*Avoiding tradeoffs between global wild seafood production and seafloor impacts through fisheries innovation*

T. Scott Smeltz, Suresh A. Sethi, Bradley Harris, Jonathan Grabowski, Olaf P. Jensen, Christopher M. Free

**Supplemental Methods**

*Standardizing recovery rates*

Recovery of seafloor habitats was parameterized as the time to recover from 5% to 95% () following an asymptotic recovery trajectory. Three benthic recovery meta-analyses (Graham *et al.*, 2011; Grabowski *et al.*, 2014; Hiddink *et al.*, 2017) were used parameterize for soft, hard, and rocky reef seafloor habitat types. However, each of these analyses employed different recovery trajectories in their estimation of recovery. Grabowski et *al*. reported the mean time to recovery (; Hiddink et *al*. estimated an intrinsic growth rate, , of a logistic recovery curve; and Graham et *al.* reported the yearly proportional recovery, , along a linear recovery path, equivalent to the slope of the recovery line. In order to standardize recovery rates across these analyses, we calculated from each of the respective recovery functions. In the following equations we set and , representing recovery from 5% to 95%.

The Hiddink et al. parameter was converted as:

|  |  |  |
| --- | --- | --- |
|  |  | (S.1) |

The Graham et al. parameter was converted as:

|  |  |  |
| --- | --- | --- |
|  |  | (S.2) |

The Grabowski et al.   parameter was converted to recovery parameter then calculated from as follows:

|  |  |  |
| --- | --- | --- |
|  |  | (S.3) |

Table S1. Reported recovery times from meta-analyses

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Habitat type | Source | Reported value | Description of value | equivalent  (years to recover from 5% to 95%) |
| Soft substrate | Hiddink et al. |  | Recovery to pre-trawl biomass | 7.2 |
|  | Recovery to pre-trawl abundance from otter trawls | 5.6 |
|  | Recovery to pre-trawl abundance from beam trawls | 1.3 |
| Grabowski et al. |  | High energy mud habitats | 9.6 |
|  | High energy sand habitats | 9.2 |
|  | High energy granule/pebble habitats | 8.8 |
|  | Low energy mud habitats | 9.7 |
|  | Low energy sand habitats | 9.3 |
|  | Low energy granule/pebble habitats | 9.3 |
| Hard substrate | Grabowski et al. |  | High energy cobble habitats | 8.69 |
|  | High energy boulder habitats | 8.57 |
|  | Low energy cobble habitats | 9.13 |
|  | Low energy boulder habitats | 9.01 |
| Rocky reef | Graham et al. |  |  | 25.28 |

*Calculating effort aggregation within Large Marine Ecosystems (LME)*

One of the key factors influencing how effective reducing contact may be at reducing seafloor disturbance within an LME is the level of aggregation of fishing effort within the LME. Generally, LMEs more highly aggregated fishing effort will not see as substantial reductions in seafloor disturbance compared to LMEs with more disbursed fishing effort. This principle is demonstrated in the figure below by showing the percent reduction in seafloor disturbance within an LME for 20% and 40% contact reduction scenarios against the level of spatial aggregation within the LME. Aggregation of fishing effort is quantified by an aggregation coefficient, , which is calculated as:

|  |  |  |
| --- | --- | --- |
|  |  | (S.4), |

where is the is the footprint of fishing effort within an LME as a proportion of the total LME area, and is the swept area ratio of the LME. Here we define the footprint, , as the proportion of the seafloor that fishing covers with spatially overlapping fishing events removed. is quantiifed based on the assumption that fishing effort is randomly distributed within 2 km x 2km, and is calculated as:

|  |  |  |
| --- | --- | --- |
|  |  | (S.5), |

where is the swept area ratio within grid cell, , of total grid cells within the LME. The total swept area of the LME, , is simply the mean swept area of all grid cells in the LME:

|  |  |  |
| --- | --- | --- |
|  |  | (S.6). |

For more details on the derivation and use of , see Smeltz et al. 2019.