Table S1. Descriptions of model edges (linkages) for the extended WAP model (Fig. 1B, main text). Weights refer to positive (=1) and negative (=-1) effects from one model component to another. Shaded rows indicate uncertain linkages.

| **From** | **To** | **Weight** | **Sources** | **Notes** |
| --- | --- | --- | --- | --- |
| Warming | Sea ice | -1 | [1,2] |  |
| Warming | Chinstrap penguins | -1 | [3] | (a) |
| Warming | Adélie penguins | -1 | [3] | (a) |
| Warming | Small phytoplankton | 1 | [4] | (b) |
| Warming | Large phytoplankton | -1 | [4] | (b) |
| Sea ice | Chinstrap penguins | -1 | [5,6] | (c) |
| Sea ice | Adélie penguins | 1 | [5,6] | (c) |
| Sea ice | Salps | -1 | [7] |  |
| Sea ice | Larval krill | 1 | [8,9] |  |
| Salps | Larval krill | -1 | [10] |  |
| Salps | Small phytoplankton | -1 | [4] |  |
| Larval krill | Salps | 1 | [10] |  |
| Larval krill | Fish | 1 | [11] |  |
| Larval krill | Adult krill | 1 |  | (d) |
| Trophic competitors | Fish | -1 | [12] |  |
| Trophic competitors | Chinstrap penguins | -1 | [5] | (e) |
| Trophic competitors | Adélie penguins | -1 | [5] | (e) |
| Trophic competitors | Adult krill | -1 | [5,12] |  |
| Krill fishery | Adult krill | -1 |  |  |
| Fish | Larval krill | -1 | [11] |  |
| Fish | Adult krill | -1 | [11] |  |
| Fish | Trophic competitors | 1 | [12] |  |
| Fish | Chinstrap penguins | 1 | [5,13,14] | (f) |
| Fish | Adélie penguins | 1 | [5,13,14] | (f) |
| Large phytoplankton | Adult krill | 1 | [4] |  |
| Small phytoplankton | Salps | 1 | [4] |  |
| Chinstrap penguins | Fish | -1 | [5,13,14] | (f) |
| Chinstrap penguins | Adult krill | -1 | [5,15] |  |
| Adult krill | Larval krill | 1 |  |  |
| Adult krill | Trophic competitors | 1 | [5,12] |  |
| Adult krill | Fish | 1 | [11] |  |
| Adult krill | Large phytoplankton | -1 | [4] |  |
| Adult krill | Chinstrap penguins | 1 | [5,15] |  |
| Adult krill | Adélie penguins | 1 | [5,15] |  |
| Adélie penguins | Fish | -1 | [5,13,14] | (f) |
| Adélie penguins | Adult krill | -1 | [5,15] |  |

1. Effect of chick wetting due to increased precipitation or snow-melt in colonies under regional warming
2. Mediated by decreased nearshore salinity due to increased meltwater
3. Chinstrap penguins forage in ice-free water during winter while Adélie penguins favor pack-ice habitat in winter
4. Krill reproduction and recruitment
5. One-way interference competition for krill prey
6. Fish comprise a low percentage of penguin diets (≤5%)

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