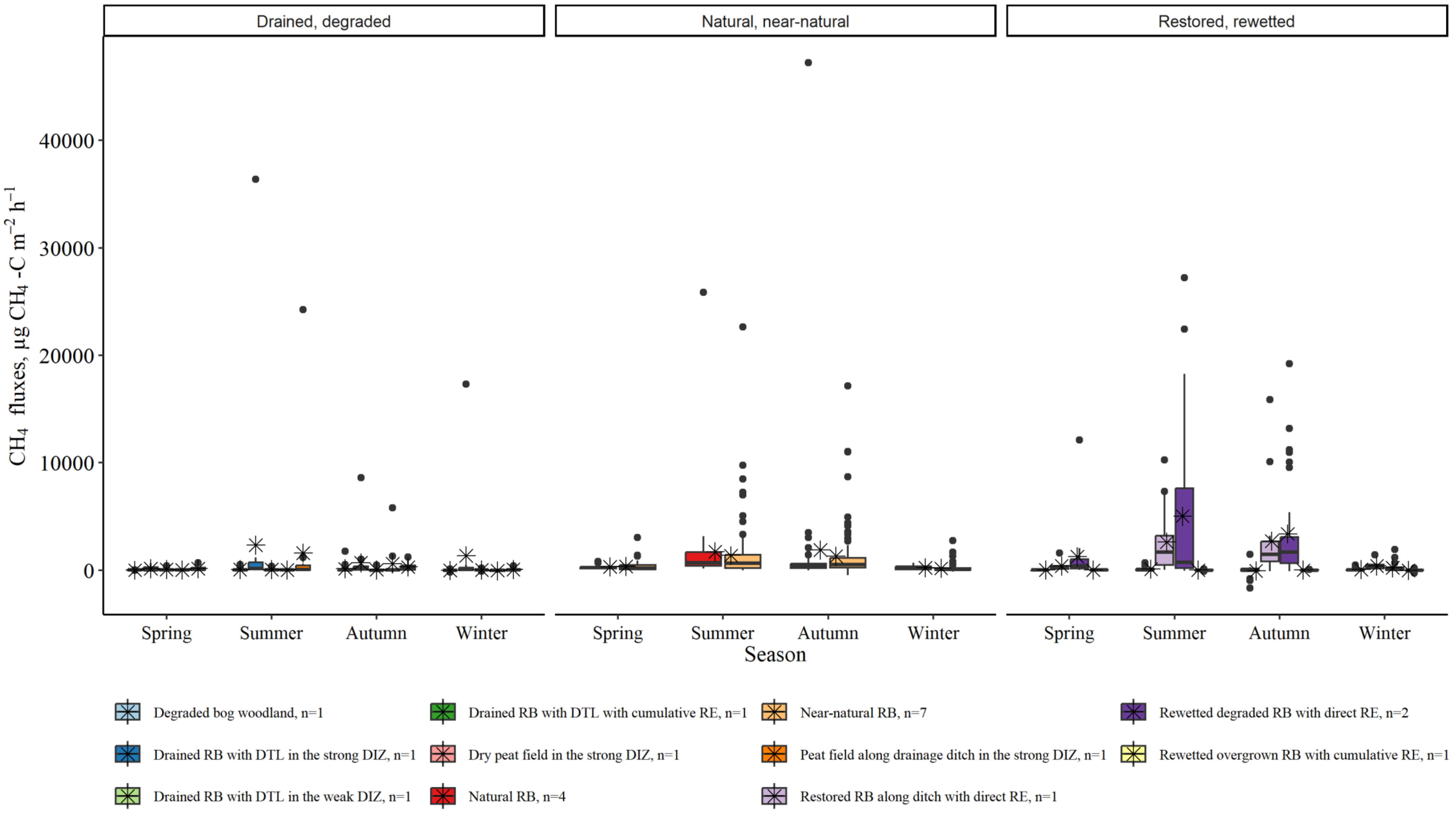

Figure: Variation in CH_4 fluxes by different types of habitat and seasons.

n – number of plots in the habitat

DTL – dense tree layer;
RB – raised bog;
DIZ – drainage impact zone;
RE – restoration effect.

Spring – March, April, May
Summer – June, July, August
Autumn – September, October, November
Winter – December, January, February

Difference in annual CH_4 fluxes compared to natural and near-natural RB: habitat approach

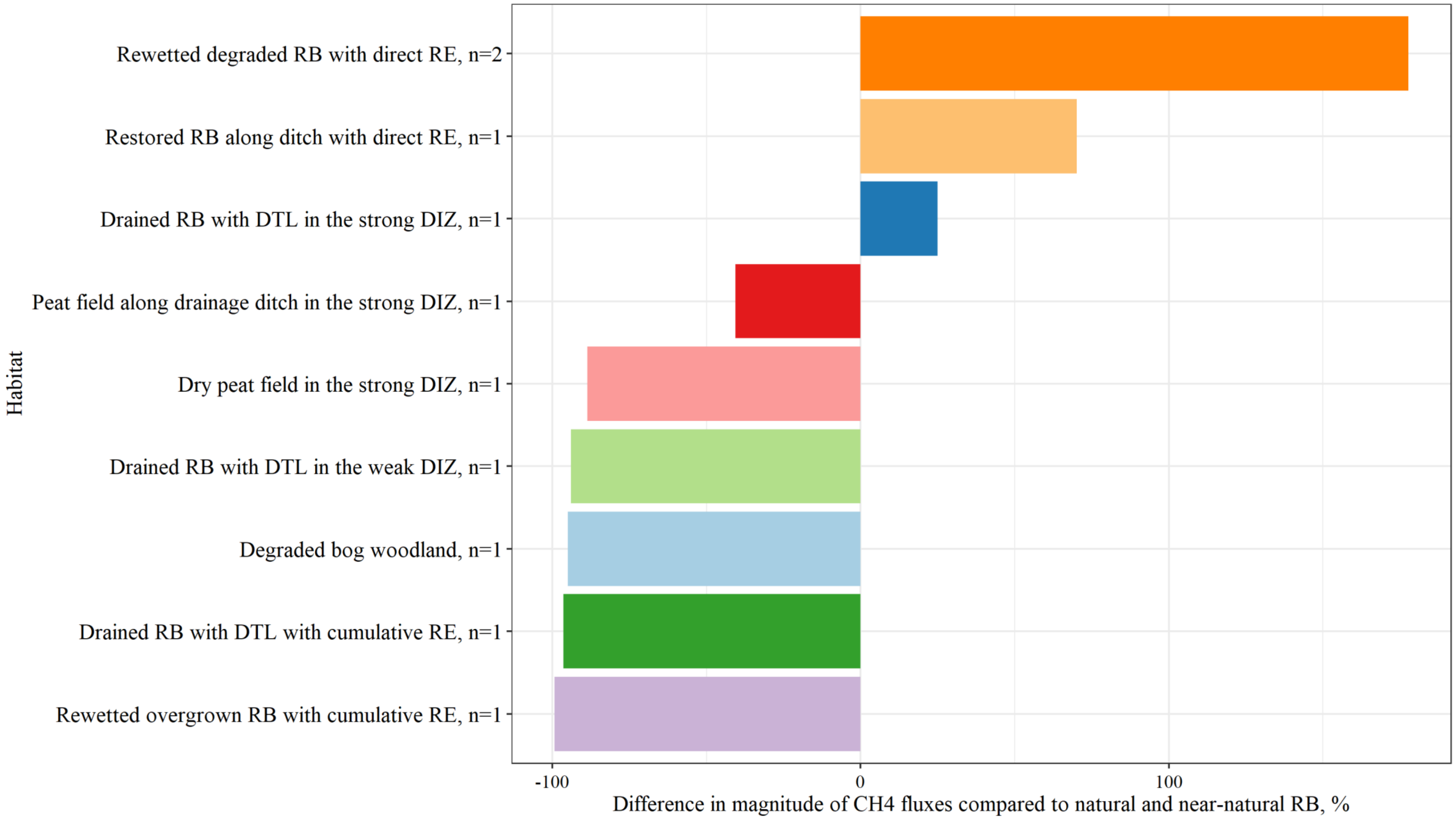

Figure: Difference in annual CH_4 fluxes compared to natural and near-natural raised bog

n – number of plots in the habitat

DTL – dense tree layer;
RB – raised bog;
DIZ – drainage impact zone;
RE – restoration effect.

N_2O fluxes: habitat approach by types

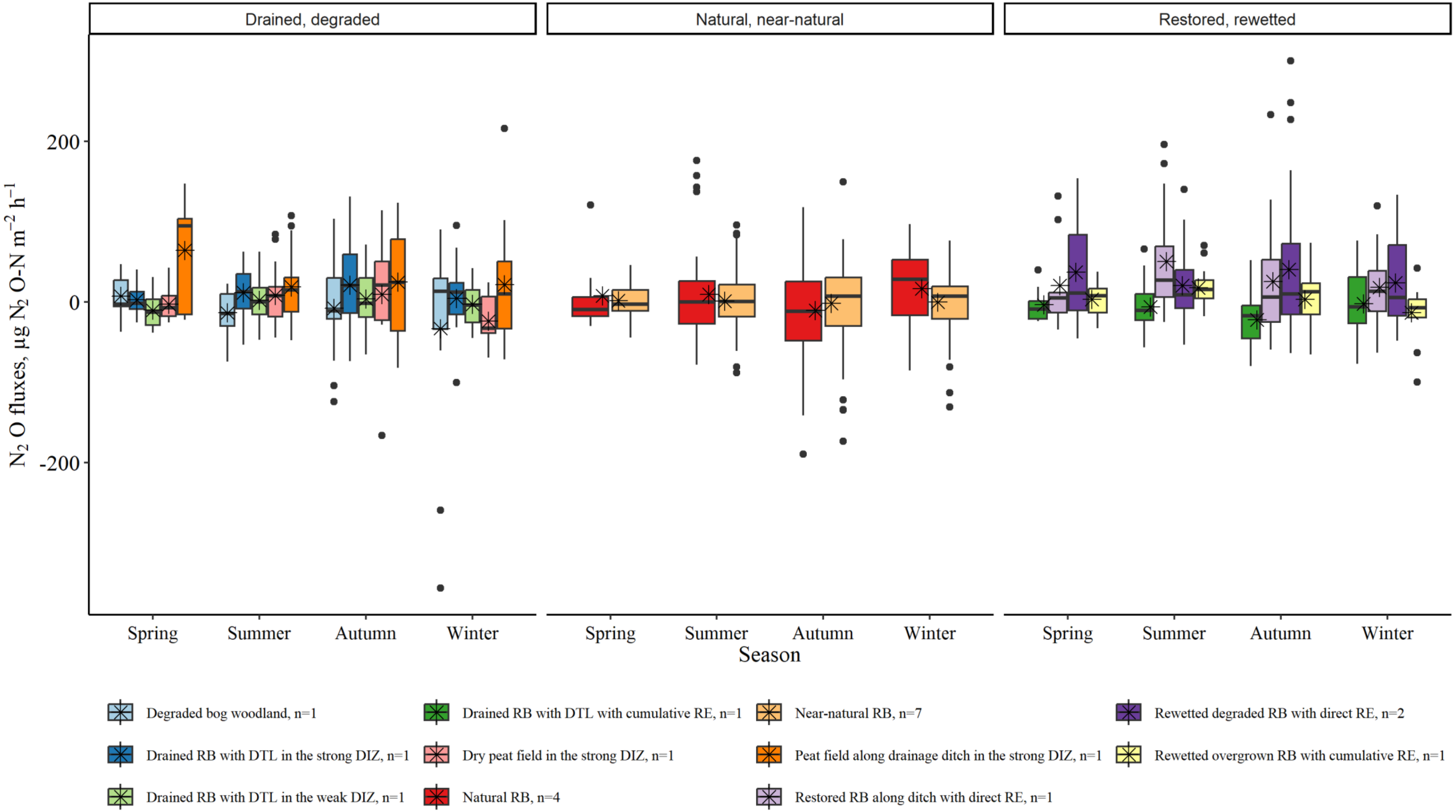

Figure: Variation in N_2O fluxes by different types of habitat and seasons.

DTL – dense tree layer;
RB – raised bog;
DIZ – drainage impact zone;
RE – restoration effect.

Spring – March, April, May
Summer – June, July, August
Autumn – September, October, November
Winter – December, January, February

Difference in annual N_2O fluxes compared to natural and near-natural RB: habitat approach

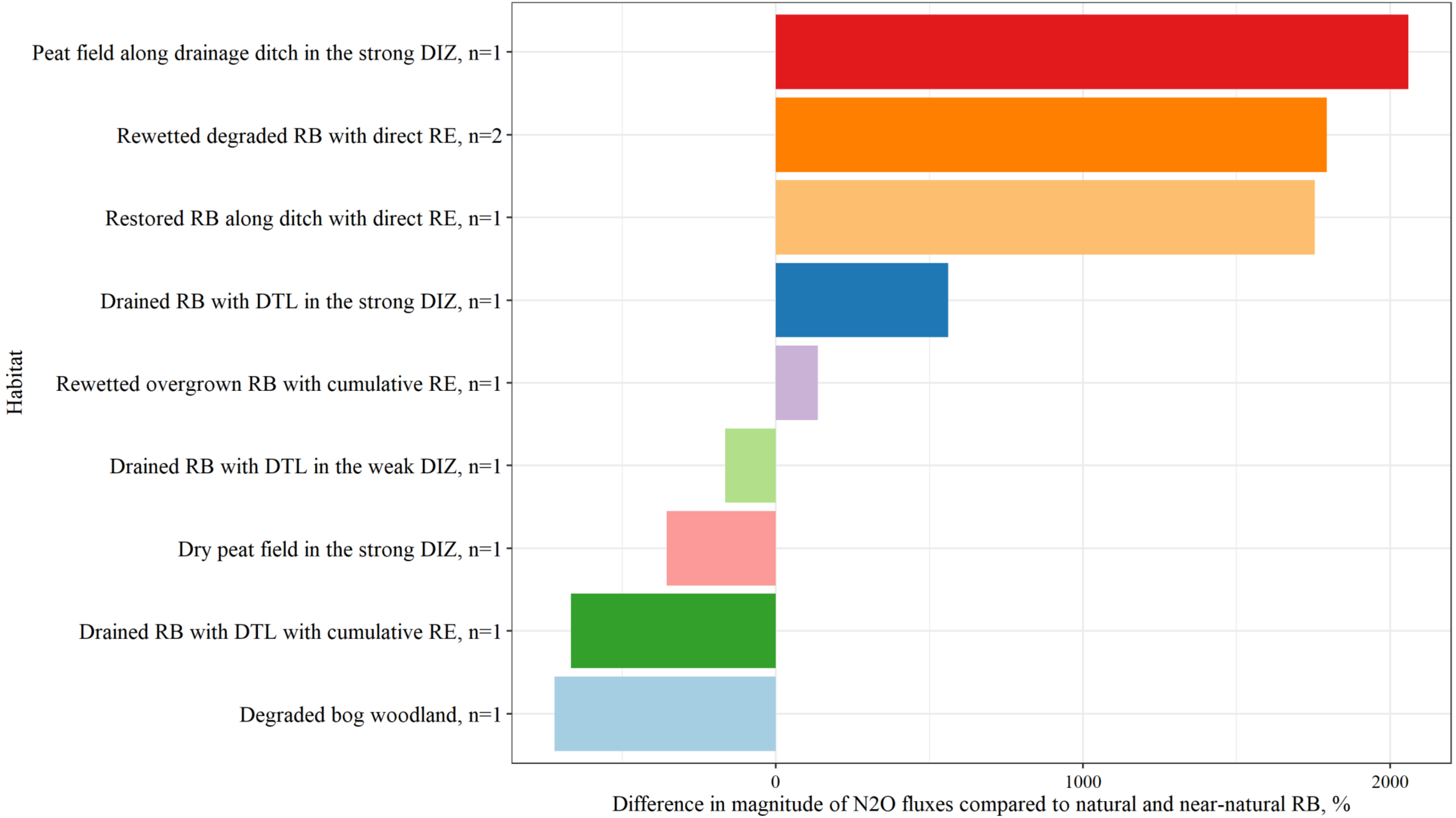

Figure: Difference in annual N_2O fluxes compared to natural and near-natural raised bog

n – number of plots in the habitat

DTL – dense tree layer;
RB – raised bog;
DIZ – drainage impact zone;
RE – restoration effect.

Annual soil GHG efflux: habitat approach by types

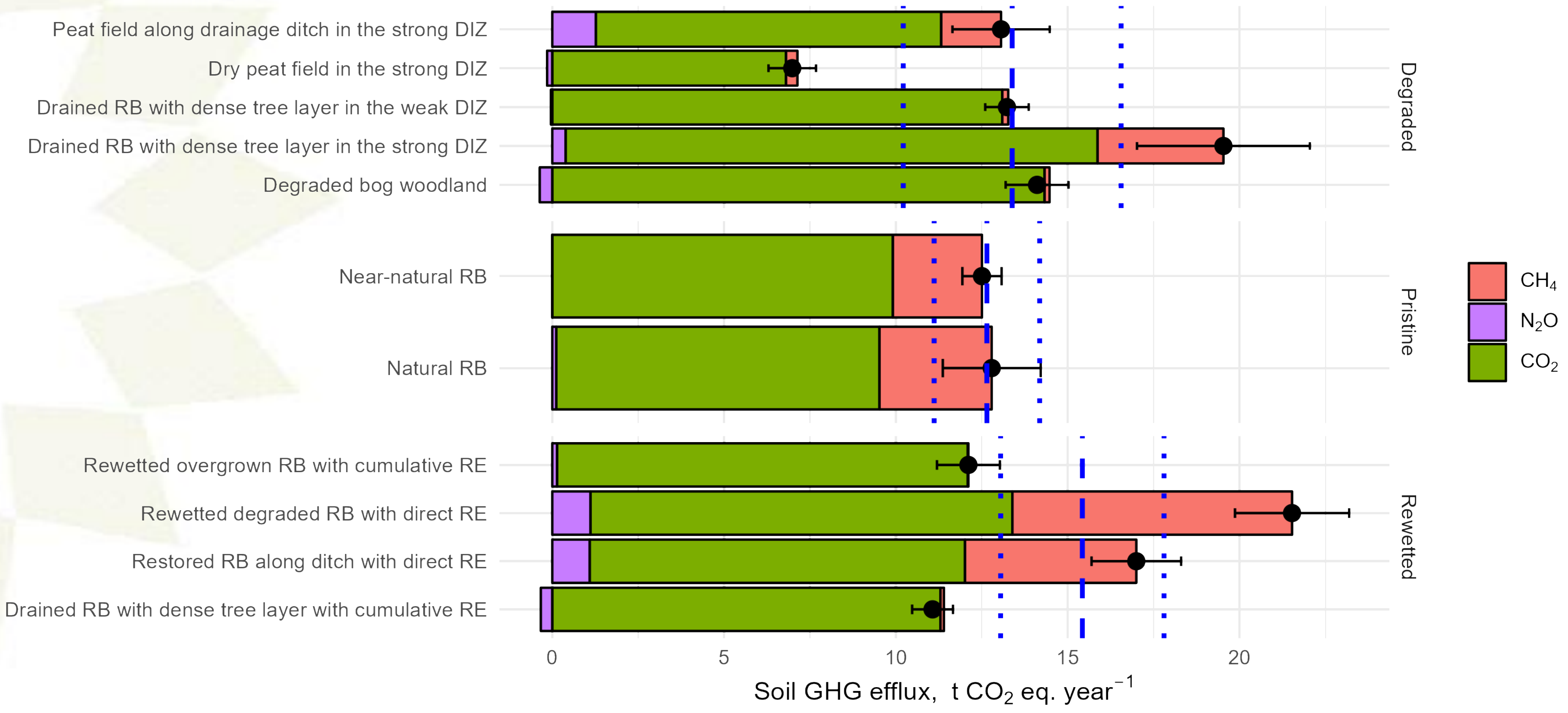

Figure: Annual soil GHG efflux. DTL – dense tree layer; RB – raised bog; DIZ – drainage impact zone; RE – restoration effect.

Annual soil net GHG emissions: habitat approach by types

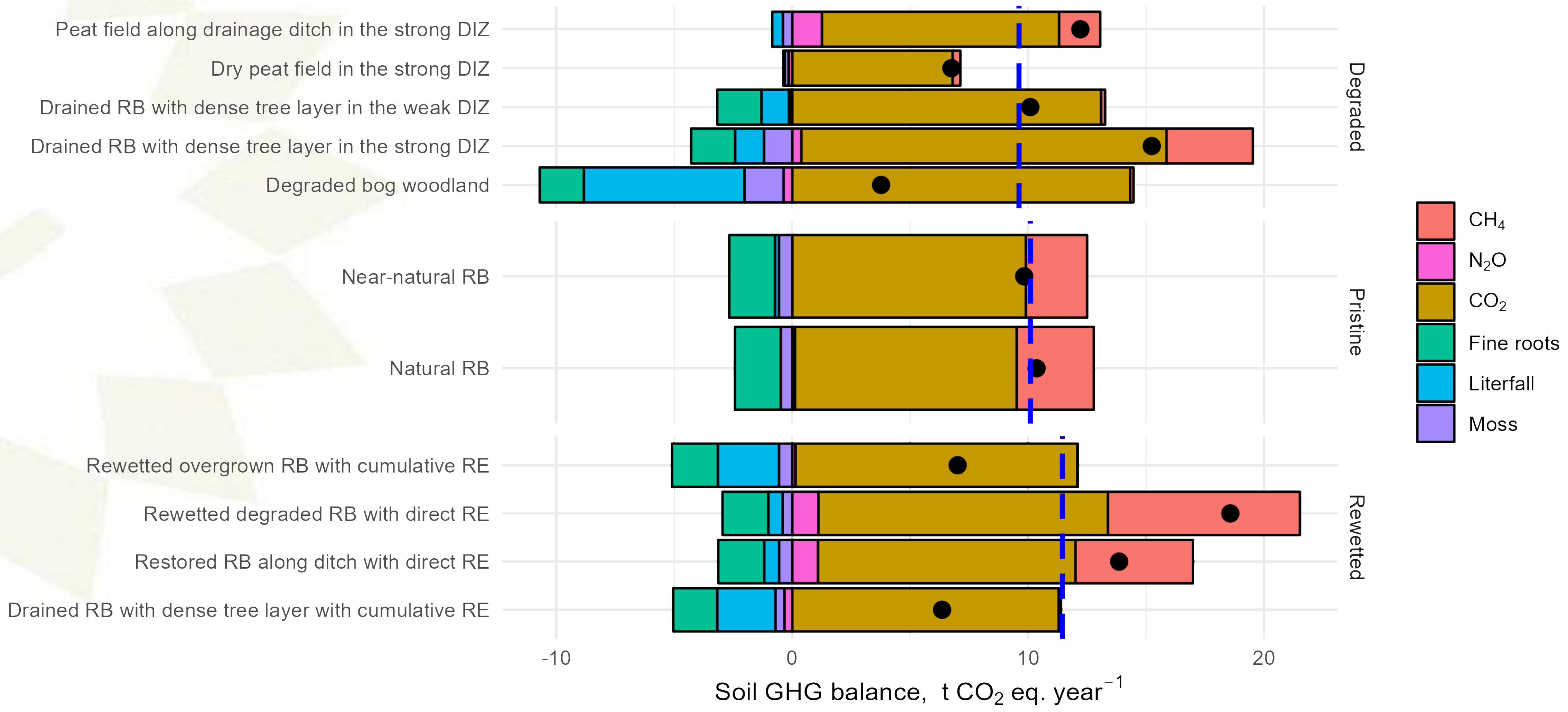

Figure: Annual soil net GHG emissions by different habitats and types
RB – raised bog; DIZ – drainage impact zone; RE – restoration effect

Annual soil net GHG balance: difference compared to drained/degraded habitats to be restored

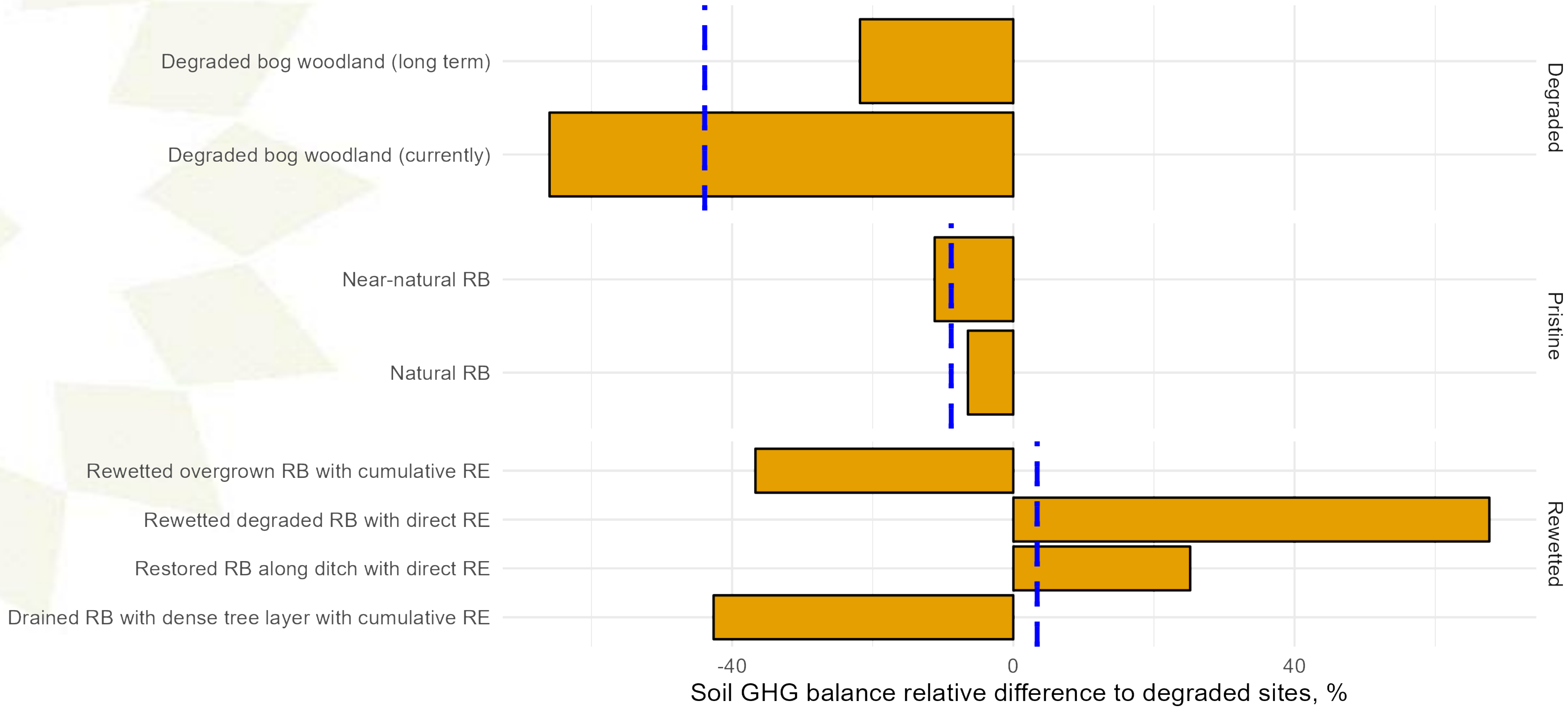

Figure: Difference in annual soil net GHG emissions compared to habitats that correspond to drained, degraded areas to be restored. DTL – dense tree layer; RB – raised bog; DIZ – drainage impact zone; RE – restoration effect.
Negative values indicate lower emissions compared to drained/degraded habitats to be restored

Melnā ezera mire
Degraded bog woodland

Figure: Melnā ezera mire, degraded bog woodland

Annual soil net GHG emissions: habitat approach by mires

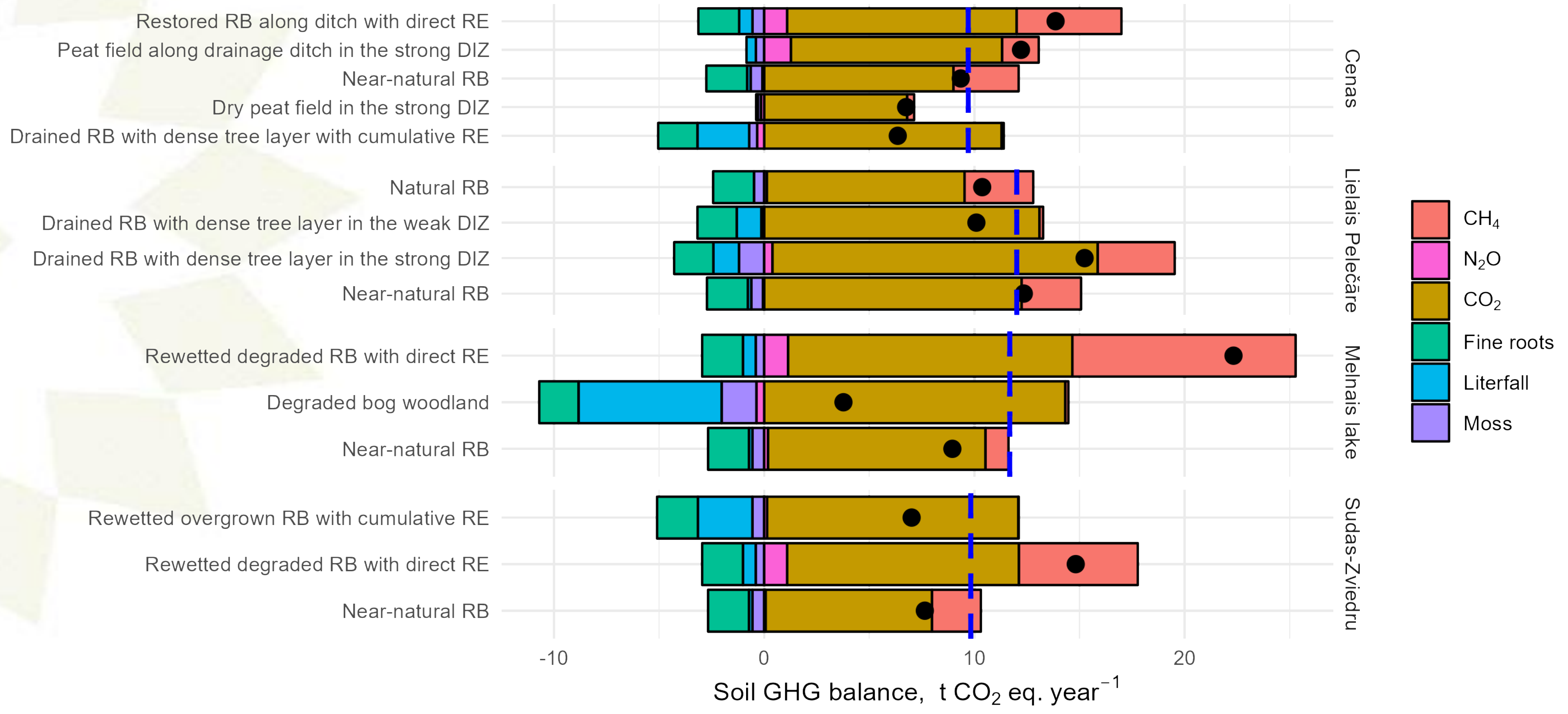

Figure: Annual soil net GHG emissions by different habitats and mires
RB – raised bog; DIZ – drainage impact zone; RE – restoration effect

Cenas mire
Peat field vs. Near-natural raised bog

Annual soil net GHG emissions

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Figure: Cenas mire, peat field along drainage ditch in the strong drainage impact zone

Figure: Cenas mire, Near-natural raised bog

Lielais Pelečāres mire
Drained raised bog vs. Natural raised bog

Annual soil net GHG emissions

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Figure: Lielais Pelečāres mire, drained raised bog with dense tree layer in the strong drainage impact zone

Figure: Lielais Pelečāres mire, natural raised bog

Lielais Pelečāres mire
Drained raised bog vs. Natural raised bog

Annual soil net GHG emissions

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Figure: Lielais Pelečāres mire, drained raised bog with dense tree layer in the weak drainage impact zone

Figure: Lielais Pelečāres mire, natural raised bog

Sudas-Zviedru mire
Rewetted vs. Cumulative restoration effect

Annual soil net GHG emissions

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Figure: Sudas-Zviedru mire, rewetted degraded raised bog with direct restoration effect

Figure: Sudas-Zviedru mire, rewetted overgrown raised bog with cumulative restoration effect

Conclusions

- All studied habitats are **source of net GHG emissions from soil**. A variation in annual soil net GHG emissions was observed across both drained/degraded habitats and restored/rewetted habitats, while variation across natural and near-natural raised bogs was relatively small.

- Across drained/degraded habitats the biggest annual soil net GHG emissions were observed in **drained raised bog with dense tree layer in the strong drainage impact zone**, while the smallest – in **degraded bog woodland**, where effluxes were the most compensated by the C influx with litter compared to all other habitat types.

- The impact of restoring/rewetting drained/degraded raised bog on net GHG emissions from soil can vary depending on initial conditions in the area and further ecosystem development. Thus, in the context of climate change mitigation, restoring/rewetting of drained/degraded raised bog is **recommended in areas where initial conditions show the highest emissions and indicate a potential reduction in net GHG emissions from soil**.

- Estimates of annual net GHG emissions from soil in natural and near-natural raised bogs indicate that rewetting/restoration of drained/degraded habitats (excluding degraded bog woodland) **can contribute to reduction of GHG emissions in long-term**, although **initial impact of rewetting/restoration can be dual** (both increase and decrease of net GHG emissions from soil can be expected).