THE PERMACULTURE

RESEARCH HANDBOOK

EDITED BY PIPPA CHAPMAN, ROSIE SINFIELD AND CHRIS WARBURTON BROWN

The Permaculture Research Handbook.

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Author Biographies

Pippa Chapman is a horticulturalist, permaculture practitioner and mother of 2. She manages a permacultre smallholding in Steeton, West Yorkshire with her husband where they run trials and experiments in sustainable food growing, in particular polycultures. The idea for the handbook came from a lack of research experience but a desire to design simple research to discover what really works in permaculture. The layout of the handbook was designed as part of her Diploma in applied permaculture design.

Dr Chris Warburton Brown is the Permaculture Association's first Research Coordinator. Current projects include a 10 year forest gardens research project, building an international permaculture research network, maintaining the *Permaculture Research Digest*, creating the Permaculture Knowledge Base, setting up the National Permaculture Library, organising member trials of wheat and soya growing, and developing soil, biodiversity and yield tests for permaculture systems. He holds a Ph.D. in Urban Studies from the University of Glasgow. Previous jobs include community development, teaching history and archaeology, a range of anti-poverty work, selling organic food, and biodynamic dairy farming. He lives in Newcastle upon Tyne with his wife and two daughters.

Rosie Sinfield is currently studying for her Masters in Activism and Social Change at Leeds University. She came to work as editor for The Permaculture Research Handbook as part of this course, completing a work based placement at the Permaculture Association. Rosie is a keen social researcher, having completed her undergraduate degree in Sociology at UWE in Bristol. Her main topics of interest revolve around issues of social justice, including homelessness, food security, and gender equality. Rosie came to be interested in permaculture in line with this interest in social justice. She completed her Permaculture Design Course in Portugal last year whilst living and working on farms practicing permaculture.

Tomas Remiarz has over 15 years experience in permaculture design, teaching and practice, having worked in the UK and various European countries. Over the years, he has been active in many different fields, with an emphasis on the restoration of land, buildings and communities. During his time as a chair and trustee of the Permaculture Association, he initiated and coordinated the creation of the organisation's first research strategy. He has been involved in setting up participatory trials for vegetable polycultures and forest gardens, and is currently researching the application of the forest garden concept. He lives in an eco-community in the Welsh borders.

Dr Naomi Van Der Velden is a plant ecologist at the University of Cumbria. She has a passion for forest ecosystems, but has expanded her research to include agroecosystems including polycultures, forest gardens and community participation. After completing her PhD in forest ecology, she spent two years exploring the world's natural ecosystems, ranging from Amazonian rainforest to the Great Barrier Reef. Naomi is the lead researcher for the Cumbria Forest Food Network, investigating local food production in forest ecosystems. She led The Permaculture Association's first participatory mixed vegetable growing trials in 2011. Naomi has recently begun working in Nepal, investigating the impact of permaculture initiatives on subsistence-level farmers.

Dr Jan Martin. With a PhD in ecology and a Masters degree in education, Jan has experience of a broad spectrum of research. Amongst other things, she teaches statistics and survey techniques to adult learners studying conservation management at Aberystwyth University and is a scientific editor. She is also co-author of *A Scientific Approach to Scientific Writing* – a guide to producing good-quality scientific documents, published by Springer in 2011. Since completing her Permaculture Design Course in 2009, she has been keen to bring a more rigorous approach to collecting data in order to demonstrate the true value of permaculture techniques.

Ed Sears chairs the Research Advisory Board at the Permaculture Association, helping to develop a published evidence base for permaculture. Until recently he was a trustee of the Association, is a trustee of Plants For A Future and an honorary member of the Earth System Science group at Exeter University. He is a director of T4 Sustainability Ltd, where he designs and installs PV arrays and biomass heating systems. These activities share the common theme of using the sun to produce sustainable supplies of food and energy, while preserving and enhancing biodiversity. He has been putting his ideas into practice for the last 17 years at Earth Heart Housing Co-operative in Derbyshire.

Dr Rachel Bailey has a degree in Zoology from University College London and a PhD in environmental toxicology from The University of St Andrews. She has worked as a research scientist in a variety of fields (environmental pollution in marine mammals, muscle biology, and heart disease) and gained practical experience in experimental design and sharing the results. For one of her permaculture diploma designs, she developed a guideline to help those interested in permaculture research understand the basics of experimental design, which led to her collaboration with Pippa Chapman on this research handbook. Currently, she is interested in helping others design their experiments.

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Appendices

Introduction: **Using a permaculture design cycle to conduct your research project**

Tomas Remiarz, Permaculture Designer and Teacher.

This introduction will help you to:

- get an overview of the way this handbook is organised
- understand what SADIMETS means
- see how the SADIMETS approach mirrors the research cycle

“Research” can be a scary concept for some of us, bringing to mind lab-coated figures staring intently at test tubes to come up with some impenetrable formula.

In truth, however, research is all around us.

Children at play for example often wonder: “what happens if I do x?” followed by an exploratory action and consideration of the result. Even these simple engagements with the world are a basic form of research; research is a fundamental human activity.

So, this is the good news: you are already a researcher!

The simple learning cycle of act – observe – reflect - plan – act -... is an expression of this innately human way of understanding the world. This is exactly why it is so prominent in permaculture design – a fundamental pattern that can produce powerful results if well understood and applied.

In every design process you will go through a series of steps to achieve the goals you set yourself, and then reflect on how well your chosen course of action has worked. Here we are using the SADIMETS series of steps because we feel it overlaps very nicely with the action research process (see fig. 1). We have structured this handbook using this overlay of the two cycles.

What is SADIMETS?

SADIMETS is a simple mnemonic that describes the steps of the design process: survey, analyse, design, maintain, implement, tweak and share. However it doesn't really matter which model you use, as long as you get the essence right.

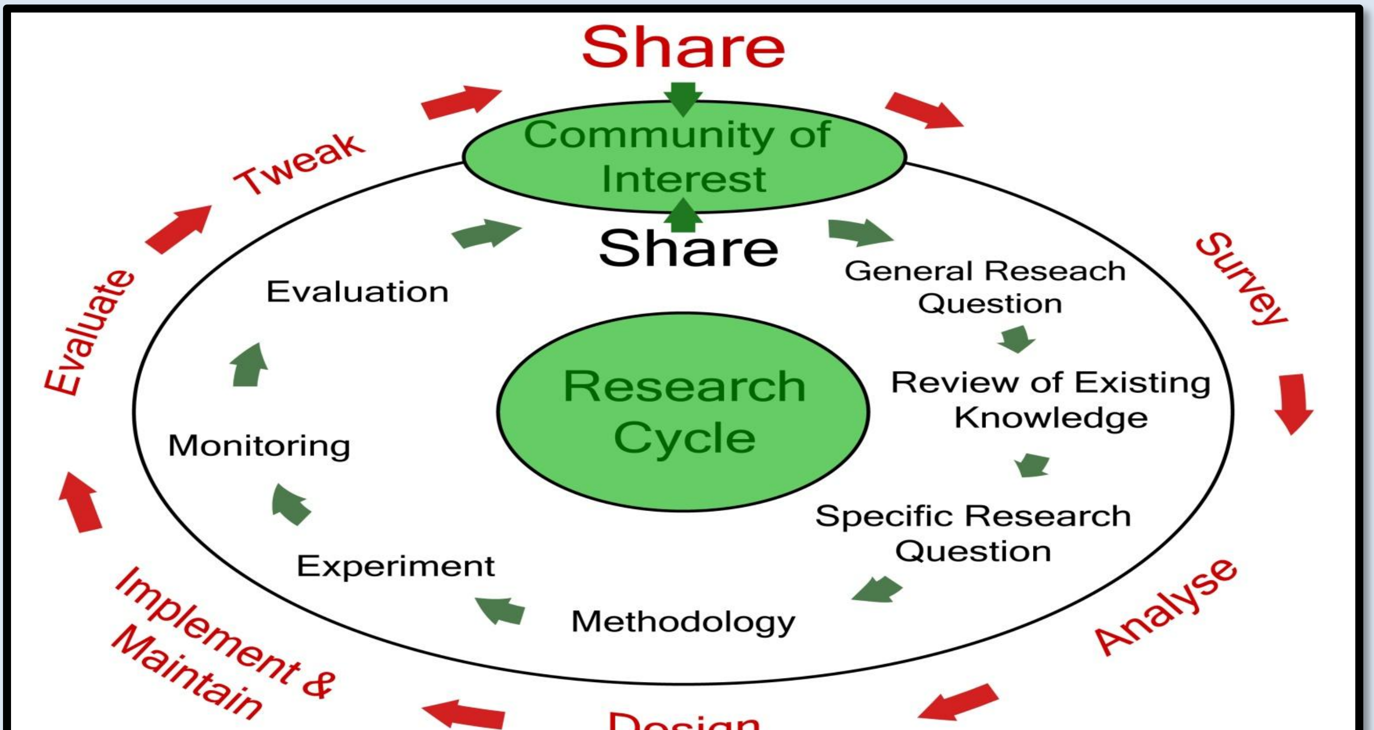

Fig. 1) SADIMETS and action research cycle

Survey

The first step is to frame your general research question. This will usually relate to one particular issue, such as

Q: 'What plants are good companions for strawberries?'

Or

Q: 'How does doing a Permaculture Design Course change people's behaviour?'

Your question will probably involve either improving what permaculture practitioners (including yourself) do, or proving the value of one aspect of permaculture practice. Answering this question is your research goal.

Having framed your question, you will survey what you've got to work with in terms of what growing sites you have access to, how many people you can recruit to take part in your research, how much time you can invest etc. You also need to survey existing knowledge. This could involve reading books or searching the internet, asking your allotment neighbour about what grows well on their plot or posting questions in discussion forums or on facebook groups.

Analyse

Having done this background survey, you now have an overview of what people have already found out about your research question. You can now narrow down what exactly you are trying to achieve, and what you still need to find out for yourself. In a permaculture design process, you would probably formulate one or a few SMART goals at this point. In the research process, the equivalent is to formulate a hypothesis or specific research question.

Design

Now you know what you want to find out. Next, you need to decide how you find out. Key to good research (and good design) is using the right ***methods*** (i.e. what you will actually do in your investigation). Research design also includes thinking about how to record your findings: what data you need to gather to verify them and how and where you will record them.

Implementation & Maintenance

Discipline is most important here. To get valid results, you will need to stick to the plan you made beforehand (even if you see how things could have been done better – you can always include that in your final report!). You will also need to be diligent in recording the necessary data at the right time and in the right way.

Evaluate

For a research project, this is where the actual yield is gathered: new information. There are many ways of analysing data, and which one you choose depends on the field your research is based in, what types of results you're looking for and your level of expertise. In your report, you will summarise all the stages of your research project, then analyse the data you gathered, and finally reflect on what the results tell you about your initial question. At this point, honesty is the most important quality.

Tweak

It is also useful to highlight any new questions or hypotheses that the results to your initial question bring up. You need to reflect honestly on the quality of the research you have produced, and think about what might have been done better. Then you need to write up your results in an appropriate format.

Share

It's likely that others will also benefit from what you find out. You could publish a report on the Association website or run a workshop at an event; if you are studying for a diploma you could include the research as a design. Hopefully this will inspire others to become permaculture investigators as well, and you may even find fellow researchers to group together for a collaborative project.

Chapter 1: **What is Research?**

Dr. Chris Warburton Brown, Research Coordinator, the Permaculture Association and Rachel Bailey, Freelance Permaculture Designer.

This chapter will help you to:

- think about why you are doing research
- recognise the characteristics of good research
- understand the difference between qualitative and quantitative research
- understand what is meant by a 'control'

Why Do Research?

The first question to ask yourself is: 'why am I doing this?' There are two likely answers:

To improve the practice of permaculture by practitioners (including yourself).	Making a comparison between different permaculture practices to see if this can lead to insight and improvements.
To build a strong body of evidence to convince people of the value of permaculture.	Making a comparison between permaculture practice and conventional practice to see what the differences are.

The characteristics of good research

Research is all about finding answers to questions. Before you can begin your research you need to be clear about what question you want to answer; **Chapter 3** will help you decide that. But good research doesn't just produce any old answers, it produces rigorous scientific answers. Three criteria define whether answers are scientific, these are: ***reliability***, ***validity*** and ***generalisability***:

- Reliability – A piece of research is reliable if the measures used are consistent over time. This means that a different researcher applying the same methods to the same question in the same place would find the same answer; a study which cannot be repeated by someone else is unreliable.

- Validity - A piece of research is valid if the measures and analysis used report on what they claim to. For example, have you actually measured the things that you claim to, and have the findings from the measurements been interpreted accurately? A study in which a researcher focuses only on findings which support their pre-determined ideas is not valid.

- Generalisability – A piece of research is generalisable when it is repeatable over time and space. For example, the results found in a piece of research conducted on an allotment in England are also true for an allotment in Scotland. Research which is generalisable often requires more resources, for example conducting the study in a variety of places.

Quantitative or qualitative?

There are two basic types of research: ***quantitative*** (number-based) and ***qualitative*** (word-based). Sometimes a combination is adopted, termed ***mixed methods*** research. Two simple ways of asking a similar question shows the difference:

- <u>Quantitative</u>*:* On a scale of one to five, how enthusiastic are you about permaculture?

- <u>Qualitative</u>*:* In your own words, tell me how enthusiastic you are about permaculture.

Some topics naturally lend themselves to **quantitative** research, such as crop yields and work on pests and diseases. Others lend themselves to **qualitative** research, especially topics exploring feelings, personal experiences and meaning-making. Many topics can be investigated equally well with either ***method***. **Chapter 5 'Design Your Research Project'** will help you choose which approach is right for you.

To control or not to control?

Traditionally, scientific experiments have included a ***control***. In many ways this is the ideal way to conduct an experiment. For example, if you wanted to test whether feeding broad beans with comfrey liquid improved yield, you would create two broad bean plots and treat both in exactly the same way except that one would be watered with the comfrey liquid, the other not. The plot that wasn't watered with the comfrey liquid would be the control.

A more sophisticated, and scientific, way of conducting this experiment would be to use a split plot design, which reduces the effects of different levels of light, moisture and soil quality within the experimental beds, meaning you can be more sure that you are measuring what you say you are measuring (see fig 2). This is one way to improve the ***validity*** of your research.

Radishes grown in different circumstances, one control group one test group.

Fig.2
Diagram of a split-plot design comparing comfrey feed (A) and No Comfrey Feed (B)

A	B	A	B
B	A	B	A

However, some issues may limit the usefulness of controls. Controls can't be applied to many social or philosophical questions, such as why people join the Permaculture Association. You may also be reluctant to implement some control systems, for example if you wanted to compare synthetic vs. organic pesticides and fertilisers it is unlikely that you would want to use these synthetic products on your land. Fortunately, sophisticated data is already available for many 'control' systems, such as yields per hectare from conventional techniques. So think carefully about controls in your research design. They may add considerable strength to your findings, but they may be impractical or unnecessary.

Hypothesis testing

A hypothesis is a suggestion that there is a relationship between a named cause and a named effect.

So you could investigate the hypothesis that a cause: for example: feeding comfrey liquid to broad beans, creates an effect: such as an increase in yield.

So your hypothesis would be: Liquid comfrey increases the yield of broad beans compared with no fertiliser (ie, water alone).

From this, you have a testable condition (the factor or thing we are interested in, i.e., liquid comfrey in water), a comparator (a factor or thing to compare to, i.e. water alone), and a measureable outcome, in this case the yield of broad beans.

For a hypothesis to be a scientific hypothesis, it must be testable. If enough research data shows a clear ***correlation*** between the cause and the effect (i.e. broad bean yields are higher when watered with comfrey liquid) it is considered proven. If research data shows ***no correlation*** (i.e. broad bean yields are no greater when watered with comfrey liquid) it is a null hypothesis – it is not proven. Hypothesis testing generally requires a ***control*****.**

Chapter 2: **Survey your Goals and Resources**

Dr. Chris Warburton Brown, Research Coordinator, the Permaculture Association

This chapter will help you to:

- identify your general research question
- think about what size you want your study to be
- find more study sites to include in your research

Your general research question

Getting the right research question is the most important part of any research project.

Come up with a single, simple question that is easy to understand, then think about what you will need to do to answer this question.

For example if you wanted to research companion crops.

- 'I want to research companion crops' - is not a research question, as it cannot be answered.
- 'Which plants make good companions?' - is a question but it is way too broad for you to answer.
- 'Do strawberries make good companions for peas?' - is much better and clearly defines your general area of interest.

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It is also potentially answerable, although you will need to develop a specific research question later that limits what you will do still further.

Take a few minutes now to write down your general research question. You may want to make several attempts before you settle on one you are happy with.

Chapter 3 – Survey your existing knowledge, will show you how to investigate your topic to see what questions others have asked and what research others have done. You may find your general research question has already been answered. You may get lots of great ideas for how you will do your research, or warnings about how not to do it. Your question is likely to change and evolve as you follow this process.

The size of your study

Every researcher wants to get cast iron answers to the questions they ask. However, few researchers have the resources to allow the production of such answers. Unless you have dozens of colleagues and twenty trial sites, you are going to have to compromise between your ambition and what is realistically possible. What you probably have readily available is one research site (known as a ***case***), be it your garden or the community outside your front door. Basing a research project on just one case may be relatively straightforward, but it is unlikely to produce results which are ***generalisable***. So you should look for additional cases and/or participants. How many cases are enough? Well, the more you have the better, but for a simple research question half a dozen well-chosen cases may give an indicative answer, while a dozen begins to approach generalisability. Note that one community as a whole will only be one case, but if your research looks at the individual members of that community then there could be thirty cases.

If you feel you really are limited to just one study site, there are two ways to proceed.

The first is to do a ***desk-based research*** project, looking at the research that others have produced and drawing conclusions from it, with no fieldwork of your own. For example, the research question 'what plants make good companions for strawberries?' has probably already been researched several times, so you could look at all these studies and draw some conclusions. Each separate study that you look at counts as a separate case. Remember to be critical of research you come across and apply the criteria of ***validity***, ***reliability*** and ***generalisability*** to each study.

Second, you could run your study on a single case but make sure a ***control*** is used. For example, if you are testing a change in how you grow a crop, divide the available space into two and cultivate one half with the new technique, the other half with the old technique. Your results will not be generalisable until others have repeated your trial, but you may produce results that are interesting enough to inspire them.

Finding more study cases

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The simplest way to find more cases is to involve neighbours or friends. If you have an allotment, ask other allotment holders to participate. If looking at household energy consumption, ask friends and family if you can survey their homes. It may be unrealistic to expect friends and family to actively conduct research for you; you will probably need to conduct the study yourself in their home, garden or wherever, or you could interview them about their practices and opinions.

However, if you are researching something explicitly about permaculture you may struggle to find friends and neighbours with the knowledge to take part. Equally, your research question may focus on something at a broad geographical level. So involve a wider network; think about where you can find people interested in your research question such as Facebook, the permaculture diploma or the Permaculture Association. You may already have a list of likely participants in your address book, if not it is worth considering if you may know or be able to find someone who does. People who can provide you with this access to potential participants are termed ***gate keepers***.

A health warning

Research does not produce perfect answers. Over time, answers that once seemed correct are abandoned and new ones take their place. And often different studies of the same research question may produce very different answers, causing controversy and dispute. No-one expects your answers to be perfect or indisputable; the really important thing is that other researchers can see how you have conducted your study and why you drew the conclusions that you did.

Chapter 3: Survey Existing Knowledge

Dr. Naomi van der Velden, Cumbria University

This chapter will help you to:

- understand your knowledge versus general knowledge
- find information (different sources and types)
- assess information (accuracy, reliability, currency)
- synthesise information (bringing it all together)

Once you've identified a general research question, the next step is finding out what is already known about it. Sometimes this extra reading will answer your question, leaving you free to investigate something different. Sometimes it will lead to even more questions! Often it will help you further refine your research question.

Your knowledge versus general knowledge

There's a key difference here between what you know (or don't know) about something, and what "we" (the world as a whole) know. For example, you probably don't know how to build an aeroplane, but "we" do. For academic research, the aim is to add something new to this global knowledge. For personal research, it might be to satisfy your own curiosity about something, or to investigate what happens in your own garden. Permaculture research is probably a mix of these things; we want to build an evidence base of new knowledge but we also want to check whether the same results are always found in different places and years. Doing the same study in a different area is also adding something new; increasing ***generalisability***, or perhaps finding that different things work in different places.

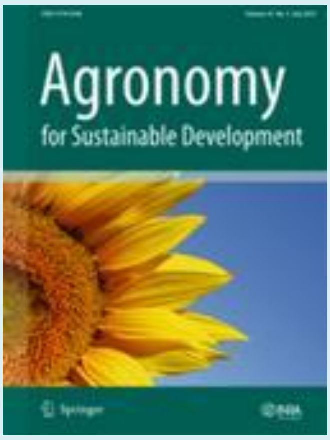
The purpose of a "***literature review***" is to bring together all the current evidence and general knowledge on a topic. Once you have as much information as you can find, you then review this information. Through this "review" you want to identify:

- Areas of certainty – studies by different people that consistently show the same unambiguous results.
- Areas of uncertainty – studies by different people that do not show the same results/ ambiguous results within a single study.
- Areas which haven't been studied at all - there are no studies!

Ideally, you don't want to spend your time re-inventing the wheel. Although there is an argument that the wheel can always be refined; from stone, to wooden cart wheels, to magnesium alloy racing car wheels!

Where to look for information

Journal papers - academic journals are the original source of most information found in textbooks, lectures, reports in popular magazines like New Scientist, or on the BBC news. The topics covered are often narrow and full of terminology (jargon). They are the best source of information for an academic literature review, but can be really hard to read at first. "Review" or "synthesis" papers are literature reviews, providing a good overview of a topic and giving links to further studies.



All academic journals are now online; both the current issue and dozens of back issues. Unfortunately, many of these journals are currently not available without a very expensive subscription, so unless you have access via a university subscription service (or a friend does) you may only be able to access the abstract (summary). Nevertheless, a good abstract will give you a clear idea of what's in the rest of the paper.

Books – Libraries remain an excellent place to find books. Once you have found one good book, raid its bibliography and/or footnotes to find dozens more. Try looking in:

- Permaculture books - specifically on permaculture or on aspects of permaculture like renewable energy, growing food, or linking with your community.
- Textbooks – these summarise knowledge from academic sources and present it in an introductory format.
- Coffee table books - are on specific subjects and usually present information in an interesting and engaging format for the non-specialist.

NB: Don't take factual statements made in books at face value unless properly referenced; it's not always clear where a piece of information is from or if it is the author's own opinion.

Online - a (bewildering) wealth of information is available via the internet. The real key is deciding what's good and what's not (see "How to decide what to include" below). Some good ways to search online are:

- Google Scholar - scholar.google.co.uk shows you academic papers from journals and published books. It will link directly to the article or website if it is available online. You can search by topic or key word and narrow your search by publication date.
- Web search - search for key words related to your topic area. Refining your search to your specific topic is a key skill to develop.
- Links from a web page - a good place to start looking is following recommended links from a professional or respected website.

How to search for information online

The words you use in your search are really important. Consider all the ways you could say the same thing (synonyms). Suppose you're interested in growing food, you could try looking for any of the following: growing food, grow food, gardening, agriculture, food production, horticulture, allotments, crops, arable, farming. Think carefully about which relate most closely to your topic of interest. Some tips are shown in the table on the following page that can be used in a search engine.

Search tip	Explanation	Example	Returns Results for:
* Asterisk	Used to find different word endings	Farm*	'Farm', 'farms', 'farming', 'farmed'
"" Quotation marks	Searches for these words exactly	"growing food"	Only results containing the words "growing food", not results containing "growing" and "food" separately
AND	Combines words in a search	Grow AND food AND back AND garden	Searches and returns results for all of these terms
OR	Search for several ways of saying something	"back garden" OR allotment	shows results containing either of these words
NOT ('-' for a google search)	Excludes words	"Back garden" NOT allotment "Back garden" -allotment	Returns results for back garden only, not allotment.

Too much information? You may need to refine several times if you are overwhelmed. You could:

- Add more specific words – 'nutrition' or 'productivity' or 'best crops'.
- Narrow down the location of studies - UK, temperate, tropical, New Zealand.
- Specify a range of dates to search - within last 5 years, between 2000 – 2014.

Not enough search results? You may need to broaden your topic if you can't find much at all. e.g. from 'vitamin B content of "artichoke hearts" grown in Surrey, England'. You could:

- Remove some quotation marks.
- Use synonyms - try 'nutritional content' in place of 'vitamin'.
- Be less specific - e.g. 'vitamin content of artichokes grown in Surrey, England'.
- Broaden the geographical area.

How to decide what to include

Once you've found lots of information, you need a closer read through to decide what is most useful to you. You need to evaluate the information you've found. The best information is:

- Relevant - closely related to your topic area, containing specific information on your subject.

- Reliable - from a source that is trustworthy. Scientific study or someone's blog? Is there likely to be an influencing agenda? Is it properly referenced so you can see where the author got their information?
- Accurate - is it correct? One easy way to tell is if other unrelated sources say the same thing.
- Up to date - is it the latest knowledge on the topic?

Bringing it all together

Identify topics and subtopics within your overall area of interest. Within each subsection, identify:

- Strong evidence - many studies that agree.
- Weak or uncertain evidence – few studies, or studies that disagree.
- No evidence.

In the case of strong evidence there's no real need for further research, but for weak/uncertain or no evidence more research is definitely needed. Think about which of these areas you'd like to study further. From this, you can start to develop your specific research question, following the steps outlined in the next chapter.

Reading other people's research helps you to be a better researcher

As well as looking for factual content, develop your critical faculties for the research process itself. Have the authors made their aims and ***method*** clear? Is the paper well written and presented? Are all the claims made properly supported by evidence? Almost any research, good or bad, will have something to teach you about how to do (or how not to do) research. Throughout your literature survey, be on the lookout for researchers who you can emulate. Look for these characteristics:

- Clarity - they lay out the research process they followed clearly.
- Great subject knowledge.
- Good writing style - especially making complex ideas seem simple and interesting.
- Simple, straightforward research methods - which you can borrow for your own project.

Chapter 4: # Analyse What You Want to Find Out

Dr. Chris Warburton Brown, Research Coordinator, the Permaculture Association

This chapter will help you to:

- hone your specific research question
- develop ideas of how you will conduct your research

Research Question – General to Specific

As you survey existing knowledge, as outlined in the previous chapter, start to hone your research question from the general (the broad topic you will work on) to the specific (the question you will actually answer).

'Does planting strawberries alongside peas improve their yield?' is a great specific question as it is answerable, specific, and focussed.

Don't try to be too ambitious! You need a question which you can actually answer with the time and resources you have. Keep your general question in mind; remember if you can answer your specific question you have contributed something towards answering the general question.

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Once you have decided on your specific research question, you need to think about how you could research the topic. Don't worry about the details at this stage; the next chapter will help you develop your research design in depth. But do think about the general approach you are going to take.

The table on the next page details this process of honing down your question and thinking of possible methods.

General Research Question	Specific Research Question	Possible approach for answering
How can garden design attract more bird species?	How can small domestic gardens be designed to attract more bird species?	This could be a desk study, or you could get friends and neighbours to do a bird species count, then implement a number of 'improvements', and count again after a few weeks.
Is nettle tea a good fertiliser?	How much does regular application of nettle tea boost potato yield?	Recruit 6 neighbours on your allotment who grow organically. Get each to set up an intervention patch and a control patch in their potato bed, both treated in exactly the same way except the intervention patch is watered with nettle tea fortnightly. Weigh and compare yields at the end.
How do you set up a successful organic box scheme?	Is there a tried and tested business model for setting up a successful organic box scheme in Yorkshire?	Send a questionnaire to a number of box schemes, follow up with a phone call, and if possible interview some of them face-to-face.
What are the food yields from forest gardens?	What are the food yields from commercial forest gardens of less than one acre?	Use the Permaculture Association to recruit 10 forest gardens, give them a simple yield record form and get them to weigh their edible yield and record it every month. Compare and analyse the yields at the end of one year. You could also ask them for historic yield data if they have records.
How do Permaculture Design Courses change the behaviour of participants?	Has participating in a PDC led by Fred Smith in Bristol changed the behaviour of the participants?	Identify areas where you might expect change, eg. car use, household insulation, gardening practices, food shopping habits, and design a questionnaire to monitor them for each participant at the start of the course, then repeat at the end of the course and again after six months.

Chapter 5: Design Your Research Project

Dr. Jan Martin, Aberystwyth University

This chapter will help you to:

- understand and choose data collection methods
- understand different types of quantitative data
- design a data recording system that is clear and consistent
- write your research design

Data collection methods

Right from the beginning of any project you need to think about the data that you are going to collect. You also need to be able to analyse your data, so you will have to consider that too. Many research projects have failed because inappropriate data have been collected or because it's not possible to analyse/draw conclusions from the data collected. By considering these issues to begin with, you will save yourself a lot of time in the long run. You should always decide HOW you are going to analyse your data when you design your research (so read Chapter 7 in this handbook before finalising the design of your experiment!).

In permaculture, many of our experiments will be ***comparative***. For example we may have an area of land and wish to apply a ***treatment*** to half of it and not to the other half to see what the effect is. We can then compare the results of two treatments (the ***control*** plot is still considered as a treatment; no treatment is still treatment!). The term treatment is used in a very broad sense; as well as meaning something like the application of compost, it could also refer to different species or varieties, different locations or different times when a measurement is taken. In addition, a treatment could refer to separate groups of people who are responding to a questionnaire: people who live in a city vs. people who live in the countryside, different age groups etc. All of these can be thought of as treatments. (The term variable is sometimes used instead of treatment).

When you collect data to answer a research question, the question should be your focus. You therefore need to minimise other things that might influence your results. For example, you may be interested in comparing the productivity of dig and no-dig systems. In this case, you should plan to compare systems that only differ with respect to digging – as far as possible; everything else should be the same – soil, light, water availability, compost additions, density of planting, crop, aspect, size of plot etc. By careful planning, for example by using a split plot design as shown in **Chapter 1** and again below (fig. 3), you can ensure that any differences that you record are most likely to be the result of the ***'treatment***' that you are interested in.

A	B	A	B
B	A	B	A

Fig 3 – Split plot design.

Types of quantitative data

There are several types of **quantitative** data which we can collect:

- Nominal data - data divided into exclusive categories, for example colour, sex, species. There is no numerical value associated with each category.

- Ordinal data - ordinal numbers indicate some sort of rank, but nothing else. The ranks just put the data in order, there is no mathematical relationship. One example is the DAFOR scale that is used in ecology: D = Dominant, rank 5, A = Abundant, rank 4, F = Frequent, rank 3, O = Occasional, rank 2, R = Rare, rank 1.

- Interval data - data can be divided up into even parts. Examples include dates and temperature. There is no definitive starting point. Values can be added and subtracted (5 May to 15 May is 10 days) but cannot be multiplied (15 May is not three times greater than 5 May). *NB:* Don't confuse this term 'interval data' with the idea of intervals in data ranges (e.g. between 1m and 2m long).

- Ratio data - this sort of data contains the most information. It does have a definitive zero point. Examples include height: 3m is three times bigger than 1m. Such data can be converted into categories or ranks (e.g. short, medium, tall). Measuring the length of a vegetable, like in the picture, would create ratio data.

Picture by: GmanViz. License: https://creativecommons.org/licenses/by-nc-nd/2.0/

Types of qualitative data

Qualitative data also take various forms:

- Simple factual data - data such as names, addresses and countries of origin of people you interview.

- Observational data - things that you observe yourself, e.g. "the fields were well managed and tidy".

- Informal interview data - things that people tell you in general conversation and which you roughly note down.

- In-depth interview data - things that people tell you during a formal interview in response to questions you have prepared in advance, and which are transcribed or taped.

- Questionnaire data - short answers that people provide in response to a questionnaire sheet provided by you.

- Secondary data - relevant information which has been written or published by someone else, such as a memoir, article, or minutes of meetings. These can also be **quantitative** in nature, such as financial accounts or visitor records.

Recording data

You should always be consistent with the way you record data. Make a note of exactly how you do it so that it is repeatable. This is particularly important if more than one person is collecting the data (you don't want to end up analysing differences between recorders rather than between ***treatments***!) or if the data are being collected over a long period of time.

Make yourself a standard recording sheet, so that you always record the same things in the same format; this might take the form of a computer spreadsheet, a questionnaire or a simple hand drawn table. If different people are collecting the data, give them each copies of the recording sheet and explain (in writing) how you want it filled in.

You can make a simple data record sheet using the table function in a word document, as has been done below. A record sheet like this could be used to record the yield of two different treatment plots in a controlled experiment.

Date (dd/mm/yy)	Treatment One Yield (Kg)	Treatment Two Yield (kg)

If you are conducting a study that involves the location of different elements, then maps and plans can be particularly valuable. For example, if you are measuring the pH of the soil in your garden, then a map showing where the samples were collected from will be invaluable.

Always make sure that you collect data at an appropriate level of precision. For, example if you are measuring the yield of potatoes from a garden, decide how precise you want the figures to be. Are you measuring to the nearest 1g, 10g, 100g, 1kg, 10kg or 100kg? If you are collecting data from small plots, then only measuring to the nearest 10kg might not reveal differences, but if you are working at the scale of a whole farm, then even 10kg increments may not be possible, and even if they are, the amount of soil on the crop might boost the weights significantly.

Chapter 6 - Implement your research design will tell you a bit more about implementing your data collection technique

Designing interviews and questionnaires

There are a number of differences between ***questionnaires*** and ***interviews***.

- Questionnaires - involve simple written responses made as the questionnaire is being completed, tend to record shorter responses, take less time to complete (maximum 15-20 minutes), and are often completed by the participant themselves.
- Interviews - are usually recorded or have a note taker rather than simple written responses, record longer responses, take longer to complete and are conducted face-to-face with the interviewer asking the questions. However, the kinds of question asked and the structure of questionnaires and interviews is often similar. Interviews should have a set of questions prepared in advance, known as an ***interview schedule***. (See **Appendix 2** for an example interview schedule).

The ***interview schedule*** or ***questionnaire*** usually begins with simple questions such as name, age, and length of involvement in the project. These are followed by questions which collect the key information the researcher is seeking. These can be **closed** or **open**; some examples of the differences between these are given in the table below.

Closed Question	Open Question
How many times a week do you come here?	Do you come here often?
On a scale of one to five, how committed are you to this project?	How committed are you to this project?
Look at this list and choose three terms which best describe what you do here.	How would you describe what you do here?

You can ensure some consistency by using closed multiple choice answers (thus producing categorical data) or a ***Likert scale*** (e.g. a statement and then a scale of 0-5 to choose from, where 0 is strongly disagree and 5 is strongly agree). But if you want more subtlety (detail) in the answers, then you might want your respondents to use their own words by using a very **open question**ing style.

Try and limit the number of questions, don't repeat yourself or ask superfluous questions, and remember that some *open questions* may take several minutes to answer. Be sure to test your ***questionnaire*** or ***interview schedule*** with a friend or colleague whom you trust to give feedback; it will probably take longer than you think, some questions may be ambiguous or too open, some questions may need to be dropped. If you are struggling to keep it to a sensible time limit, focus questions on what you really need to find out.

There is no problem collecting this sort of data from a questionnaire requiring written responses, but if you are conducting **qualitative** interviews then the responses can be more difficult to harvest. Ideally, you want to save all the words of a respondent, which requires recording equipment or another person to scribe for you. Trying to write down responses word for word is impossible if you are also conducting the interview.

Whatever type of data you are collecting it should be compatible with other studies if you want to make comparisons. Always ensure that the ***methods, treatments*** and data collected are the same if you plan to combine results and gain a broader picture.

Chapter 6: Implement Your Research Design and Maintain Steady Progress

Dr. Chris Warburton Brown, Research Coordinator, the Permaculture Association

This chapter will help you to:

- understand how to conduct your research in an ethical manner
- conduct good interviews
- gather data successfully

Research ethics (people care)

One of the three core permaculture ethics is 'people care', and this should be applied in any research you do. The three key areas to think about are: risks, rights and responsibility.

- Avoid risk - consider your personal safety and the safety of others. For example, don't ask people to lift weights beyond their capacity, don't place yourself or others in risky places especially at night. You also need to protect people from the risk that what they have told you might cause them harm or discomfort; if they moan about the allotment committee, don't let the committee find out! If you are dealing with sensitive or controversial topics, you may need to offer ***anonymity*** or ***confidentiality*** to your participants; be sure to do so in writing and explain what this means.

- Research participants have rights - including the right to withdraw from the research. You should include a short written summary of your research in your questionnaire, interview or experiment instructions. For online or paper questionnaires where you don't collect personal details, they do not need to sign a consent form, but in all other research they should. Always make it clear what you will use their data for. Check at the end that they are happy for you to use what they have said, and give another chance to withdraw. If possible, send them a summary of your findings at the end of the project.

- You must act with responsibility - if you promise ***anonymity*** or ***confidentiality***, make sure you keep it, by locking up your research notes and by changing names and all identifying details when you write up your project. You may also need to make sure that you get permission to conduct your research before you begin. If working with young people, ensure permission from parents or teachers. If in doubt, ask.

Conducting interviews

It is easy to confuse conversation with interviews. Interviews are a very specific type of human interaction, requiring considerable thought and preparation. The first thing needed is a good ***interview schedule***, covered in the previous chapter: **Chapter 5 Design your research**. You also need to try to:

- Create the right atmosphere.

- Allow enough time.
- Be uninterrupted.
- Ensure it is quiet and calm so you can hear each other.
- Be relaxed.
- Create a good rapport between interviewer and interviewee.

Ensure that all the questions get asked in the time available, and that the same questions are asked in all the interviews, even if the time taken to answer each one differs. Most of these things can be ensured through good planning. For long distance interviews, using the phone or Skype is a good option, but make sure you have a way to accurately record the interview, such as recording the Skype call.

Gathering experimental data

As explored in the previous chapter, **Chapter 5 Design your research**, the key feature of good experimental data is good record keeping. Make sure that you (and all those who help you conduct your experiment) keep thorough records of what you do. Depending on the nature of the experiment, provide anyone helping you with data collection with a standardised data recording sheet or a log book, this can include maps or plans of the site or the experimental area. See **Chapter 5** and **Appendix 2** for examples of data collection sheets.

Clear, standardised written instructions for all participants are also vital. Remember you will eventually need to organise your data into a standardised format. Working out this format before the experiment begins and working it into the design can help immensely and save you time later. Make sure that all the data you gather is clearly labelled according to where it has come from and who has collected it (a contact name and number for each site in your experiment is essential). The case study in **Appendix 2** shows a real world example of how to formulate instructions to give to participants of a study.

If you have a number of different sites participating in your experiment, visiting each one early in the experiment would be a good idea. If they are geographically widely spread, phone them or e-mail to check they are on track and understand what is expected. Stress to participants that data needs to be recorded and done so consistently.

It may also be possible to gather data that people have already collected themselves, such as financial accounts or yield records. If you can identify the right sites and convince them to share their data, this can give you access to a wider data set than you could gather yourself. However, you will need to convert all the data into the same format; there may be a mixture of imperial or metric measurements, or categories in accounts may not match. See **Appendix 2** for an example data collection sheet which was used to establish what information was already collected by participants of a study.

Chapter 7: **Evaluate Your Data**

Dr. Jan Martin, Aberystwyth University

This chapter will help you to:

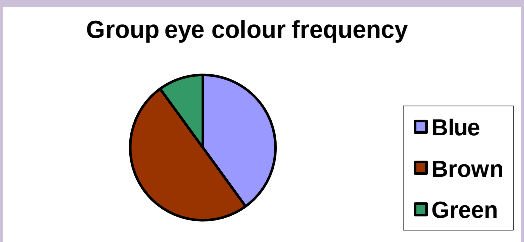
- present quantitative data
- find patterns in your data
- present qualitative data
- interpret your results

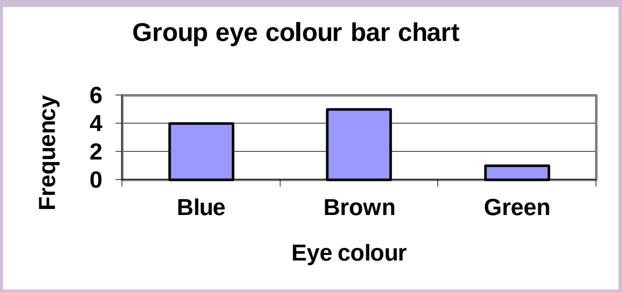
Once you have finished collecting your data, you can start your analysis. This is the process of converting a mass of data into a form which can be interpreted, with the view to answering your research question.

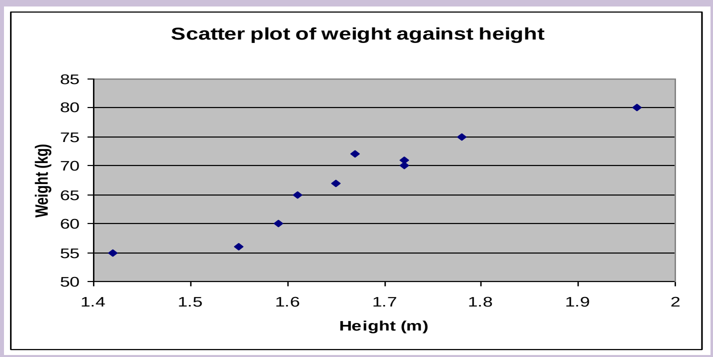
Presenting quantitative data

Often the easiest way to interpret **quantitative** data is to display it graphically. This can help to identify trends and patterns which are impossible to see in a table of 'raw' data. Various types of graph can be drawn and each is appropriate for a different situation; many of them can be produced using a computer spreadsheet.

Data can be displayed in the form of bar charts, pie charts, scatter graphs, kite diagrams… whatever format makes patterns in the data clear. Most people find it easier to interpret a visual representation of numerical data than the numbers themselves. Here are some examples:







How to produce graphs from a spreadsheet

(Using 'Microsoft Excel' or 'Open Office Calc')

1. Enter your data into the spreadsheet
2. Highlight the boxes containing the data that you want to appear in your chart/graph
3. Click the 'chart wizard' or 'chart' icon on the top tool bar (the icon shows a bar graph)
4. Follow the simple instructions you are given
5. Alter the style, layout and labels until you are happy
6. Save your graph

Where relevant, graphs should have:

- A title
- A Key
- A label for each axis
- A scale for each axis
- Units on each axis
- An appropriate scale (as you can see from the scatter plot the axes do not have to start at 0)

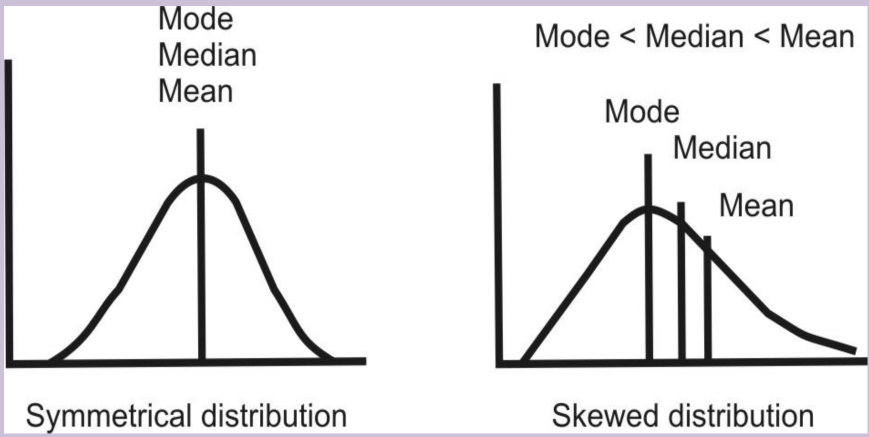
Summary statistics Using summary statistics enables you to understand your data in terms of 'data sets' as opposed to just individual single items of data. For example, if you collected 14 individual items of data, 7 recording the yield of broad bean plants treated with comfrey and 7 recording the yield of broad bean plants not treated with comfrey, these would become two data sets – comfrey treated and not comfrey treated.

Summary statistics are a way of describing each set of data through a single number. The simplest form of summary statistics are different kinds of averages. The table below tells you how to calculate three types of average and an example. The example is based on the following data set:

Broad bean plant height: 22cm, 29cm, 24cm, 28cm, 24cm, 31cm and 32cm.

Type of Average	**How to calculate**	**Broad bean example**
Mean	Add all the individual pieces of data which make up the set together. After you have done this, divide this number by the number of individual pieces of data in the set.	22, + 29 + 24 + 28 + 24 + 31 + 32. / 7 = 27.1
Median	List each individual piece of data in numerical order. The number in the middle of the data set is the median.	22, 24, 24, 28, 29, 31, 32 Middle number = 28
Mode	This is the most common number in the data set. To find it, look for the number that occurs most often.	22, 29, 24, 28, 24, 31, 32. Most common = 24

The term distribution is used to describe how your data is spread across the entire set. If the distribution of your data is perfectly symmetrical this means that the ***mode***, ***median*** and ***mean*** are exactly the same. If the distribution is skewed they are different as in the broad bean group above. Looking at the distribution curve of a set of data is another way to visually look for patterns as you do with graphs and charts.



The spread of the data (how much variation there is between the numbers) can be described by the ***range***, which is a set of two numbers demonstrating the lowest and highest values of a data set. In the broad bean sample above this would be 22-32cm.

Another way of considering the range is the ***standard deviation***, a calculated number which tells you how much the data vary. This is more useful because it gives a better understanding of how the data cluster together. For example, if we compare the sample above with a sample in which one plant is 22cm and six plants are 32cm, they both have the same range (22-32cm), but a different standard deviation. The easiest way to work this out is to use an online standard deviation calculator. One can be found at: www.standarddeviationcalculator.net.

Correlations and Statistical Significance

What we want to identify from **quantitative** data are patterns or trends. Graphs and summary statistics can help us to do this, but there are more complex approaches for those of a mathematical bent. We can examine the relationship between two variables (***treatments***), for example soil organic matter and crop yield, by calculating a correlation coefficient.

Correlation Coefficient

In **Chapter 1 What is Research,** we talked about correlations and hypothesis testing. If you find a correlation between two variables this can be used to prove or disprove your hypothesis. A rough correlation might be immediately obvious, for example in the scatter plot of height and weight displayed at the start of this chapter. A correlation coefficient is a more scientific way of testing for a correlation between two variables on the computer using a statistical software package.

Some statistics packages can be expensive to access, but you can download free ones instead from: www.freestatistics.altervista.org/en/stat.php

If you do not have any experience of using statistical software it may take some time to get to grips with it, but there are many useful tutorials on YouTube and elsewhere to help you do this.

Once you have your statistical software, use the internet to look up how to perform a correlation coefficient. This is too complicated to explain here, however as noted above there are many useful tutorial resources out there. Here are a few:

If you are using SPSS - www.youtube.com/watch?v=CBITk_Jt2xo

If you are using R (a free software package) - www.youtube.com/watch?v=pzzP6FGQP5o

What we will explain here is how to interpret your correlation coefficient. A correlation coefficient yields a single value, usually in the range –1 to +1.

- –1 - indicates a perfect ***negative correlation*** (as variable A increases, variable B always decreases, for example the relationship between shade and yield in potatoes).
- 0 - indicates ***no correlation*** between the two variables (for example, the relationship between the length of your hair and yield in your potatoes)
- +1 - indicates a perfect ***positive correlation*** (as variable A increases, variable B always also increases, for example the relationship between sunshine and yield in potatoes).

Note: correlation coefficients will generally have range limits; for example, potato yields will not go on increasing forever as sunshine increases, they will vary little between sunny and very sunny conditions. Make sure you look for where these range limits might lie.

An important note of caution; correlation does not always equal causation. For example, you may find that there is a correlation between birdsong and potato yield on your plot, but the actual cause may be that the birds are eating slugs and other pests which would otherwise be damaging you potatoes'

T-test and ANOVA
Many experiments are designed to make comparisons:
Do I get higher yields from my garden if I add organic matter?
Does adding Lactobacillus to my soil reduce fungal infection in onions?
Does completing a Permaculture Design Certificate lead to a reduction in car use?

In all these cases we can use a statistical test to examine if the correlation we have observed is statistically significant (i.e. much too strong to be just a product of chance). When we only have two treatments, we can use a t-test. Again, this is too complicated to explain here, but if you're keen you could visit:
www.socialresearchmethods.net/kb/stat_t.php

You can also get your statics software to perform this function for you. For SPSS, R and R Commander see: www.youtube.com/watch?v=viu-wDuIH6I

If there are more than two treatments analysis is significantly more complex; you could try using ANalysis Of VAriation (ANOVA), this is heavy stats but an explanation is available here: www.psych.uw.edu.pl/wderaad/Statistics/Help-ANOVA.pdf

Qualitative data

The most common sort of ***qualitative*** data is from ***interviews***, ***questionnaires*** or text sources (for example you might be examining newspaper articles about sustainability). If you have conducted interviews the first step is to transcribe (type up) your interview to turn it into text.

The most straightforward way to examine **qualitative** data is to group it by theme. Identifying the right themes is important; to some extent the themes will be set by the questions you have asked but there are also likely to be cross-cutting themes. Keep reading and re-reading your data until themes begin to appear. Bear in mind that themes may emerge that you did not expect, so don't pre-judge the data.

Once you have identified themes, group data from different interviews together by theme. This will probably mean cutting and pasting your interview transcripts on the computer – be sure to save the original transcripts separately! You will now easily be able to see what all your interviewees have said about a certain theme, such as 'volunteering' or 'potatoes'. Start to look for juicy quotes that summarise a lot of the data or shed light on a particular theme, these will be very useful when you are writing your report.

You could also use some form of content analysis. This is a structured and objective way of examining **qualitative** data. Based on keywords or key phrases, content analysis can be based on concepts (for example, how often sustainability is mentioned in articles from different newspapers) or relationships (for example, identifying what other concepts are linked to sustainability and the different meanings associated with these clusters of concepts). A simple form of content analysis is to make a word cloud: see www.wordle.net.

Identifying themes in **qualitative** data is important and, as with **quantitative** data, we are often looking to identify patterns or trends. We may even wish to make comparisons between sources (including different interviewees or groups of interviewees), just as we do between treatments in **quantitative** data.

Interpreting results

It is not enough, however, simply to conduct statistical analysis or identify themes. The key output is the subsequent interpretation. Remember that you are looking for answers to your specific research question; other data you have generated may be very interesting but really its use is limited to suggesting areas for future research. Once you have evaluated all your data and established patterns, trends or themes, you need to think about explanation. Explaining the patterns can be challenging, but is nevertheless essential. Hopefully you will now be able to see an answer emerging for your research question. This can take time and requires you to really get to know your data; you may have to go back to it several times, or rearrange it into different themes or groups, before an answer starts to emerge. The next chapter will help you with the process of honestly reflecting on the answers your research has produced, or of realising you haven't produced the answers that you hoped for.

Chapter 8: # Tweak and Reflect on Lessons Learned

Dr. Chris Warburton Brown, Research Coordinator, the Permaculture Association

This chapter will help you to:
- decide whether you have answered your research question
- reflect on the quality of your research
- write up your results

Decide whether you have answered your research question

Before you can start writing up your findings, you need to decide if you have actually answered your research question. It is time for honesty and self-reflection! Five answers are possible:

- Yes, the question has been answered conclusively and clearly - well done!

- Yes, the question has been answered but suggestively rather than conclusively - most experimental research produces results which are suggestive rather than conclusive, so don't worry if your results are not wholly clear cut.

- No, no clear answer emerged from the data - if backed by sufficiently strong evidence and a good research ***method***, a conclusion that there is no clear answer to your research question is entirely acceptable.

- No, the question cannot be answered because of flaws in the research design - all research is a learning experience, don't be upset if you feel you made significant errors along the way or realise you asked the wrong question in the first place!

- No, the question hasn't been answered because too little data was gathered - you will need to decide if you want to do more yourself, or if you want to leave it to others.

Reflect on the quality of your research

Way back in **Chapter 1 What is Research**, three key criteria of scientific research were identified; ***reliability***, ***validity*** and ***generalisability***. You now need to decide if your research meets those three criteria. So ask yourself these simple questions:

- Reliability - would a different researcher applying the same ***methods*** to the same question in the same place find the same answer as you have?

- Validity - are the answers you have given an accurate and true representation of what you found?

Note that your research is extremely unlikely to produce fully ***generalisable*** results. The best you can hope for is that your conclusions can be tested by others. So your third question is:

- Generalisability - Have you produced conclusions that can be tested in new settings, peoples or samples?

Some key points to remember when evaluating your research:

Answering 'no' to one or more of these quality questions opens up the chance to explore why, and what you could have done differently to get a 'yes'.

Your research is much more likely to be indicative than conclusive, particularly considering the limitations of time, money and training, so don't make exaggerated claims!

A null hypothesis (i.e. you found no link between feeding comfrey tea and increasing broad bean yield) is still a very useful outcome from your research, it is a contribution to human knowledge, and is well worth writing up.

Almost all research concludes that 'more research is needed', so give thought to what further research is suggested by what you have done and found.

A lot of the problems and uncertainties that have emerged during your research can be explored and explained in your writing up.

Write up your results

A number of outlets are available for your research, from diploma tutors if you are a student to visitors to your website. You can read about those potential audiences next in **Chapter 9, Share your Findings**. The key differences between them will be the length and depth of information you give them. However the basic things you need to tell any audience will be the same, and in the same order:

- Title page - including author name, author contact details and date of writing, and perhaps briefly acknowledging help from funders, tutors, colleagues, proof readers etc.

- Abstract or summary - 200 words or less, states your research question, your ***method***, sample size and brief conclusion. Write this last.

- Introduction - explain the importance of the study, its contribution to knowledge, the general and specific research questions, briefly describe the ***method*** and why you chose it.

- Methods - explain what you did and why you did it in depth, including sample selection and size. Don't give step by step instructions, but do make sure the reader knows why you chose this ***method*** and could copy what you did if they wanted.

- Results - say what results you collected, but do not draw conclusions from them at this point. This can be supported by some key graphs, charts or tables but keep detailed numbers in an appendix or leave them out completely. The reader wants to get an overview of your results without getting lost or bored.

- Discussion or conclusion - discuss what you think the results mean and if they are scientific (***valid***, ***reliable***, ***generalisable***), describe any problems with the results and if you have got sufficient data, say how you have answered your research question, finally suggest further research that is needed.

- Literature cited or bibliography - literature cited only gives works you actually mention in your text, a bibliography gives all the books you have used. List them in alphabetical order by author surname, reference them in full so that others can find your sources for themselves. Use the Harvard referencing system of: author surname/s, author initials, (date of publication in brackets), *title in italics*, publisher, place of publication, chapter or pages used e.g. Whitefield, P. (2011) *The Earth Care Manual* Permanent Publications, East Meon, Hampshire, pp.56-78. If you refer to a source in the main text then just use the short form of author, date and page number in brackets e.g. (Whitefield 2011, 57), but make sure there is a matching full entry in the literature cited/bibliography section).

Depending on your audience, the introduction, methods and results sections could vary from a hundred words in a short article to ten thousand words in a book! Fit the length and depth to the knowledge and interest of your intended audience.

One labour-saving approach is to write your most detailed report first and then cut it down to different lengths to meet the requirements of different audiences. You can choose to include photos, graphs and diagrams depending on the needs of the audience you are targeting. Through all of this, you need to be guided by two key principles: (1) can other people understand what you have done and copy it if they want to, and (2) can others use your research as a starting point for their own studies, building on what you have found.

Don't be afraid to say where you went wrong or what you could have done better, reflection is a key aspect of any research project.

Here are a few style tips:

- Stay focused - on the research topic of the paper.
- Use paragraphs - to separate each important point.
- Present your points in a logical order.
- Avoid Jargon and technical terms - unless writing for a specific expert audience, write for a well educated lay person.
- Use normal prose - with full sentences including articles ("a", "the," etc.).
- Avoid informal wording - don't address the reader directly, and don't use slang or superlatives.
- Use a 12 point standard font - like Times New Roman.
- Start each new section on a new page.
- Confine each figure/table to a single page.
- Don't place a heading at the bottom of a page - with the related text on the next page.

Chapter 9: # Share Your Findings

Ed Sears, Exeter University

This chapter will help you to:

- understand why we disseminate our research projects
- understand what we disseminate
- understand where to disseminate

Dissemination is the stage where you communicate your research project and results with people who may be interested in hearing them. Another word for disseminate is simply to share.

Why share?

A number of valuable benefits can come from distributing the results of your research. Dissemination of quality work helps to develop permaculture, by spreading best practice and helping people learn from experience. Techniques, old and new, can be tested through research to see if they produce benefits that match up to the claims made for them. Through sharing these results individuals can easily see how different practices are likely to work for them. The permaculture movement, through spreading interesting and forward-thinking research, can forge links and raise credibility with ecology and sustainability researchers, who are our counterparts in the scientific community.

Share what?

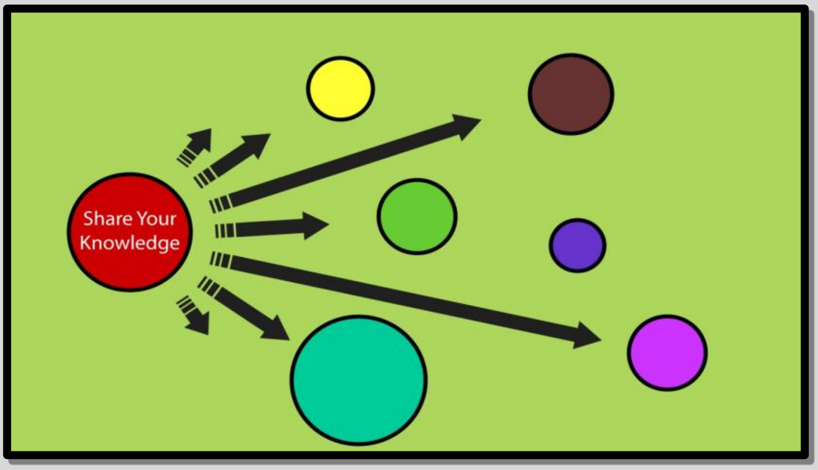
The fruits of a research project which are available to be disseminated may be tangible or intangible. They can come in physical form, such as an actual harvest from the plants you have grown or the electricity from solar panels which you have monitored, and these may be the most convincing results of all for influencing people in your local area. The output of a breeding project would be seeds with desired characteristics, and collections of field samples gathered in the past can still generate new knowledge when investigated with new techniques.

The most common form of dissemination, however, occurs through the process described in the previous chapter whereby you document your research project and its results. Documented results which can be disseminated through publication could include yield figures, footprints, photo-diaries, financial records of livelihoods, designs, reviews and case histories, studies of cultures, and system parameters for experimental models. Careful assembly and packaging of sets of data with their metadata (the information which describes how they were collected, their scope, accuracy, completeness and structure) allows for their use by other researchers at a later date. On top of the objective data is your thought, investigation and analysis, discussion and comments. We want to hear that too.

Where to share?

The places to disseminate your results are where they can be found by your intended audience, both now and into the future.

- The internet - This should be a high priority as it can be accessed by so many people. Posting material on websites and blogs, including your own, is a way to place material into the public domain, and dedicated sites such as 'Plants For A Future' for perennial plant-related research or the 'Permaculture Digest' for permaculture focused material, provide a common access point for high numbers of interested viewers from around the world.



- Through academic institutions - You can contribute to the ongoing effort to raise the profile of permaculture within academia and get a published evidence base in the scientific literature by placing your results in the traditional academic channels, which are peer-reviewed journal articles and conference presentations (you are likely to need some help with this process, so contact the Permaculture Association to discuss potential academic allies). Access to the most reputable journals and talking slots is highly competitive, even among professional researchers, so it would take high quality work, considerable effort and a lot of patience to get published in some of these venues. However, it is in the nature of both permaculture and science to collaborate widely in the effort to achieve the best results, and this is something that is being worked towards.

- Friends, family and fellow Permies - The permaculture press and gatherings are opportunities to reach the home crowd, and don't forget to let people know what you have been up to round your area and over the allotment hedge. At the very least, feedback your conclusions to your research participants.

Appendix 1 - Jargon Buster

Rosie Sinfield

Here you will find an alphabetical list, and accompanying definitions, of all the words highlighted with italics throughout the text.

Anonymity – If a participant in your research does not want to be identified in your write up you may offer them anonymity. This means that you will either not use a name, or use a fake name – a pseudonym - so that people reading the research cannot identify who they are. If you offer anonymity make sure you go to all lengths to make sure it is achieved.

Closed questions - Quantitative questionnaires/interviews ask closed questions where participants choose/respond to a list of pre-decided answers. (see also: quantitative and questionnaires and interviews)

Comparative research – Comparative research is used to compare results across circumstances, for example between a control group and a treatment group or between two different types of treatment.
(see also: control and treatment)

Confidentiality – concerns who has access to data collected from participants. For example, you may ask for somebody's opinion about something under the condition that this will not be available to certain groups. Confidentiality is usually combined with anonymity to ensure that if information does reach unintended audiences they still cannot individually identify participants. (see also: anonymity)

Control - Using a control means not applying the experimental condition of a piece of research to one group of participants or plot of land/crops. This allows comparisons to be made between what would have happened under 'normal' conditions as opposed to those induced through the experiment.

Correlation – Describing something as having a correlation, or as correlating, means that two factors are directly related.* (see also: positive correlation, negative correlation and no correlation)

Desk-based research – Not all research has to involve going out and collecting your own primary data. Lots of good conclusions and discoveries can be made by looking at, collating and comparing the findings of previous research projects. Research done in this way is referred to as desk-based research.

Gatekeepers – If you do not have direct access to a group of participants/land for your research you may be able to access them through a gatekeeper: an individual/organisation that already has this contact.

Generalisability – A piece of research can be described as generalisable when it is repeatable over time and space. For example the results found in a piece of research conducted on an allotment in England are also true for an allotment in Scotland. Research which is generalisable often requires more resources, for example conducting the study in a variety of places or with a large sample of people. (see also: reliability and validity)

Interview – An interview is a form of data collection where a researcher asks a participant a series of questions. Like questionnaires these can be quantitative or qualitative but are most often qualitative. These can also be structured or semi-structured. This means the degree to which the interview is pre-scheduled and the degree to which this schedule is stuck to. (see also: interview schedule, quantitative and qualitative)

Interview schedule – An interview schedule contains a list of pre-decided questions to ask in an interview. For a quantitative interview with closed questions this interview schedule will also contain the list of answers which respondents can choose from. In a semi-structured qualitative interview this interview schedule is not stuck to strictly, allowing for a natural flow to occur, the schedule is there as a guide as opposed to a strict format. (see also: interview, quantitative, qualitative and closed questions)

Likert scale – A Likert scale is a type of closed question which can be used in quantitative questionnaires or interviews. In a Likert scale a respondent is asked to rate their agreement with a statement, for example using a measure such as strongly agree, agree, neutral, disagree, strongly disagree. (see also closed questions, quantitative, interview and interview schedule)

Literature review – All research projects involve conducting a literature review. This is a summary of all the research currently conducted in your field of interest; what is known and what is still unknown. Through presenting these previous studies a literature review orientates and justifies the current research question. A literature review is crucially important not only as an outcome but as a process. Through conducting a literature review you gain an in depth understanding of your research area, this will often lead to changes to your research question in light of previous research.

Mean – To find the mean of a data set, add all the individual pieces of data which make up the set together. After you have done this, divide this number by the number of individual pieces of data in the set. (see also: median and mode)

Median – To find the median, list each individual piece of data in numerical order. The number in the middle of the data set is the median. (see also: mean and mode)

Methods – Research methods refers to your chosen technique for gathering data, for example you may use interviews or a questionnaire to measure opinions on permaculture or crop yields. (see also: mixed methods, interviews, questionnaire)

Mixed methods – This term is used to describe a piece of research that uses both quantitative and qualitative methods together. For example qualitative interviews combined with quantitative questionnaires. (see also: methods, quantitative and qualitative)

Mode - the mode simply means the most common number in the data set. To find it, look for the number that occurs most often. (see also: mean and median)

Negative Correlation - A negative correlation means that as one factor goes up, the other factor goes down. As shade increases, crop yield decreases.* (see also: correlation, positive correlation and no correlation).

No correlation – If two factors are not related they can be described as having no correlation. (see also: correlation, positive correlation and negative correlation)

Open questions - Qualitative questionnaires/interviews ask open questions where participants are left space to write/tell their own answer as opposed to choosing from a list. (see also qualitative, questionnaire and interviews)

Positive Correlation - A positive correlation means that that as one factor goes up so does the other, for example, as sunlight increases, crop yield increases.* (see also: correlation, negative correlation and no correlation)

Qualitative – Research which analyses non-numerical data, for example written or spoken words is described as qualitative. Qualitative data is used to gather rich descriptive data, for example through interviews. ** (see also: qualitative, interview and mixed methods)

Quantitative – Research which analyses numerical data, for example the height or weight of a plant is decried as quantitative. Quantitative data is used to gather number data only, for example through questionnaires. This form of data lends itself to statistical analysis. ** (see also: quantitative, questionnaire and mixed methods)

Questionnaire – A questionnaire is a form of data collection. It consists of a written (paper or online) form of questions which participants of your research fill out with their answers. Questionnaires can be both quantitative and qualitative. (see also: quantitative and qualitative)

Reliability – A piece of research can be describes as reliable if the measures used are consistent over time. This means that a different researcher applying the same methods to the same question in the same place would find the same answer; a study which cannot be repeated by someone else is unreliable. (see also: validity and generalisability)

Standard deviation – The standard deviation of a set of statistical results tells us how much deviation from the mean average there is within this set of results. A low deviation means that the results fall close together. A high deviation indicates that the results are spread out. (see also: mean)

Treatment – The term treatment is used to describe the element of an experiment which you change (or do not change) and measure the results of. The term treatment is used in a very broad sense; as well as meaning something like the application of compost, it could also refer to different species or varieties, different locations or different times when a measurement is taken.

Validity - A piece of research can be described as valid if the measures and analysis used report on what they claim to. For example, have they actually measured the things that they claim to, and have the findings from the measurements been interpreted accurately and without bias; a study in which a researcher focuses only on findings which support their pre-determined ideas is not valid. (see also: reliability and generalisability)

* Correlation does not necessarily indicate causation, always be sure not to assume that because one factor is related to another that this means that one causes the other or visa-versa.

**Non-numerical qualitative data can be turned into quantitative data by assigning categories and counting frequencies. For example, by recording how many times certain words are used in an interview, counting and recording numerically different categories of colour variation of a crop, or recording the frequencies of each answer given on a questionnaire.

Appendix 2 – Templates and Practical Examples

Forest Garden Interview Schedule – Barney Thompson

As explored through **chapters 5 and 6,** a popular way of collecting qualitative data is through conducting interviews. The following is an example of an interview schedule which was used for collecting data for a piece of research conducted by the Permaculture Association. This research sought to explore ecological, economic and social aspects of forest gardens.

Interview Schedule

Project name: Interviewee name:

Date of interview: Interviewer name:

1 – Are you happy with the progress of your Forest Garden thus far?

2 – What have been the biggest gains / strengths thus far?

3 – What have been the biggest struggles / weaknesses thus far?

4a – What do you feel can be learnt from these weak points and how will you adapt in the future?

4b – If you could what would you change about your Forest Garden?

5 – What community involvement have you had with your project and do you keep records of these activities?

6 – What advantages do you gain from this involvement?

7 – Do you run any events or courses on your site?

8 – Do you keep a record of your accounts?

9 – Do you have a planting scheme of the Forest Garden?

10 – What plants are within this scheme (see list)?

11 – Do you keep any record of yield output from your Forest Garden?

12 – Do you carry out soil tests at your Forest Garden?

13 – Have you observed any changes to the biodiversity of the site since the implementation of the Forest Garden?

14 – How do you feel you could be better supported in your work?

15 – What would be the most convenient platform for a peer-to-peer support group to be setup?

16 – What were your reasons for starting up a Forest Garden?

17 – Have you learnt any new skills from your involvement in Forest Gardening?

18 – Has your participation in Forest Gardens affected your diet?

As well as interviews in person, the Forest Gardens research also collected data from participants over the phone. This data was recorded using a spreadsheet, shown below. One aim of this exercise was to find out what data the projects involved were already collecting, using a simple tick list. This established that lots of data was already being gathered, and saved replication of effort. The second aim was to gather a range of basic information about each project before conducting a site visit and interview.

Type	Item	Collect/Comments
ECONOMIC	Accounts	
	Sales of edibles	
	Sales of non-edibles	
	Purchases of edibles	
	Purchases of non-edibles	
	Visitor income	
	Event income	
	Course income	
	Staff/volunteer expenses	
	Staff/volunteer hours	
	other	
SOCIAL	Visitor type/number	
	Event log/type	
	Volunteer hours	
	Accredited learning	
	other	
ENVIRONMENT	Biodiversity	
	Soil	
	other	
PRODUCTIVE	inputs	
	outputs	
	amount of edibles	
	amount of non-edibles	
	other	
GENERAL	Funding apps/reports	
	Journal etc	
	other	
Size		**SEE REPORT**
Location		
Plants		
(layers, incl. non-edibles)		
Other parts of site		
Current FG Activities		

Participants/volunteers		
Partner orgs.		
What could help you the most?		
Key constraints?		
Your biggest success?		
Your biggest fail-ure/disppoitments?		
Future Plans for site		
Aims/Vision		
length of time for whole project		
Length of time for FG		
How long is their involvement?		
Their role		
Their background/experience		
How long for others' involvement?		
Others' roles?		
Others' background/experience		
Grant spend		All spent on plants
Amount of data have capacity to collect		
(people, time, ability)		

Soils Test participant instructions – Tom Kennedy and Chris Warburton Borwn

The following is an extract from a 'soils test' study undertaken by the Permaculture Association. The purpose of this research project was to gather data on the quality of soils on permaculture growing sites. This study is a good example of how to formulate research which is to be carried out by a number of different participants. Note how clearly the instructions are formulated. Details such as what equipment will be needed and how to select a site as well as point by point instructions on how to conduct the experiment are crucial.

Selecting sample locations

When selecting the place to conduct your test, it is important to pick a sample spot that is typical of the site. There are several important factors to consider:

- **The slope or gradient relative to the rest of the site**
- **The drainage of the soil (is it wet and waterlogged or dry?)**
- **What has the soil been used for (Edible, non-edible etc)**
- **Ideally the soil has not recently been disturbed (not recently harvested, tilled etc)**
- **The soil should be bare (you can clear away any grass or vegetation just before you do the test)**

Equipment you will need

- **Empty baked bean tin**
- **gardening gloves**
- **500ml bottle**
- **Distilled/rain water**
- **Timer**
- **Spade**
- **Ruler/Tape measure**
- **Plastic sheet (bin liner)**
- **Flat bottomed plastic container**
- **Fine tip marker pen**
- **Mustard sachet**
- **Glass Jar**
- **pH paper**
- **pH chart**

Main Soil tests

1. Drainage

Purpose:
To test how well water drains through your soil. Drainage is important if your soil is not going to get waterlogged in wet weather. Clay soil will drain more slowly than sandy soil. Heavily compacted soil will not drain well. Shallow soil will not drain well.

The infiltration test:
Equipment: Empty baked bean tin, gardening gloves, 500ml bottle, distilled/rain water, timer

1. Remove the top and bottom of the tin so you are left with a metal tube
2. Wearing gloves, firmly push the tin into the soil (a piece of wood and a hammer can help with this in firm soil) until it is half-way in
3. Gently use your finger to firm the soil around the edge of the ring, taking care not to disturb the soil in the middle
4. Pour 500ml of rain/distilled water as gently as possible into the tin
5. As soon as you start pouring start the timer
6. Stop the timer when the soil surface is glistening rather than submerged
7. Record the time this took.

2. Earthworms

Purpose:
To establish how many earthworms are in your soil. They are a proxy for all biological life in the soil, large and small.

Earthworm count:
Equipment: Spade, ruler/tape measure, plastic sheet (bin liner), distilled/rain water, plastic container, sachet of mustard sauce.

1. Dig a 20cm x 20cm pit with a depth of 10cm.
2. Place soil on a flat surface (bin liner recommended).
3. Count the number of earthworms and place them in a container with some loose soil.
4. Mix a sachet of mustard sauce with 750ml of water and pour it into the pit to extract deep-burrowing earthworms.
5. Wait for 3 minutes then repeat steps 2-4.
6. Record the total number of earthworms and return them all to the soil.

3. Top soil depth

Purpose:
To measure the depth of your top soil. The deeper the top soil, the further roots can grow and the more water and nutrients will be available. Deep soil will also drain better than shallow soil.

The soil depth test:
Equipment: Garden spade, ruler/ tape measure

Warning: This will be hard work so please don't overdo it!

1. **Dig a hole at least 60cm deep if possible.**
2. **If you cannot easily reach this depth make a note in the records section**
3. **Make a note of the top soil depth. Only measure the top soil; sub soil will be much more compact and probably a different colour. Record which of the following bands it falls into:**

- **very shallow (<15 cm)**
- **shallow (15-30 cm)**
- **moderately deep (30-60 cm)**
- **deep (>60 cm)**

4. **Record your results.**

Appendix 3 - Resources

Reading Resources:

Bell, Judith (1999) *Doing your research project: A guide for first-time researchers in education and social science*. Open University Press.

Bryman, A, (2008) *Social Research Methods,* New York: Oxford University Press.

Chalmers, N. and Parker, P. (1986) *Fieldwork and statistics for ecological projects:*

The OU project guide. Taunton: Field Studies Council/Open University.

Flowerdew, R and Martin, D (1997) *Methods in Human Geography: A Guide for Students Doing A Research Project*, Essex: Pearson Education Limited.

Fowler, J., Cohen, L. and Jarvis, P. (1998) *Practical statistics for field biology*. Wiley.

Heath, David (1995) *An introduction to experimental design and statistics for biology*. UCL Press.

Henderson, P.A. (2003) *Practical methods in ecology*. Blackwell Publishing.

Kent, M. and Coker, P. (1992) *Vegetation description and analysis*. A practical approach. John Wiley and Sons.

Parsons, T. and Knight, P.G. (1995) How to do your dissertation in Geography and other disciplines. London: Chapman and Hall.

van Emden, Helmut (2008) Statistics for terrified biologists. Blackwell Publishing.

Gliessman, S (2006) *Field and Laboratory Investigations in Agroecology.* CRC Press.

Software Resources:

Kovach Computing Services sell a range of statistical software for quantitative, qualitative and multi-variate analysis. Find them at: - www.kovcomp.co.uk/.

There are various spreadsheets with graphical functions, including OpenOffice and Microsoft Excel. – You can download Open Office from the following link for free: www.openoffice.org/download/.

A list of free statistics packages can be found from the following link: freestatistics.altervista.org/en/stat.php

Picture Credits

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