

*New Idea***The ‘Research Derby’: A pressure cooker for creative and collaborative science****Brett Favaro¹, Douglas C. Braun, and the Earth₂Ocean Research Derby²**

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Abstract

Ecology and evolution research benefits when scientists engage in meaningful collaborations. However, making time for such efforts is difficult, particularly for early-career graduate students who are often focused on an independent and self-driven research program. Here, we introduce the concept of the Research Derby, a collaborative and semi-competitive workshop where teams are given 24 hours to complete a research project. This ‘pressure-cooker’ environment is designed to give scientists a fun and short-term opportunity to conduct research outside their primary field, promote skills exchange within the research group, and ultimately produce high-quality scientific publications. In this manuscript we outline the goals of the Research Derby, explain how to set up such an event, and recount our experiences running a Derby within our research group at Simon Fraser University, Burnaby, B.C., Canada. We argue that Research Derbies have the potential to achieve creative and collaborative high-impact science, and are a fun and productive research activity.

Keywords: Research methods, working group, skills development, graduate training, education, hackathon

Background

Collaboration is essential to producing cutting-edge research in ecology and evolution. Modern science requires teamwork to incorporate a broad range of disciplines and expertise necessary to produce outstanding research. The value of collaboration can be clearly measured. Papers with more authors are cited more often (Leimu and Koricheva 2005, Borsuk et al. 2009), and if the authors are from multiple institutions, the paper’s impact increases further (Figg et al. 2006). Therefore, opportunities to engage fellow researchers in collaborations should be actively pursued wherever appropriate.

Despite the clear value of collaborative research, these opportunities are rarely built into the fabric of academic science, particularly in graduate studies. Instead, academic research labs are typically built around a single principle investigator who supervises several graduate students. Each student project is independent—i.e., that student “owns” an area of research and must complete a program around that topic. While lab meetings, conferences, and other venues offer opportunities to discuss results, the project is ultimately driven by a small number of individuals, often just the graduate student and their supervisory

committee. In some cases, co-authorship of manuscripts is even discouraged, owing to the perceived reduction of one's contribution to the manuscript.

How can the need for graduate students to direct their own independent research programs be reconciled with the many benefits of teamwork and collaboration? We have developed a solution through a novel exercise that we have termed the 'Research Derby.' The Research Derby is a workshop in which participants join into small teams, and spend a short, intense period of time (typically 24 hours) generating a research question, gathering data, conducting analysis, and ultimately presenting their answer to a problem. The Research Derby was inspired by Google's '20% rule' which recognizes the importance of spending time on side projects (Atwood 2012), 48-hour film competitions, and other short, competitive, intensive events designed to stimulate productivity within severe time constraints.

The Research Derby is meant to achieve three main goals. First, provide a stimulating environment for researchers to pursue novel projects whose scope may be wider than their primary field of study. Second, promote the exchange of skills and ideas between peers. Third, promote the publication of these projects after the conclusion of the Derby itself, so that the findings benefit science as a whole. Equally important, it is designed to make science fun.

In this paper, we outline how the Research Derby works, describe a completed Research Derby that we conducted at our university (Simon Fraser University, Burnaby, Canada), and show how follow-up work can be conducted after the event to communicate the work in the form of scientific publications.

The Research Derby:

In a Research Derby, groups compete to bring a research project from start to finish within an allotted amount of time—and the 'best' research project wins. The group must complete four stages: (1) determine a research question, (2) collect data, (3) analyze the data, and (4) present the synthesis at the completion of the event. At the conclusion of the event, groups deliver a 15-minute presentation of their findings, which should describe their research question, the data collected to answer their research question, and place their findings into appropriate context (i.e. describe everything that they would describe if trying to publish the finished product). The deliverable should be as complete as possible at the end of the allotted work time. After the presentations, a vote is taken to acknowledge the 'best' project. Below, we describe the steps to hosting a Research Derby event, and outline some key guidelines for organizers to follow in setting up a successful workshop.

Step 1: Select a theme

Unlike a conventional research workshop, the specific research objective is not set prior to the start of the event. Rather, we suggest that Derbies should be guided by a research theme. For example, teams could focus on a research prioritization document, such as Sutherland et al. (2009), which outlines 100 important questions in applied ecology. A Derby theme could be for teams to attempt to answer any of these questions. Other options include having a small committee of organizers determine a research theme, or the participants could vote on a theme before the start of the event. In any case, the theme should serve as creative inspiration for research projects rather than as a rigid framework that constrains group activities. Organizers should be mindful that broad, general themes will invite more interdisciplinary collaboration than narrow, specific themes.

Step 2: Create Research Teams

We suggest that teams should be composed of no more than four people, preferably distributed across experience level, so that senior and junior members of the research group will have the opportunity to work together. Faculty can participate in research groups, but we suggest that they do so with the understanding that they will be treated as equals (i.e. not given disproportionate influence on setting the team's research agenda). It is important that there be no pre-determined hierarchy within research teams, so that good ideas can be developed regardless of who proposes them. If this is not possible given the group dynamics, an alternative approach would be to have all-faculty teams. We recommend that researchers be randomly assigned to teams, and not be told who they will work with until the start of the Derby, ensuring that groups do not begin work prior to the start of the event. Preventing groups from self-selecting will make it less likely that people will segregate based on their familiarity with each other.

Step 3: Determine the event structure and schedule

We recommend that a Research Derby be constrained to 24 hours of work, which can be done consecutively (e.g., the IEEEExtreme 24-hour programming competition, <http://www.ieee.org/xtreme>) or spread out over several days. The most important factor is that the time is less than participants think they need. This serves two purposes: it minimizes the footprint on people's schedules, and it adds intensity to the event that researchers may not be accustomed to in ecology and evolution research, which often requires months or years of largely isolated research.

Step 4: Execute the event

At the start of the event, all participants gather together and are organized into their teams. Groups then retreat to separate quarters where they will work exclusively until the completion of the Derby. We recommend that groups not communicate with each other about their research projects until the end of the event. This is to enable the generation of independent ideas within each group, and to reduce early dismissal of interesting and novel ideas before they develop—something that tends to occur in large group environments. While this may seem counterintuitive to a collaborative event, we recommend that time be set aside later for all groups to discuss their projects.

Groups have to decide for themselves how to spend their limited hours of work, but will need to manage their time wisely: they must conceive of a question, collect data (if necessary—purely theoretical projects would be possible too), conduct their analysis and synthesis, and construct their presentation, all within their allotted work time. At the conclusion of the work time, groups present their projects, and a winner is determined (i.e., all participants vote by secret ballot on which group they think produced the best project). This can be done by a simple poll of participants, and/or by invited judges (e.g., faculty members that did not participate on a team). We suggest that the research group establishes its own collective criteria for what constitutes the ‘best’ project. Some examples of criteria could be the relative novelty of each project, its potential impact, or the policy relevance of the research question. Presentations should be scholarly and professional, but the environment should be relaxed and encouraging (i.e., food and drinks should be served). After the presentations and selection of a winner, we recommend that groups co-mingle to exchange stories and dialogue about their respective projects in a relaxed social setting.

The 2011 Earth to Ocean Research Derby

The Earth to Ocean Research Group (www.earth2ocean.org) is a multidisciplinary association of six faculty members and their graduate students within the Department of Biological Sciences at Simon Fraser University, Burnaby, BC, Canada. In 2011, members of our group joined together to conduct a Research Derby. We had 16 participants in our event (9 Ph.D. students, 4 M.Sc. students, one undergraduate student, and one non-student staff member) whose primary research focused on a wide variety of applied topics, including community ecology, species invasions, population dynamics, and fisheries science. We randomly assigned the participants into four teams of four researchers each. During the Derby, teams worked in separate rooms and did not

communicate with each other, except socially at mealtimes.

We built our event around the research theme of ‘important applied conservation questions’. Prior to the Derby, participants read Sutherland et al. (2009), and the mission was for groups to address one of the questions in the document, or use the questions as inspiration for related project ideas. We began the event on June 2, 2011, which was a Thursday afternoon, and allowed for a total of about 24 work hours over the course of three days (Figure 1). We concluded with presentations on Saturday afternoon. The four groups used the time in roughly the same manner: they developed research questions on the Thursday afternoon; spent Friday gathering, organizing, and analyzing data; and spent Saturday morning building the presentation.

Teams were surprised at the volume of work they were able to achieve, and the intensity of the collaboration that occurred in this relatively short period of time. The intensive work period encouraged teams to employ effective division of labour, with some teammates collecting data while others wrote code, prepared databases, or reviewed literature about the team’s research topic. This created an opportunity for individuals to share their strengths by working closely with their teammates. Groups used collaboration technologies, such as Google Docs, Dropbox, shared databases, and other tools that some individuals in our group had limited experience with prior to the event. Even selecting the group’s research topic was an exercise in teamwork, as four people with distinct and differing interests had to quickly agree on a team research program for the event.

In order to complete their projects on time, teammates shared their knowledge about how to complete tasks quickly—whether it was sharing statistical information, R scripts, or even keyboard shortcuts and other software tricks to speed up workflow. In addition, it forced researchers to stay focused on the overall goal of completing the project and avoid getting stuck on minor details or exploring tangential ideas. This team focus resulted in synergistic teamwork that quickly generated interesting and pertinent research questions, while also building the database and analytical foundations for answering these questions.

Follow-up and publication

Following the Research Derby event, our group decided how to proceed with publishing their work. During the Derby, four teams each came up with a distinct project (Table 1), which were driven by publically-available online data, and were synthesized in the presentations given at the end of the event. Each communication in the form of a publication. Hence, we

Figure 1. Work schedule for the Earth2Ocean Research Derby. Participants had slightly less than 24 hours to complete their projects. For the “work time,” teams did not interact with each other, aside from socially at mealtimes.

Time of Day	Thursday	Friday	Saturday
9:00		Work time <i>Teams collect data, conduct analysis, and synthesize their results</i>	Work time <i>Create and rehearse presentations</i>
10:00			
11:00			
12:00			
13:00			Presentations <i>Teams deliver talks, and projects are discussed among groups</i> <i>Group votes to select ‘best project’</i>
14:00			
15:00			
16:00	Group Meeting <i>Establish teams and rules of the Derby</i>		
17:00	Work time <i>Teams develop research questions</i>		
18:00			
19:00			
20:00	<i>Data collection begins</i>		
21:00			

project had promise, but some were more worthy of had to make a collective decision as a research group about how to proceed.

We held a meeting approximately two weeks after the Derby where we discussed which project or projects we wanted to develop into full manuscripts. During this process we weighed the novelty of each project, the validity of our approach, the potential impacts of the findings, the relative amount of further work required to create a manuscript suitable for publication, and the time that people had available to complete these tasks. To date, one project has been carried all the way forward to publication (Phillis et al. 2012), with which all individuals assisted. This project happened to be winner of the ‘best project’ award at the conclusion of our Derby as voted by the participants.

After deciding on which project to develop, we assigned tasks to individuals. In order to complete the paper we needed to create figures, gather additional data to supplement our findings, write and edit sections of the manuscript, and submit it for publication. It took a full year to publish a final paper from the Derby project. While a core group of authors acted as the facilitators for the project, and ensured that we met milestones and target dates for task completion, distributing tasks across Derby participants helped to reduce the task load

for any one individual. We assigned authorship order as follows: the four authors who spearheaded this Derby project were listed first, followed by other significant contributors and the Derby participants as a group author, with BF listed last because of his direct contribution to the paper and as the main facilitator of the Derby itself. Our paper was subsequently published in the journal *Conservation Letters* (Phillis et al. 2012). It has already received one citation at the time of writing, and earned an Altmetric score of 26, placing it in the top 5% of all tracked articles (http://altmetric.com/details.php?citation_id=954787).

Discussion

The Research Derby was a resounding success within our research group. The event created collaborations and interactions among researchers within our lab group that would not have existed otherwise. The resulting paper was the first scientific publication for many participants, giving them a head start on understanding the requirements and challenges of the peer-review and publication process. In addition, it was many participants’ first experience collaborating with a researcher who was not an academic supervisor or committee member.

Table 1. Summary of four research projects conducted during the 2011 Earth2Ocean Research Derby.

Project title	Central question	Method and outcome	Derby Team Members
Multiple pathways to conservation success	What is the relationship between scientific research, popular news articles, and government policy on conservation outcomes?	Used Google News archives and Web of Science to plot frequency of publication on a given topic over time for three case studies. Directionality of effects was variable—sometimes science came first, but not always. Directionality of influence was variable based on case study (see Phillis et al. 2012).	Jeanette E.B. Bruce, Stephanie J. Green, Sacha M. O'Regan, Corey C. Phillis
Does research prioritization actually influence research topics?	Research prioritization workshops such as Sutherland et al. (2009) are popular scientific tools. Have the outputs from these “horizon scanning” workshops influenced current research?	Conducted a systematic review of search terms to see if ecology and conservation literature shifted towards the use of terms outlined in Sutherland et al. (2009). Results were mixed, and the group decided that insufficient time had passed to detect an effect in the literature.	Sean C. Anderson, Lucy R. Harrison, Jennifer N. Harding, Noel R. Swain
Governance, corruption and conservation outcomes	Do countries with good governance and less corruption experience more conservation success?	Examined changes in species risk status as a function of governance indicators for countries around the world.	Lindsay Davidson, Christopher Mull, Jennifer Sunday, Natascia Tamburello
Human health and ecological footprints	How do human health metrics correlate with a country’s ecological footprint and what factors drive this relationship?	Countries with higher average caloric consumption have higher ecological footprints, but also higher measures of human health. Countries that consumed more animal protein had proportionally higher ecological footprints than countries with plant-based diets.	Michael P. Beakes, Douglas C. Braun, Emily S. Darling, Brett Favaro

Our event did not proceed without some challenges. Students who had never worked closely together had to quickly converge into functioning team units within the limited time provided by the event. The speed and intensity at which they worked resulted in some personality clashes and other stressful situations—and due to the structure of the groups (i.e. mostly students), there was no established hierarchy with which to resolve these issues. Rather, teammates had to band together and overcome personal disagreements. Even once the Derby was complete and the larger group was collectively working on our publication, there was some disagreement about the best way to complete the paper. Different work schedules and commitment levels to the project had to be overcome, again without an established hierarchical structure. However, these were all challenges that researchers will undoubtedly encounter, regardless of what career they ultimately pursue. Expos-

ure to these situations can be beneficial to graduate students early in their career, and the Research Derby provided exposure to all aspects of collaboration—both beneficial and challenging. These experiences informed the guidelines that we propose for managing a future Research Derby event (Box 1).

We conducted a survey at the conclusion of the Earth to Ocean Research Derby to assess participants’ opinions of the event and whether they would want to repeat it in the future (Appendix). All but one participant responded, and indicated that they believed the Research Derby to be a good use of their time, that it was fun, and that they would like to do another Derby in the future. All but one respondent agreed that as a result of the Research Derby, they would be more likely to collaborate with their labmates on future projects.

Our efforts have produced one complete publication in a high-level peer-reviewed journal (Phillis et al.

Box 1: Guidelines for conducting a Research Derby

A Research Derby is designed to inspire participants to explore questions outside of their comfort area, while encouraging the exchange of knowledge within teams and within the larger research group. Consequently, rules should be kept to a minimum. However, a few basic guidelines are necessary to ensure the success of the workshop.

1. Work only within the designated work times. This exercise should not be excessively burdensome on anyone's work schedule, or else it would no longer be fun.
2. Before the event, hold a short set-up workshop that serves as a launch pad for the Derby itself. At this workshop, explain how the Derby will work, and collectively determine the workshop's theme, to help groups construct novel and interesting research questions when the event begins.
3. All participants will be recognized for their efforts on any published product that the group produces. Authorship on publications are subject to the requirements of the journal at which the paper is submitted, therefore recognition may need to be flexible. For example, list your Derby as a working group author to recognize participants that may not individually meet the requirements of authorship (e.g. Phillis et al 2012, this paper) but participated in the Derby and contributed to shaping final publications (i.e. comments and ideas throughout the publication process). Authorship credit serves to ensure 'buy-in' when the group is trying to publish the final product, and will benefit participants by demonstrating their experience with scientific publishing.
4. Participants must be team players. One of the main goals of the Derby is to generate new ideas and share skills among participants. Individuals must support their team by participating for the entire duration of the Research Derby, and should strive to be inclusive and positive towards unconventional ideas. Teams should avoid establishing hierarchies based on participants' seniority.
5. Participants should feel free to explore ideas that are outside of the general research group's current focus.

2012) as well as three other projects that exposed us to areas of research outside the focus of our thesis programs. The Research Derby reminded our group that

while ecology and evolution research is hard work, it can also be fun. Modern data availability makes it possible to quickly generate ideas and conduct scientific research, and it can be done in a way that is minimally intrusive on peoples' schedules. The open structure of the Derby also enables participants to explore non-data projects, and generate theoretical ideas, synthesize literature, or conduct any exercise they wish within the 24 work-hours of the event. By exposing researchers to new methods, techniques, and tools, we expect that participation in Research Derbies will also teach researchers to improve the efficiency of their workflow in their main research programs, thereby increasing their ability to publish prolifically.

The Research Derby was a novel and effective idea-generation tool that promoted team-building, exchange of information within the research group, and enabled us to develop collaborative skills that are essential in the field of ecology and evolution. The success we found by using this tool suggests that high-intensity events can supplement a research group's day-to-day work and may benefit any large research team.

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Referees

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Response to Referees

Both Thornhill (2013) and Donaldson (2013) explored the role that Research Derbies could play in the conduct of ecology and evolution research within research groups. Donaldson (2013) focused on how Derbies can stimulate prolific development of high-quality research projects, and in building the professional networks necessary to make these projects successful. Thornhill (2013) found that it was difficult to determine the optimal assemblage of people to invite to participate in a Derby that he began to organize at the University of Birmingham. If it was too broad, it would be hard for groups to determine an acceptable research topic. Too narrow, and the groups would lack the diversity needed to tackle an interesting and novel project.

We believe that people interested in trying a Research Derby should not worry about being overly cautious in determining who to invite, and from what disciplines they should be invited. The point of the event is to work outside of one's comfort zone, such that creative and interesting projects can emerge. At the very least, individuals will gain practice and familiarity with working collaboratively—something that is often lacking, particularly for early career researchers.

We strongly agree with Donaldson (2013), who identified that Research Derbies have the potential to increase the quantity and quality of output of a given research group. A favourite quip of ecologists is that ecology is not rocket science—it's harder (Hilborn and Ludwig 1993). If this is true, then it is worth reflecting

on the role that collaboration played in this “easier” field. The Apollo program employed over 400,000 people from an incredible diversity of professional disciplines (Hansen 1995). Engineers, physicists, test pilots, computer scientists, and even doctors and physiologists collaborated (supported by \$100 billion in 2013 dollars) on a project that dwarfs most ecology and evolution research in terms of scale, impact, and historic significance.

What would happen if 400,000 people devoted themselves to a unified project in our discipline? We do not know, but for this to occur we need to be comfortable with the concept of working with others, particularly those who may not speak the same academic language that we do. We hope that the Research Derby will provide a tool that will facilitate the sorts of collaborations that make cooperation fun, such that researchers in our field will want to reach out and work together in new, creative and inspiring ways.

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