Decision Support Tool

**Step 2: Identify responses, drivers and the design**

The [Decision Support Tool](https://meddle-scor149.org/decision-support-tool/) is a 3-step guide to help you plan your multiple driver research. Each step of the guide takes you through a different stage of the planning process: (1) define the research question, **(2) identify responses, drivers and the design** and (3) finalise the design. For more information see the complete resources for the *Best Practice Guide for Multiple Drivers Marine Research* on the [MEDDLE website](https://meddle-scor149.org/).

**Part 1: What is the nature of the study?**

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| *Mechanisms* vs *scenarios*Will this be a study to understand the *mechanisms* of the response under study?* Do you want to understand a dose-response relationship or identify a tipping point? If so, you will need to gain detailed biological knowledge (physiological response curves, tolerance ranges, ecology, behaviour, biochemistry, etc.).

Or do you want to know how species or ecosystems will respond to different environmental *scenarios* (future combinations of drivers)? * Do you want to predict a response under two, or a range of, IPCC scenarios? If so, you will need access to regionally relevant environmental forecasts.

Note: you may be able to combine these two approaches, but this will limit your choice of treatments. See the open access article [*Experimental strategies to assess the biological ramifications of multiple drivers of global ocean change - A review*](https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.14102) for more detail.  |  |
| What are the relevant spatial scales? This may range from nanometer to global. |  |
| What are the relevant temporal scales?* Past, present or future?
* Seconds or millennia?
* Will you include environmental variability on diurnal, seasonal, or decadal scales?
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| How many experimental units will you have (i.e. total number of all replicates)? Your answer to this will define much of your experimental design. If you have relatively few units (≤ 10), consider using:* a *regression* design with many driver levels, but only one or two replicates per level. This may be appropriate for a mechanistic study.
* a *scenario* design to study responses to different future combinations of drivers.
* a *collapsed* design to study the cumulative, combined effects of multiple drivers operating together.

If you have many more units, or your question relates to a number of specific levels of a driver, consider using:* a *full factorial* design to study all individual effects and interactions.
* a *major vectors* design to study both the responses to individual drivers and a scenario of combined effects.

See the [Experimental Design](https://www.youtube.com/watch?v=AthzYRVIFyw&t=3s) and [Data Analysis](https://www.youtube.com/watch?v=hH_3NZFW7EI) video tutorials for more information. |  |

**Part 2: What biological responses are most relevant?**

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| Which specific biota will you study? This may include ecosystems, communities, species, genetic strains and different life stages. |  |
| Which specific biological responses and/or traits will you measure? * How will you measure them?
* Do you have the necessary tools to measure them?
* After what time of exposure do you expect a response?
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| Are the parameters listed above the most relevant or most tractable responses and/or traits? * Are more easily measured variables available that can be used as a proxy? For example, can change in ash weight be used instead of rate of calcification?
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| What additional biological processes / parameters may affect the responses?* Are there age or sex specific differences?
* Will you be able to adequately acclimatize your organism(s)?
* Do you expect responses to differ between locations and populations?
* Does the presence of mates, predators, competitors, shelter, or other variables (e.g. light) alter the response?
* Are any of the above processes and parameters essential to measure? For example, they may explain a large proportion of the variation in your response. Alternatively, you may be able to avoid them.
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**Part 3: Which driver(s) are most relevant?**

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| What specific driver/s you want to measure or manipulate? * Have you done an inventory of regionally relevant drivers? This may include local, regional and/or global drivers.
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| Do adequate environmental or field data already exist to tell you what you need to know, so you don’t need to measure them yourself? See the *Handbook* on the[MEDDLE website](https://meddle-scor149.org/) (“DOWNLOAD HANDBOOK” link) for more information about accessing data through remote sensing tools and marine observing systems.  |  |
| If adequate environmental or field data does not exist, how will you measure these drivers? List specific tools you will use. |  |
| Are other drivers more easily measured or more tractable and can be used as proxy for the driver you’re interested in?For example, it may be easier to measure Secchi depth instead of analysis of suspended solids, or pH and alkalinity instead of pH and pCO2. |  |
| For exposure experiments: what are their regionally environmentally relevant levels?* Do you have access to the regional conditions (climatology)?
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| Do you need to measure additional drivers? * What secondary drivers may be altered by your primary driver?
* For example, a change in temperature alters the carbonate saturation state. Or, the food quality for your focal species may be affected by your driver.
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Next task: complete Step 3 of the [Decision Support Tool](https://meddle-scor149.org/decision-support-tool/).

