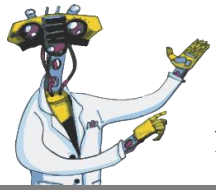


Developing a driver inventory

Tutorial: The Developing a driver inventory video tutorial can be found on the MEDDLE for Multiple Drivers Research YouTube channel.

Speaker: Philip Boyd, Institute for Marine and Antarctic Studies, University of Tasmania, Australia.

Video: Christina McGraw, University of Otago, New Zealand

Transcripts: Rebecca Zitoun, University of Otago, New Zealand

Resources: The complete resources for the *Best Practice Guide for Multiple Drivers Marine Research* are available on the MEDDLE website.

0:00 - *Introduction*

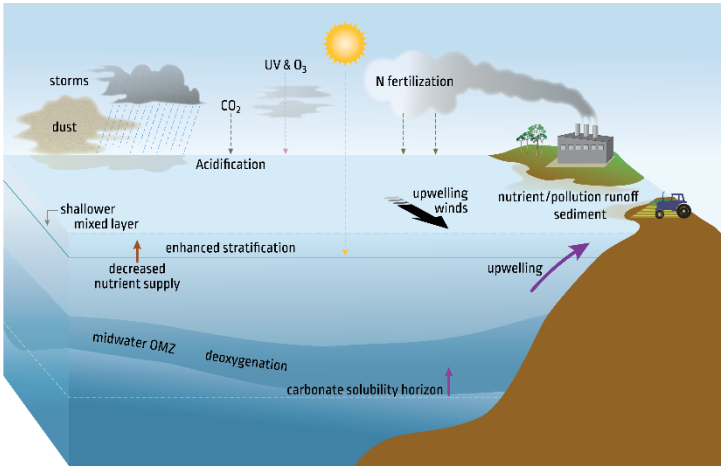
This tutorial is really about getting started in multiple driver research. What we'd like to do here is try and get you started with confidence and guide you through some of the pit falls, because it can be very intimidating.

The reason this might be off putting is because there any many different permutations. We have multiple drivers. And by multiple drivers that could be 4 or 5 or 6 or even 10 and those drivers will vary from region to region, they may even vary from month to month.

0:35 – *Step 1: Make a list of all potential environmental drivers*

Make a list of all of the potential environmental drivers in your particular location, or with the species and the community that you are looking at. Or, the season that you are looking at, because each of these factors will influence what that list of drivers will be.

In the cartoon you can see the ocean (*0:52 min*). On the left hand side, we have the open ocean, on the right hand side we have the near shore coast, right by the land. There are a couple of points to take from this.



Text (1:03): The suite of drivers you consider will depend on your location.

Depending on where you are in the ocean you are going to see a different set or suite of drivers. On the left hand side, we have many drivers which may be more influenced by climate change. But be careful, on the right hand side we also have other anthropogenic pressures such as eutrophication, sedimentation from increased rainfall and runoff, and point-source pollutants. So don't just always target the obvious climate change factors like acidification.

Text (1:22): Don't forget other anthropogenic drivers, such as eutrophication, sedimentation and point-source pollution.

1:29 – *Step 2: Use your driver inventory to start to build an experimental design.*

Build an experimental design by trying to rank the drivers and see which one is the most important, which is perhaps the one of least consequence. But again by starting in this manner it means that you are not going to miss anything and a year into your research you won't think '*maybe I should have thought more about anthropogenic pollutants*' or '*I should have considered sedimentation or some other factor'*.

1:55 – *Example: Developing a driver inventory for the Southern Ocean.*

The example I will give you is actually one just south of Tasmania here, where we are making this video. I work in the Southern Ocean, several thousand kilometres from land, so I don't have to worry about things like point-source pollutants or about run-off and

sedimentation events. But nonetheless, when I started to look at my list of drivers there were quite a few. I counted at least 5. For example: temperature, CO_2 and hence acidification, nutrients, trace metals such as iron, and also just the light climate.

Text (2:18): Drivers in Philip's region include: temperature, CO_2, and acidification, nutrients, trace metals, light.

All of these climate change variables will alter in the coming decades and alter considerably. So there are five [drivers] to begin with. If I look at those with a range of treatment levels, I am looking at hundreds to possibly thousands of different permutations. And that is even without having any replication.

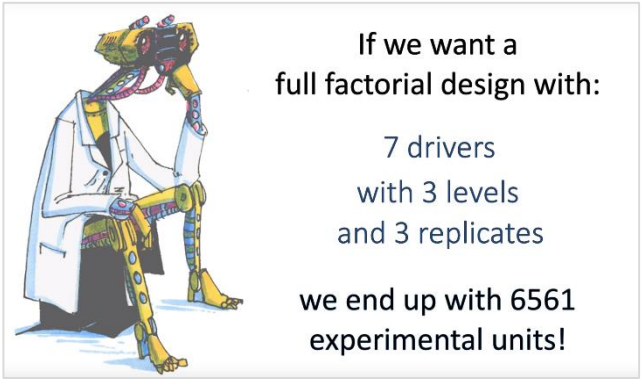
Text (2:36): With FIVE drivers and THREE levels per driver, a full factorial requires 143 permutations! With FIVE drivers and FIVE levels per driver, a full factorial requires 3125 permutations!

2:44 – *Step 3: Identify the dominant driver(s) from your inventory list*

We have our list of drivers and then the next step in terms of getting started is to try and find out which driver is dominant or in some cases several drivers maybe co-dominant. Two or three [drivers] may have an equal role.

In our case, we were able to look at the literature, they were around 50 publications and they pointed us towards temperature being the ultimate driver. But again, many of these studies were not from South of Tasmania. Some of them were from the Atlantic sector of the Southern Ocean, were conditions may be subtly different. So again, you have to be very careful and cast a critical eye over these publications. But again, we took temperature and we decided then to carry out a further experiment to try and make sure that we were moving into the right direction with our experimental design.

3:34 – *Step 4: Simplify your experiment by focusing on the dominant drivers*



You can very simply calculate the number of permutations. It is called doing a factorial. It is a very simple mathematical calculation. You will find that something like a factorial 7 will give you over 5000 different permutations.

3:52 – Summary

So it is very easy to dial that up in terms of the interplay of different drivers, and also the interplay of treatment levels. Again, never mind replication. And so clearly we have to be clever in our design. We have to try and work out what drivers will be in our inventory and which are the most important drivers. The key thing to bear in mind is that it is all about location, location, location or season, season, season.

Text (4:15): Location, location, location

There are many permutations, they are constantly shifting around, and what might be your driver inventory might differ considerably from someone in the next lab, who might be working on a different organism, or different community. And so, when you meet at coffee and you are both doing studies differently, don't be alarmed, because that is just the nature of this. So it is a case of really keeping an open mind, looking very carefully and diligently. This is the first step towards your comprehensive and valuable experimental design.