Guidelines for writing a naive search

1) Identify your research question. Clearly articulate in one sentence what the question is that you are trying to answer with your review.

2) Identify your concept groups. Public health and medical reviews generally use the PICO (Population, Intervention, Control, Outcome) format for identifying concept groups. This approach would translate well for many cases where environmental management is the subject of a review, or where experimental tests are being done, but it does not translate as well to other areas of ecology or evolutionary biology where systematic reviews are conducted. In these cases, one can think of population more broadly as the study system, intervention as the predictor variables, and outcome as the response variables. The control group will not always be relevant. Sometimes, you will want your population to be composed of two concept groups separated by "AND", for example if you need to capture both the taxa and habitat. For example, you might want to separate out "forest-dwelling birds" into ((words for birds) AND (words for forest)).

3) Use your prior knowledge or consult with colleagues or experts in your field to generate an initial list of search terms that fit in your concept groups. litsearchr should pick up on important terms you missed, but you want your naive search to be as relevant to your topic as possible. Otherwise, it may return too many irrelevant results, which will dilute the keyword co-occurrence network and result in suggested keywords that are not as relevant to your question. Carefully consider whether any of your search terms are "unsearchable" because of ambiguous meaning. For example, if you are interested in the distribution of black-backed woodpeckers (*Picoides arcticus*), you would not want to search for (distrib* AND woodpecker*) because this will also pick up any papers about woodpeckers that include phrases such as "the data were normally distributed". When choosing terms, be sure to not only think laterally (synonyms), but also vertically (different levels of your term). For example, if you are interested in pair bond maintenance behaviors then you also should include terms for specific examples of those behaviors, such as allopreening or triumph ceremonies.

4) Combine your concept groups into a search string. Use Boolean operators and, if applicable, truncation to write your search string. Consult with an information specialist to ensure you have written the search properly and that it is formatted for the platforms and databases you are running the naive search in.

The two Boolean operators that almost every search string will contain are OR and AND. The OR operator will search for either one or both of the terms on either side of it. For example, searching "bird OR avian" will return articles that contain either bird, avian, or both. The AND operator will require that the terms on either side of it both be in an article. These operators can be combined with parentheses to change the order of operations. Operators within parentheses will be evaluated before those outsides of parentheses. To search for articles about birds that also mention territoriality or aggression, you would search for "(bird OR avian) AND (territoriality OR aggression)" which would allow for multiple combinations (e.g. bird + aggression, bird + territoriality, avian + aggression, etc...).

In general, it is best to use truncation and stemming in your naive search and in your final search. By adding an asterisk (*) to a word stem, you will capture word forms as well. In the example above, this would mean searching for "(bird* OR avian) AND (territor* OR aggress*)" which would expand the terms: (1) bird would include birds, (2) territoriality would return territory, territories, and territorial, (3) aggress* would include aggression, aggressive, aggressor, etc. As a general rule, never truncate a word to fewer than 3-4 characters. Think about other potential words you could be capturing from the truncated root word. For example, if you want articles about cats, you wouldn't want to include cat* in your search to represent both "cat" and "cats" because your search will also capture words like: cation, catheter, catapult, catastrophic, etc...

5) **Assess how discrete your search is and modify as needed.** Try running your search in a major database/platform (e.g. Scopus) to see how many hits you get and how relevant they are to your core question. The number of hits you get will depend on how broad your question is, but generally speaking, if you get more than 700 for a narrowly defined question or more than 1500 for a broader question, you are not being precise enough and the keywords that litsearchr identifies will not be as relevant because the keyword co-occurrence network will be diluted by irrelevant studies. If you are getting too many hits, consult an information specialist to help identify which terms are inflating search results.

Resources relevant to writing search strategies:

Collaboration for Environmental Evidence. 2018. Guidelines and Standards for Evidence synthesis in Environmental Management. Version 5.0 (AS Pullin, GK Frampton, B Livoreil & G Petrokofsky, Eds) www.environmentalevidence.org/information-for-authors.

Stewart, G., Côté, I., Rothstein, H., & Curtis, P. (2013). First Steps in Beginning a Meta-analysis. In Koricheva J., Gurevitch J., & Mengersen K. (Eds.), *Handbook of Meta-analysis in Ecology and Evolution* (pp. 27-36). Princeton University Press.

Côté, I., Curtis, P., Rothstein, H., & Stewart, G. (2013). Gathering Data: Searching Literature and Selection Criteria. In Koricheva J., Gurevitch J., & Mengersen K. (Eds.), *Handbook of Meta-analysis in Ecology and Evolution* (pp. 37-51). Princeton University Press.