Sensitivity Study of the Icelandic Atlantis Model

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Introduction

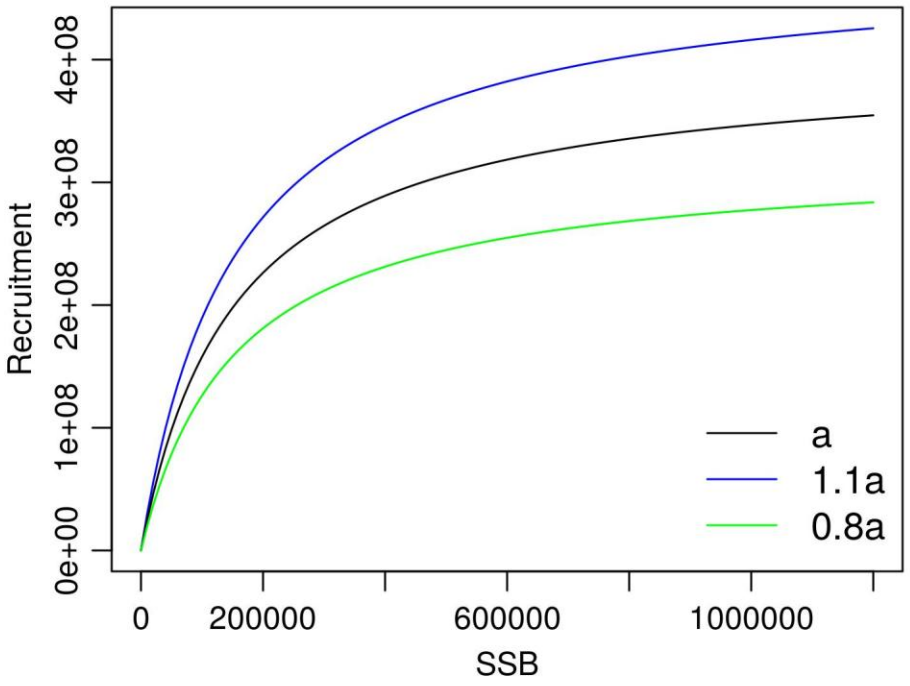
- **Sensitivity analysis can give insight into what parameters contribute to uncertainty in the output.**

- **It can also be helpful in understanding behaviour and functioning of the system.**

Recruitment Parameters

- **Maximum recruitment (α) in the Beverton-Holt function was altered by ±20%**
- **The change in actual recruitment can become >20%.**

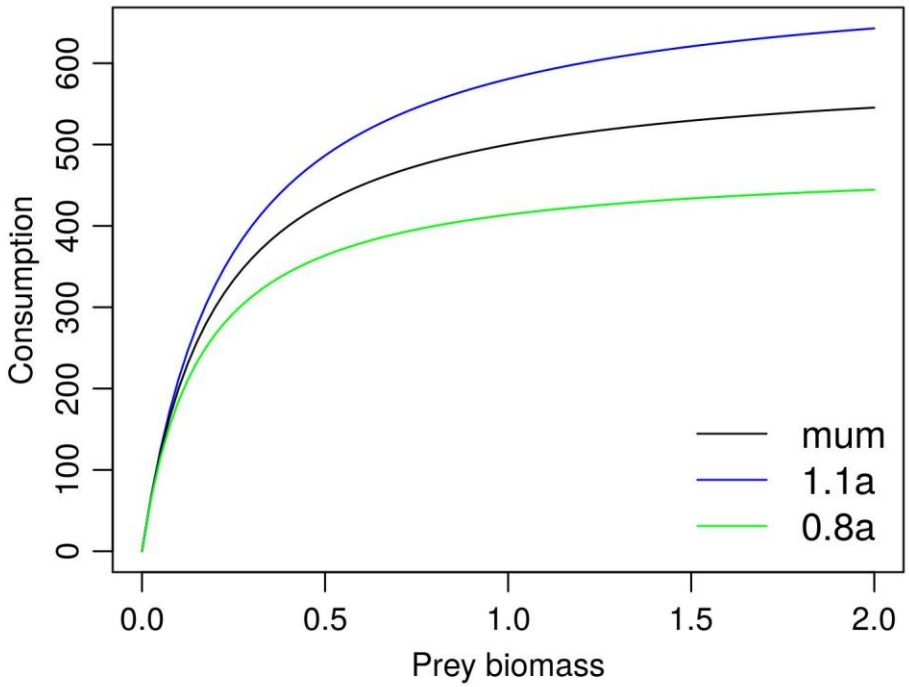
$$Rec = \frac{\alpha * SSB}{\beta + SSB}$$



Growth Parameters

- The maximum growth rate (mum) in Holling II was altered by ±20% for Zooplankton.
- Growth rate for phytoplankton altered by ±20%.
- Interactions between ZL, PS and PL studied.

$$Cons = \frac{C \cdot B}{1 + \frac{C}{mum}[B \cdot E]}$$



Interactions for the growth parameters

Model runs	PS	PL	ZL
Psb_Plb_Zlb	0.70	0.40	0.80
Psb_Plb_Zld	0.70	0.40	0.64
Psb_Plb_Zli	0.70	0.40	0.96
Psb_Pld_Zlb	0.70	0.32	0.80
Psb_Pld_Zld	0.70	0.32	0.64
Psb_Pld_Zli	0.70	0.32	0.96
Psb_Pli_Zlb	0.70	0.48	0.80
Psb_Pli_Zld	0.70	0.48	0.64
Psb_Pli_Zli	0.70	0.48	0.96
Psd_Plb_Zlb	0.56	0.40	0.80
:	:	:	:

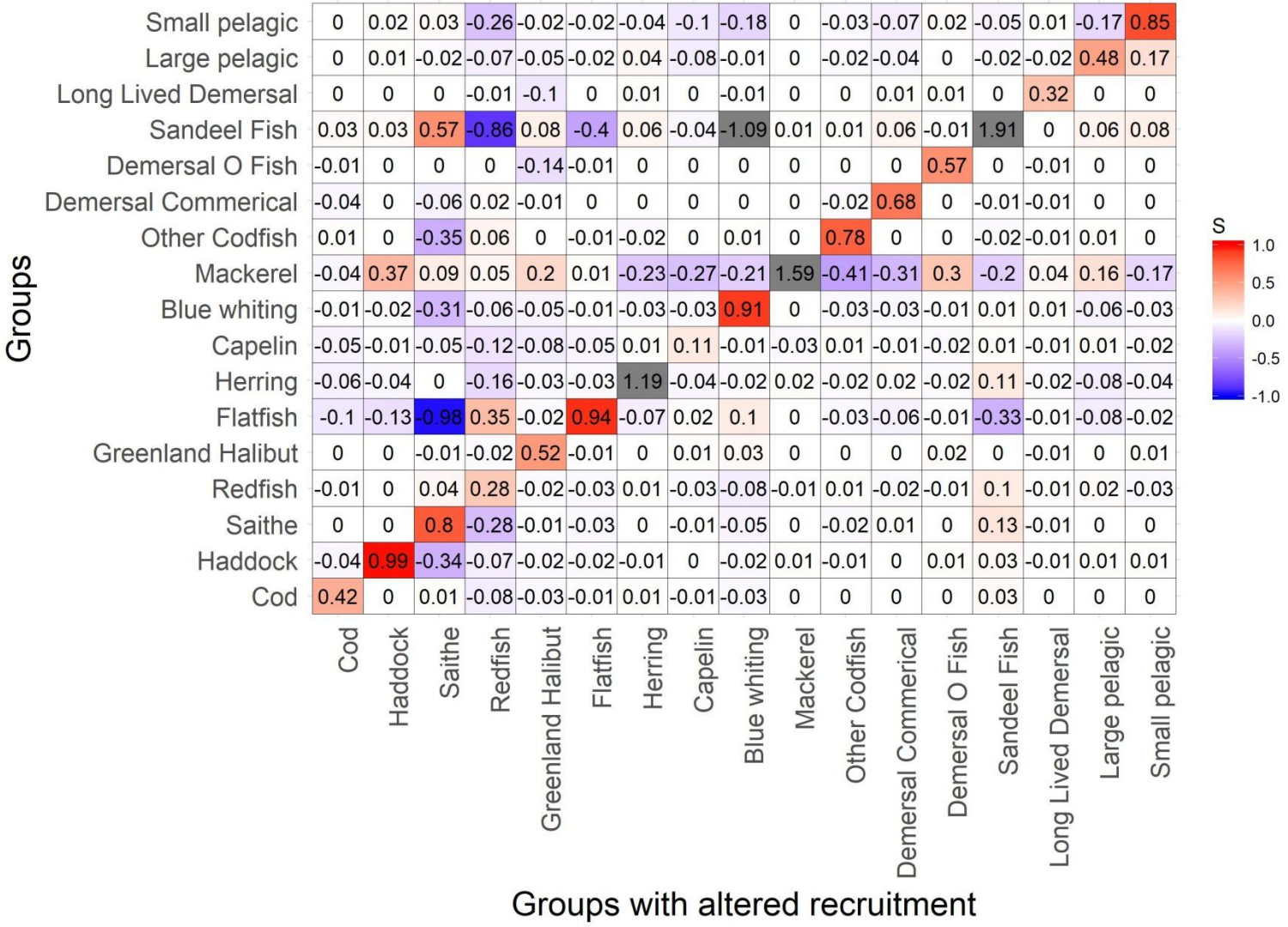
Measure of sensitivity

- **Sensitivity of recruitment parameters measured with:**

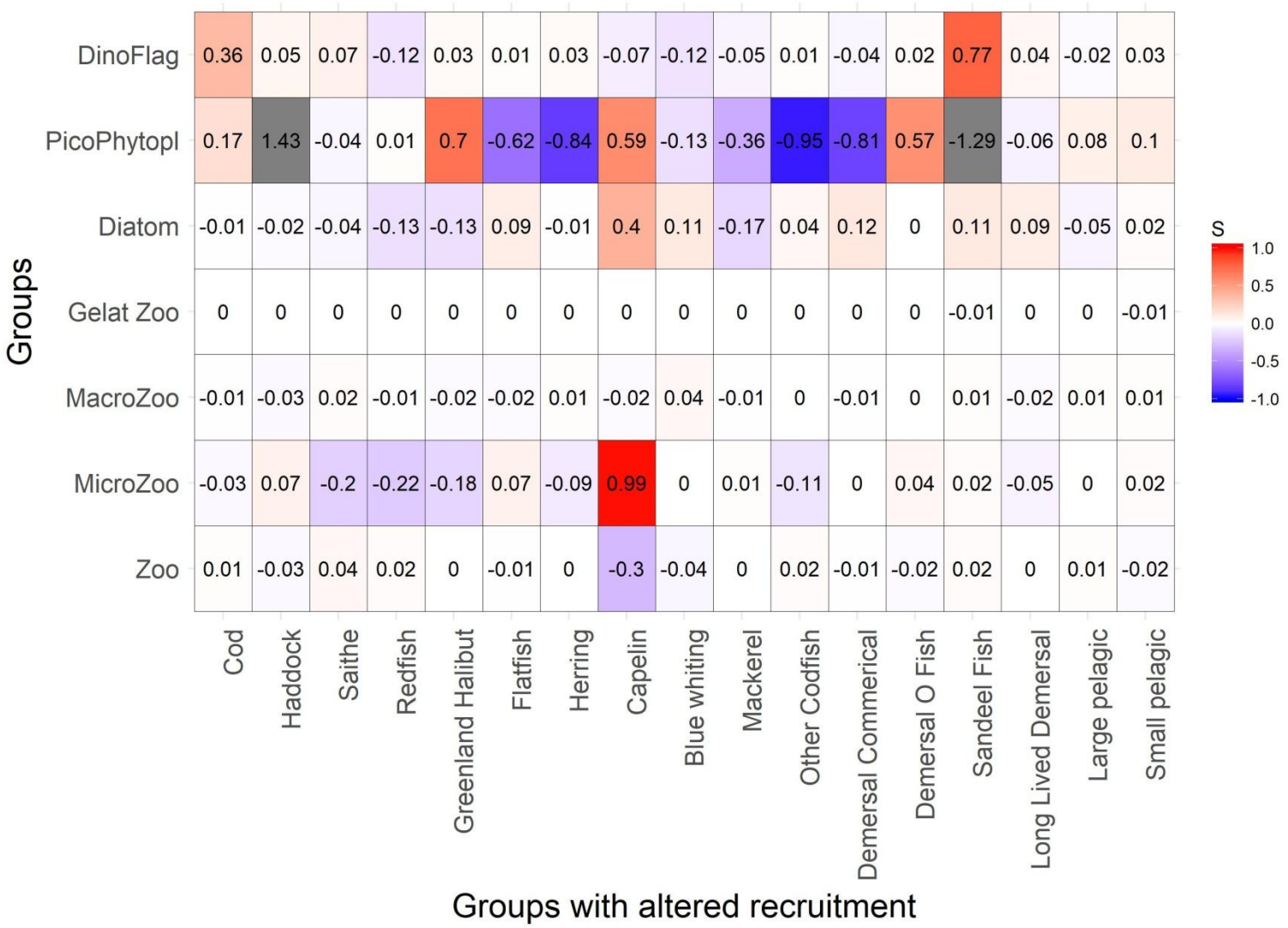
$$S_{ij} = \frac{V_i(1.2\alpha_j) - V_i(0.8\alpha_j)}{0.4V_i(\alpha_j)}$$

- **Sensitivity of growth parameters and their interactions measured with percentage change in biomass.**

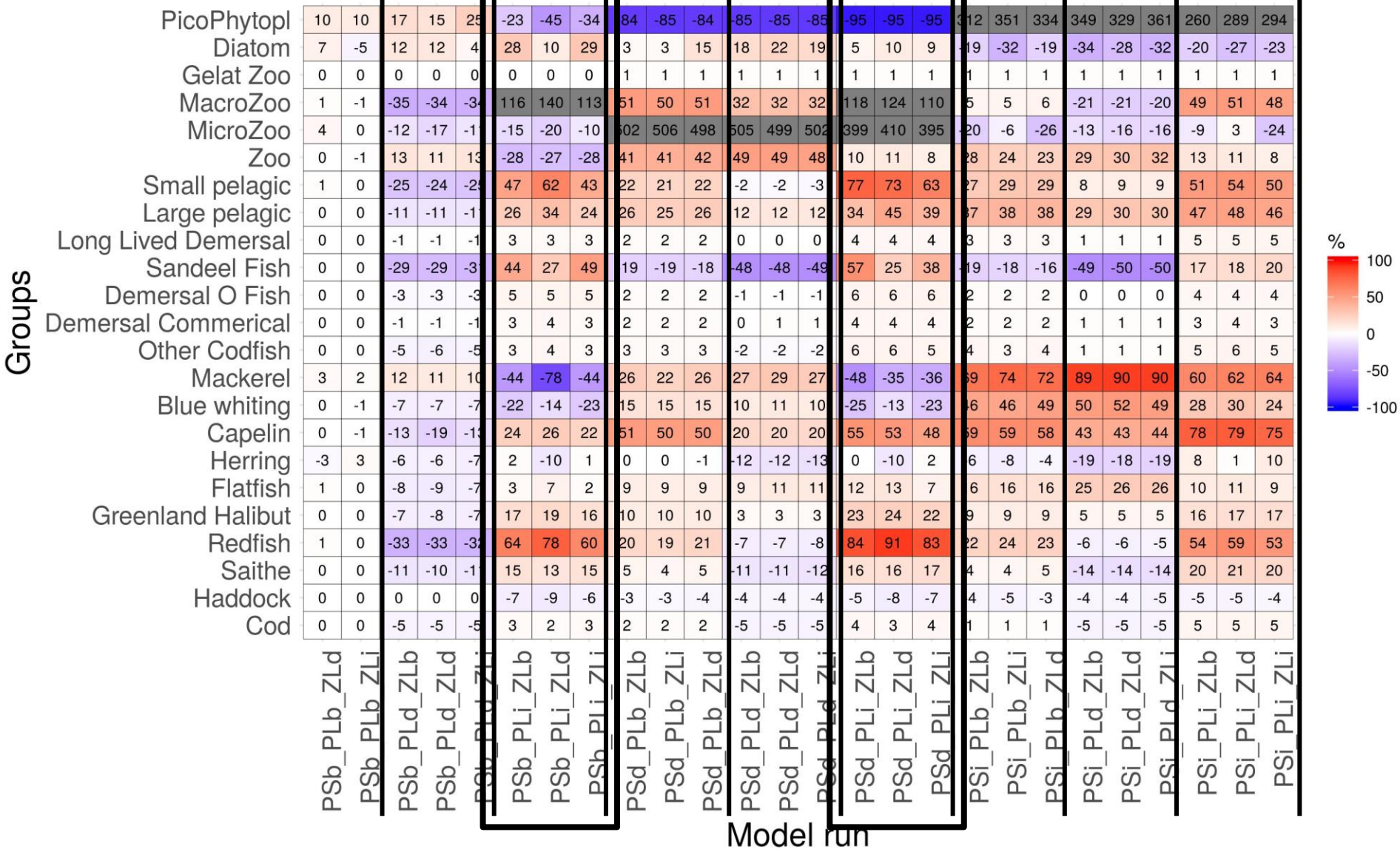
S for fish groups



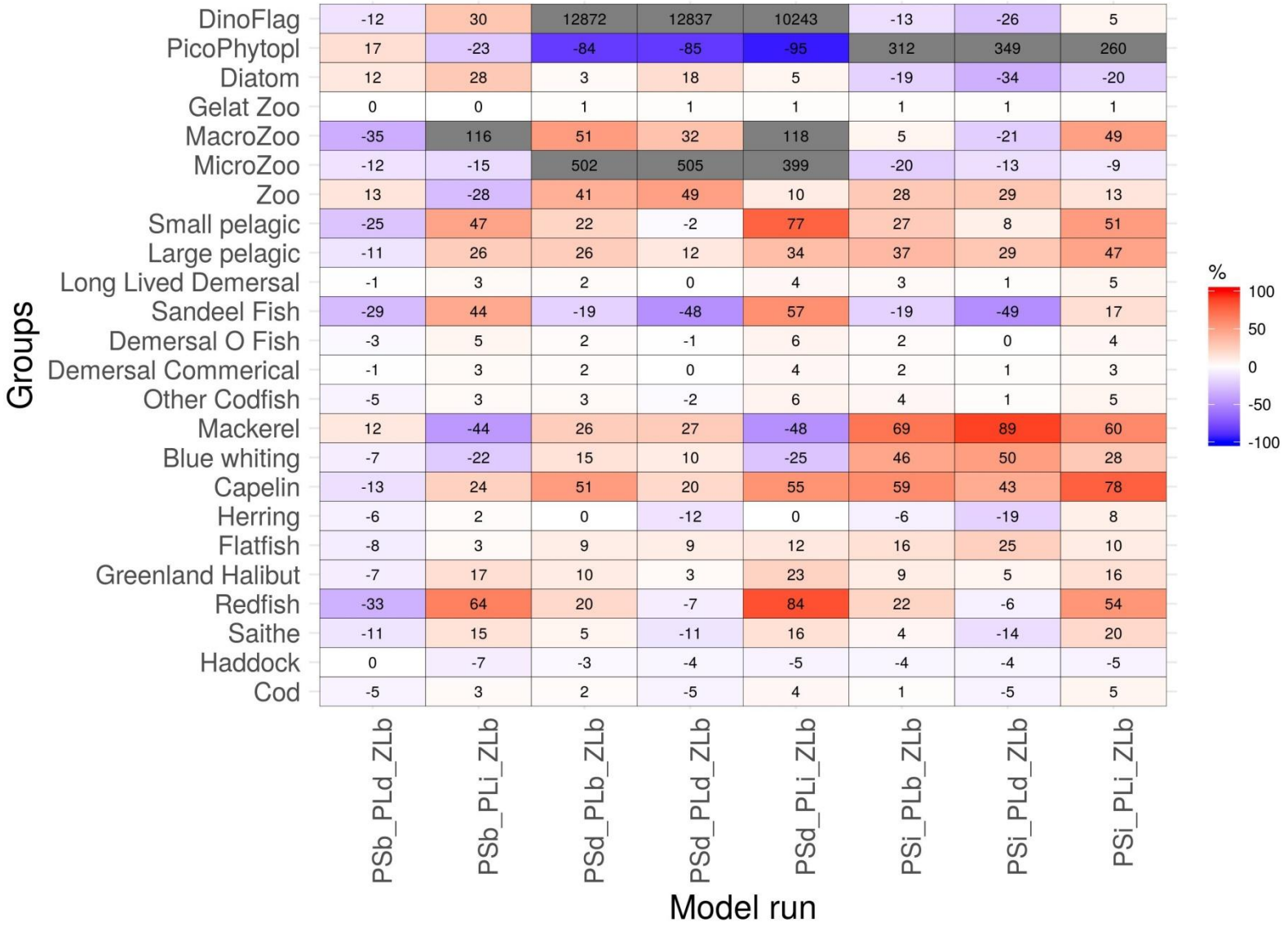
S for plankton groups



% for growth


Groups
PicoPhytopl 10 10 17 15 25 -23 -45 -34 -84 -85 -84 -85 -85 -85 -95 -95 -95 312 351 334 349 329 361 260 289 294
Diatom 7 -5 12 12 4 28 10 29 3 3 15 18 22 19 5 10 9 19 -32 -19 -34 -28 -32 -20 -27 -23
Gelat Zoo 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
MacroZoo 1 -1 -35 -34 -34 116 140 113 51 50 51 32 32 32 118 124 110 5 5 6 -21 -21 -20 49 51 48
MicroZoo 4 0 -12 -17 -11 -15 -20 -10 502 506 498 505 499 502 399 410 395 20 -6 -26 -13 -16 -16 -9 3 -24
Zoo 0 -1 13 11 13 -28 -27 -28 41 41 42 49 49 48 10 11 8 28 24 23 29 30 32 13 11 8
Small pelagic 1 0 -25 -24 -29 47 62 43 22 21 22 -2 -2 -3 77 73 63 27 29 29 8 9 9 51 54 50
Large pelagic 0 0 -11 -11 -11 26 34 24 26 25 26 12 12 12 34 45 39 37 38 38 29 30 30 47 48 46
Long Lived Demersal 0 0 -1 -1 -1 3 3 3 2 2 2 0 0 0 4 4 4 3 3 3 1 1 1 5 5 5
Sandeel Fish 0 0 -29 -29 -31 44 27 49 19 -19 -18 -48 -48 -49 57 25 38 19 -18 -16 -49 -50 -50 17 18 20
Demersal O Fish 0 0 -3 -3 -3 5 5 5 2 2 2 -1 -1 -1 6 6 6 2 2 2 0 0 0 4 4 4
Demersal Commerical 0 0 -1 -1 -1 3 4 3 2 2 2 0 1 1 4 4 4 2 2 2 1 1 1 3 4 3
Other Codfish 0 0 -5 -6 -5 3 4 3 3 3 3 -2 -2 -2 6 6 5 4 3 4 1 1 1 5 6 5
Mackerel 3 2 12 11 10 -44 -78 -44 26 22 26 27 29 27 -48 -35 -36 69 74 72 89 90 90 60 62 64
Blue whiting 0 -1 -7 -7 -7 -22 -14 -23 15 15 15 10 11 10 -25 -13 -23 46 46 49 50 52 49 28 30 24
Capelin 0 -1 -13 -19 -13 24 26 22 51 50 50 20 20 20 55 53 48 59 59 58 43 43 44 78 79 75
Herring -3 3 -6 -6 -7 2 -10 1 0 0 -1 -12 -12 -13 0 -10 2 6 -8 -4 -19 -18 -19 8 1 10
Flatfish 1 0 -8 -9 -7 3 7 2 9 9 9 9 11 11 12 13 7 6 16 16 25 26 26 10 11 9
Greenland Halibut 0 0 -7 -8 -7 17 19 16 10 10 10 3 3 3 23 24 22 9 9 9 5 5 5 16 17 17
Redfish 1 0 -33 -33 -32 64 78 60 20 19 21 -7 -7 -8 84 91 83 22 24 23 -6 -6 -5 54 59 53
Saithe 0 0 -11 -10 -11 15 13 15 5 4 5 -11 -11 -12 16 16 17 4 4 5 -14 -14 -14 20 21 20
Haddock 0 0 0 0 0 -7 -9 -6 -3 -3 -4 -4 -4 -4 -5 -8 -7 4 -5 -3 -4 -4 -5 -5 -5 -4
Cod 0 0 -5 -5 -5 3 2 3 2 2 2 -5 -5 -5 4 3 4 1 1 1 -5 -5 -5 5 5 5
PSb_PLb_ZLd
PSb_PLb_ZLi
PSb_PLd_ZLb
PSb_PLd_ZLd
PSb_PLi_ZLb
PSb_PLi_ZLd
PSb_PLi_ZLi
PSd_PLb_ZLb
PSd_PLb_ZLi
PSd_PLb_ZLd
PSd_PLd_ZLb
PSd_PLd_ZLd
PSd_PLi_ZLb
PSd_PLi_ZLd
PSd_PLi_ZLi
PSi_PLb_ZLb
PSi_PLb_ZLi
PSi_PLb_ZLd
PSi_PLd_ZLb
PSi_PLd_ZLd
PSi_PLi_ZLb
PSi_PLi_ZLd
PSi_PLi_ZLi
Model run
%
100
50
0
-50
-100

% change in Biomass for growth paramaters



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