
Article:
Schofield, Arthur John orcid.org/0000-0001-6903-7395, Wyles, Kayleigh, Doherty, Sean et al. (3 more authors) (2020) Object Narratives as a Methodology for Mitigating Marine Plastic Pollution:a New Multidisciplinary Approach, and a Case Study from Galápagos. Antiquity. pp. 228-244. ISSN 0003-598X

https://doi.org/10.15184/aqy.2019.232

Object Narratives as a Methodology for Mitigating Marine Plastic Pollution: a New Multidisciplinary Approach, and a Case Study from Galápagos

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Abstract

Over the past few decades, marine plastic pollution has become a major environmental concern with its impact being felt across the globe. With close reference to approaches in contemporary archaeology, object biographies and psychology, this paper presents the application of a novel type of 'World Café' methodology that aims to not only further understand marine plastic pollution, but can be used as a valuable tool to encourage behaviour change. After presenting the research context, this paper demonstrates proof-of-concept through an event involving local people in Galápagos, Ecuador in May 2018, alongside a brief summary of some results.

Introduction

The ubiquity and consequent popularity of plastic is undeniable (e.g., Madden et al. 2012). However, alongside obvious benefits it also has evident costs to the environment and society when it becomes waste (see Gabrys et al. 2013; Barthes 1972 [1957]), giving form to a 'very disturbing future' (Hawkins 2018: 101). Often

seen as a disposable material (e.g. single-use packaging), the *use* of plastic can have a very short use life, yet its durable material means the story lasts far longer. With a small proportion of plastic waste being incinerated (12%) or recycled (only 9%), the majority ultimately goes to landfill or enters the natural environment (Geyer et al. 2017). It was recently estimated that nine million metric tons of plastic waste enter the oceans from land each year (Sherrington 2016). It is hard to imagine that, when Baekeland invented Bakelite in 1907, there would be soups of plastic floating around the globe on ocean currents within 100 years; or that every beach ever encountered, including in remote places like Galápagos (Ecuador) and Antarctica, would have plastic washing up with almost every tide (Obbard et al. 2014; Thompson et al. 2009; Woodall et al. 2014; and see Lavers et al. 2019 for plastic accumulations at another remote island group off Australia).

Plastics can have lethal and sub-lethal effects on wildlife, from processes such as ingestion, entanglement and chemical contamination (e.g. Gall and Thompson 2015; Wilcox et al. 2015). Plastic waste has also been demonstrated to have a social cost, such as negative economic impacts to maritime industries but also to our health and wellbeing (Beaumont et al. 2019; Kershaw and Rochman 2016; Wright and Kelly 2017; Wyles et al. 2016). Galápagos is no exception to this problem and against this background, in May 2018 a group of scientists and stakeholders (see Acknowledgements) met in Galápagos for a ‘Science to Solutions’ workshop. In total 82 representatives (representing 16 organisations) from Ecuador (81%), the UK (16%) and overseas (3%) attended the workshop over the course of four days with the aim of:

- gathering evidence on the impacts of plastics on Galápagos wildlife;
- finding out what the major sources and sinks of plastic pollution are in Galápagos, and how they can be tackled more effectively;
- working with science and businesses to find sustainable solutions; and
- building on existing education programmes to empower local community champions to promote behavioural changes towards plastic usage.

Central to the four-day workshop was a ‘World Café’ event involving a combination of the Science to Solutions project team (as participants and facilitators) and

members of the local community. This event will be discussed further below, as Stage 3 of the methodology.

Some of the methods used to understand marine plastic pollution are already well developed and tested. What has not been attempted before is the close collaboration between disciplines across the natural sciences, social sciences and humanities and, more specifically, within that wider multidisciplinary context, the close alignment of archaeological and behavioural methods centred around local communities and co-creative storytelling. This is not the first time archaeological approaches have been taken towards beach (or 'drift') materials (e.g. Pétursdóttir 2017). But here the archaeological focus is on object narratives, set within the context of archaeologies of the contemporary past (e.g. Harrison and Schofield 2010), and 'garbology' (or 'basurologia' in Spanish, the archaeological study of modern rubbish) in particular (e.g. Reno 2013, Sosna and Brunclikova 2017).

This paper describes an innovative and multifaceted methodology built around co-creation and the collaborative opportunities provided through archaeology and behavioural psychology. The paper includes a short summary of the results, as proof of method. A more detailed analysis of results and impacts will be published separately (Schofield and Wyles forthcoming).

Through close examination of items of marine waste, and developing 'intimate relations' with it (Moreu and Goméz 2019), including story-telling, we argue that participants will be encouraged to think differently about it, to develop empathy towards the landscape on which it has an impact, and adjust their behaviours accordingly.

Research Context

Objects have a life, and have agency (Olsen 2003; see also Moreu and Goméz 2019, on objects as 'actants'). They are not merely a product of society, but are fundamental to it (Thomas 1996); they have become intimately entangled with us and with society (Moreu and Goméz 2019, 321 and Turkle 2007). As Joy (2009) has observed, in some societies objects take on the personalities of people or have lives

that are similar to people's lives. It therefore seems logical to apply a biographical approach to objects, to reveal their life histories, and notably their relationships to people through the course of their lives, an idea first promoted by Kopytoff (1986), and later by Gosden and Marshall (1999), amongst others.

But there is a difference between object biographies, being the 'histories' revealed by exploring and understanding the actual relationships between people and things, and object *narratives*, being stories about objects, that may contain elements of fact, but may equally be speculative and fictional (Herman 2009). In archaeological work there is often a fine line between biography and narrative. The work presented here has elements of both. There is an aspiration towards object biography, but a realisation that more likely are *possible* trajectories in an object's life, and the various courses objects *may* have taken to reach their current location and life stage. By combining these narratives with closer (including some scientific) analysis, a better understanding of the sources and pathways of plastic items can emerge. How did they get here, and what behaviours caused their lives to follow a particular course that resulted ultimately in marine pollution? Oceanographic research also forms part of the narrative, providing data on likely geographical sources thus narrowing the area of search within which the 'taps' responsible for the flow of plastic might be found.

As Humphries and Smith (2014: 478) have noted, narrative theorists, 'treat objects as things to tell stories *with* or *about* or to narrate meaning *through*' (emphasis in original). Objects thus become the central character within stories. They both produce and participate in narrative production (ibid), while also and vitally making a difference through their role and position as agents, or entities with the capacity to *do* something (ibid.: 479 and Latour 2007: 53). These principles form a starting point for the methodology, alongside the recognition of the benefits of storytelling in co-creative and community led conservation practice (e.g. Gislason et al. 2018; Fanini and Fahd 2009) and the importance of wider 'storyworlds', the universes in which these stories are set, and their contribution to future building (von Stackelberg and McDowell 2015).

In summary, the 'object narratives' work takes an archaeological approach to the problem of marine pollution, working with other disciplines, recognising also the added value inherent within the framework of public participation. Through understanding flow (e.g. ocean currents), activities (e.g. fishing), and behaviours (e.g. carelessness), and through workshops centred around co-creative storytelling with local communities (e.g. Duffy and Popple 2017), we hope to further understand and ultimately change behaviours thus mitigating the future impact of plastic pollution on the marine environment. The work involved four stages and was applied in Galápagos, a case study site with the benefits of being widely known, tightly defined and with a diverse yet fragile ecosystem on which the impact of plastic pollution would be (and is fast becoming) significant.

Case Study Site: Galápagos

Galápagos is an isolated archipelago situated in the Pacific Ocean 1000 km west of Ecuador, and at the confluence of three ocean currents. It is a UNESCO World Heritage Site known for its rich and diverse marine environment, its terrestrial ecology, and its history in understanding evolution, following Darwin's visit in 1835. The UNESCO Inscription describes it as a 'living museum and showcase of evolution', the confluence of major currents making it one of the richest ecosystems in the world (https://whc.unesco.org/en/list/1 - accessed 13 February 2019). The history of occupation dates back circa 200 years, and has been subject to limited archaeological investigation (e.g. Jamieson 2018). Increased accessibility and affordability, and its growing profile through television programmes such as *Blue Planet* and *Blue Planet II* (https://www.bbc.co.uk/programmes/p04tjbtx/episodes/guide) have meant that the archipelago has rapidly increased in popularity as a tourist destination (in particular ecotourism) in recent years (Taylor et al. 2009; Izurieta 2017). Consequently more people are living on the islands to serve the needs of visitors. Balancing the requirements of humans, both residents and tourists, with the necessity to conserve the natural environment which has drawn them to be there, has become a critical challenge in Galápagos (e.g., Quiroga 2009; Kvan and Karakiewicz 2019).

Like elsewhere in the world, marine plastic pollution is becoming an increasing threat to the human and non-human residents of this archipelago (Figure 1, and see Mestanza et al. 2019). Here, as elsewhere, plastic bags are mistaken for food by turtles and seals (e.g. Shuyler et al. 2014), and microplastics are ingested by filter feeders from small mussels (van Cauwenberghe and Janssen 2014) to large Humpback whales (Besseling et al. 2015). Indeed as of 2015, globally, 344 species had been affected by entanglement in marine debris and 331 species by ingesting it (Kühn et al. 2015). Furthermore, in Galápagos, the plastic items that are causing these impacts appear to be from the local region. Specifically, modelling work by van Sebille (et al. under review.) using virtual plastic particles (Lange and Van Sebille 2017) - suggests that the sources of plastic ending up in the Galápagos from outside the archipelago itself are confined to a narrow band on the west coast of South America (mostly Northern coastal Peru and Southern Ecuador), and fishing fleets in the vicinity of the archipelago (whose presence and movements are now tracked by satellite and are accessible online). In the case of Galápagos, therefore, this appears to be a local problem, which therefore requires local solutions.

In recent years, the Directorate of the Galápagos National Park (DGNP) has increased its intensity of clean-up operations and encouraged relationships with not–for-profit organisations with access to the world's foremost international expertise in the issue. Over the course of a series of 'Science to Solutions' meetings in 2018, the group concluded that due to a combination of oceanographic and societal reasons, Galápagos is best placed of any archipelago in the world to demonstrate how to tackle the threat of marine plastic pollution in a marine reserve. Subsequently the team developed a multidisciplinary programme to achieve this. A series of pilot research programmes are being conducted with seed funding from partners into the physical, biological and human nature of the issue, and a full four-year programme has been proposed based on the results of the first year of pilot work. The methodology described in this paper supports this work.

Figure 1 HERE

Methods

Within this context, an object narratives methodology was developed and tested in Galápagos. This involved four distinct but related stages, the first of which was **surface beach collection**. The Science to Solutions team visited a remote beach on San Cristobal island, Bahia Rosa Blanca (Figure 2), a site accessible only by boat, and one that is tightly controlled and restricted to National Park staff. Tourists and all other visitors are strictly prohibited for reasons of wildlife conservation. Unlike tourist beaches on the islands, this beach is rarely cleaned and large areas are therefore covered in an accumulation of plastic. Some of this material (especially at the backshore area behind the beaches, some distance behind Mean High Water) is bleached and brittle and appears to have been there for a long time. Other items are very obviously recent, as determined by Sell By and Use By dates, and a relative lack of weathering. Some of the older items have been visibly transformed, by weathering and maybe also animal action, into microplastics (items of less than 5 mm diameter, Arthur et al. 2009), which is also present here in significant quantities.

Upon arrival, and after a rapid overall inspection of the site, the team made a representative collection of artefacts (Figure 3). A stratified random sampling methodology was adopted for this collection (after Shennan 1988: 315). In short, the beach assemblage was perceived in terms of categories of artefacts, and then a random sample of objects was drawn for each category from different areas of the beach. The main categories of artefacts were single-use plastic containers of various kinds (bags, bottles, styrofoam cups), clothing (shoes in the form of mostly trainers and flip-flops or ‘thongs’, hats and caps), discarded or lost fishing equipment (mainly the plastic components of traps, fishing line, and parts of fishing rafts), toys (lego, dolls, buckets and spades) and, far less frequent, a range of other (including unidentifiable) objects, such as a syringe, although local knowledge suggested this may belong under ‘fishing equipment’. Artefacts were collected in refuse bags (one per pair, and thus about 15 bags between c. 30 people) and taken back to the laboratories at the Galápagos Science Center, which hosted this part of the

workshop. Photographs were taken of the beach collection survey, and of the area in general.

FIGS 2-3 HERE

The second stage of the process involved systematic **sampling** of this collection from Bahia Rosa Blanca, to produce a short-list of eight items that together provided a range representative of the wider beach sample for further investigation, and specifically for the object narratives work. All of the collected items were first laid out and, over the course of an hour, one of the authors (JS) sifted them, to make the selection. These items included (a-h in Figure 4): a plastic pot once containing liquid detergent and with Japanese labelling, the sole of a child's shoe, the torso of a doll, a sun visor, a closed plastic bottle containing a tooth-brush, a red container that had been re-used as a float, to act as a marker buoy for some maritime purpose (the attached string probably tethered it to the boat), a plastic water bottle with a Galápagos label, and a packet once containing snacks.

Figure 4 HERE

The third stage of the methodology was the **object narratives** workshop itself, which took place in a laboratory and involved eight teams of 3-5 people each moving around the collection of objects building a series of narratives around each item (Figure 5), a variation of the World Café method (e.g. Carson 2011; Fouché and Light 2010; Prewitt 2011). The teams were typically mixed, comprising a combination of local participants from NGOs, the National Park, as well as members of GECO, a group working on San Cristobal island to empower local youth to make a positive difference to their community (https://gecoGalápagos.wordpress.com - accessed 14 February 2019), and local and international members of the Science to Solutions team. For logistical reasons, Spanish- and English-speaking participants typically worked separately although some people were bilingual. Following the model of the World Café methodology referred to earlier, the task was intentionally 'quick-fire' with five minutes on each object for each of seven stages of the narrative we sought to

compile. These stages were framed as questions set out on a grid on large sheets of paper, each on a separate desk or ‘station’: Where was the object from? What was it made of, and how was it made? How had it been used, by whom and for what? How had it ended up in the sea, and eventually therefore on a remote beach in Galápagos? What human actions might have caused this outcome, and what actions might therefore have prevented it? Groups were encouraged to think about the evidence that might support their narratives and as they progressed through the collection, from object to object, each group had access to what the previous groups had already written. They could work on the next stage in the story, or create alternative stories for stages that had already been addressed. They could offer something for each stage if they wished, and if they had time. Each team had its own coloured pen, with every one a different colour - this allowed the possibility to follow each team’s object narrative, and their distinctive approach and perspective after the event (Figure 6).

Figures 5-6 HERE

The final round brought the groups back to the objects with which they began. They were asked to review the various stories and possibilities that had been produced, and present the one they preferred, or which they felt the most likely, to the wider group. Some of these stories were realistic (the toothbrush in the bottle being contained on a fishing boat to retain its sterility in a dirty environment, for example) while some were wonderfully preposterous (e.g. that the visor belonged to a sea lion, who used it to impress other sea lions). Vitally though, all participants thought critically about how these objects had ended up on a Galápagos beach, and the behaviours that might have caused this to happen. They critically examined the cultural and natural transforms that have acted upon these objects (one set of participants, trained in marine biology and specialists in colonisation for example, noting how one could tell how long an item had been in a marine environment, from the development of colonies on its surface), what might have happened to them next if they had not been collected, and what will happen to them now that they have.

A fourth and final stage involved scientific and web-based **analysis**, and aimed to bring some factual elements into the stories. This has two separate components. First, small samples were taken of each of the eight items, with the aim to examine their composition and degradation. In short, what more can we learn about the origins and narrative of each object that we didn't already know? This work was undertaken at the University of Exeter. The samples were scanned by Fourier Transformed Infrared Spectroscopy (Attenuated Total Reflectance) (FTIR - ATR) to determine their polymer signature (Figure 7). A Perkin-Elmer Spotlight 400 was used in ATR scanning mode to identify the spectra of the eight items compared to spectra from industrial spectral libraries.

Figure 7 HERE

The second component, conducted separately at the University of York, involved examining and researching the various pieces of coded information visible on some of the objects. These were mainly stamps, logos and labels which formed the basis for further Internet-based research, alongside examination for any more obvious traces of use. This second technique builds on work conducted previously by Myers (2011) as part of Schofield et al's forensic examination of a Ford Transit Van (Bailey et al. 2009). In future we hope to build this online research into the workshops themselves, with each team having their own 'research station' with web access.

Results

For each item, a diverse range of stories and possibilities were created by the teams described earlier. With the shoe, for example, stories revolved around its accidental loss. It was clearly a child's shoe, and perhaps one for smart occasions judging from the pointed toe. One imagines the child walking home barefoot, perhaps carrying the one remaining shoe. The oceanographic data suggests the loss must have been comparatively local, either from the islands or from the nearby mainland. In comparison, the detergent container, it was suggested, came off a fishing boat, the container being ideal for keeping powder dry on board, and small enough to tuck away. Its small size may also suggest it was the personal possession of one of the

crew, and that all fishermen were perhaps responsible for their own personal hygiene. The container was probably discarded, to save precious space aboard a crowded fishing boat, away from home for months at a time.

Scientific and web-based analysis produced some further information, and some challenges. The sole of the shoe, for example, has no production codes to identify what it was made of, or who it was manufactured by, but we can say something about its use, and its users. The only text is an “8”, indicating the size of the shoe, and thus of the person wearing it. One can further personalise the item through wear patterns. Shoes typically display either instep wear (supination) or outside step wear (overpronation). This shoe shows both, implying at least two users (Figure 8). The fact this is likely a child’s shoe may provide an explanation, as children’s shoes are more frequently passed on and reused. FTIR results gave a 73% spectral match to polyester (Figure 9). Polyester is a dense polymer (1.37 g cm^{-3}; seawater has an average density of ~1.03 g cm^{-3}) and this, along with its solid construction (no air spaces), suggests that the item would not have floated far. It was not therefore transported by sea from distance and must have been lost in Galápagos. Furthermore the use of polyester in the formation of shoe soles indicates a ‘fast’ or ‘cheap fashion’ culture as it is a less expensive polymer and less durable than other polymers used in the construction of shoe soles. One website describes how, ‘[t]hese attributes are best suited to footwear markets with rapidly changing designs and where consumers frequently purchase new footwear styles to keep up with current fashion trends’ (https://www.chemtrend.com/process/polyurethane_shoe_soling/shoe_soling_polyurethane - accessed 18 February 2019).

Figures 8-9 HERE

By contrast, the white round detergent container revealed details of its age, manufacture and content, but not its use or users or narrative. Moulding on the base of the item indicates it was made from ♳ (polypropylene) by “Berry [crown symbol] Plastics”, a packaging manufacturer based in Québec, Canada. In 2017, the

company changed its name to Berry Global Inc. and dropped the crown logo, suggesting a production date prior to this. Product code “140916CP9” also features in the mould, a line which is now discontinued. The item was produced via injection moulding, as evidenced through the spruce mark in the centre of the base. A design featuring a globe, Japanese text, telephone number and website was subsequently screen-printed onto the container. Translation of the writing indicates the item once contained a sodium bicarbonate based washing powder. The product is described as, “skin, clothing and environmentally friendly” and suitable for use on baby clothes. The product was sold by Bluebell, based in Kashiwa, Japan. On the website listed on the packaging (www.bluebell-web.jp - no longer accessible) the company indicates that they do not manufacture the product, but instead “import and sell detergents and softening agents that take into consideration the natural environment … from Canada”.

There is no visible use-by or best before date on the container. There is also minimal marine growth and weathering/fading to the ink. The Internet Archive’s Wayback Machine indicates that the ‘Bluebell’ website was active between March 2008 and January 2015, after which date the domain was no longer active. A pre-2017 date is supported by the older ‘Berry Plastics’ name, prior to the company’s rebranding. FTIR provided additional information on the polymers, yielding a 94% match to Polypropylene. This is a buoyant polymer that floats in seawater and is therefore susceptible to dispersion by wind and waves. Polypropylene is a typical polymer for packaging with around 10 million tonnes produced annually in Europe alone.

In summary, the workshops proved successful. Local people had fun. There was serious discussion, and laughter. The laughter was confined to some of the more fanciful stories created. The discussion of behaviours, and what actions might have prevented these items entering the ocean was entirely serious. However, one item perhaps above all others, demonstrated the transformative qualities of narrative: the closed 500 cl water bottle containing a toothbrush. There was no disputing that the bottle was being repurposed as a storage container. But what was the toothbrush for? When the bottle was unscrewed, the contents gave off a strong chemical odour

(much like meths). This completely changed the narrative from the initial mundane and reasonable suggestion of a toothbrush being kept sterile, for its original and intended purpose, to the idea of the toothbrush also being re-used, as a multipurpose boat-cleaning item stored in a convenient container.

Conclusions

The workshops and associated analysis undertaken for this project centred around stories, or narratives created by (predominantly young) local people. In creating these narratives, participants were encouraged to think of these items not simply as part of the massive global environmental crisis that is marine plastic pollution, but as archaeological signatures or 'traces' that people's individual actions have caused to be left on the landscape and which thus contribute to this problem. During the workshops we compared marine plastic items to the millions of flint artefacts and related debitage found by archaeologists across the globe. Each item is a signature of past human activity, around which narratives are routinely constructed by archaeologists. Plastic is no different. The shoe may have been left on a beach somewhere, and its wear patterns say something very specific about its owner (or owners). The detergent container may have fallen off (or been thrown off) a fishing boat or yacht. And we know something of the earlier history of these contemporary artefacts, before they were purchased, used and discarded. We know of the raw materials' geological and prehistoric origins, and we can say something about their time at sea.

By taking each item of waste, each *artefact*, as a problem in itself, by revealing how people's actions can have an environmental consequence, and by telling stories about these actions and the journeys the items have taken to the beach on which they were collected, we personalise the problem; it becomes our problem, not somebody else's problem, or the world's problem. And by involving people in the story-telling we can impress upon them their own responsibilities, highlighting the key take-home messages: that every action has consequences and that every plastic item in the sea could have been avoided. Archaeology concerns the understanding of past human behaviors through the material culture people leave

behind. In this particular case, contemporary archaeology alongside other specialisms and academic traditions, can help develop new frameworks for addressing one of the most pressing issues this century - the detrimental impact of humanity on the environment.

Acknowledgements

This is part of an multidisciplinary project which, additional to the archaeological component (JS), involves marine biologists (Ceri Lewis, AP and JJ, University of Exeter, UK; Juan Pablo Muñoz, University of San Francisco de Quito, Ecuador; Kathy Townsend, University of the Sunshine Coast, Australia; Richard Thompson, University of Plymouth, UK; Denise Hardesty, Commonwealth Scientific and Industrial Research Organisation, Australia), a conservation scientist (Brendan Godley, University of Exeter, UK), an ecotoxicologist (Tamara Galloway, University of Exeter, UK), environmental psychologists (Sabine Pahl, University of Plymouth and KW, UK), and an oceanographer and climate scientist (Erik van Sebille, Utrecht University, Netherlands). It is coordinated by the Galapagos Conservation Trust, through AD and JJ (the latter now also at University of Exeter), and supported by the Directorate of the Galápagos National Park. In addition to many of those people listed above, the workshop described in this paper involved significant participation from the Charles Darwin Research Station and the Galapagos Science Center. Access to the PerkinElmer Frontier FT-IR spectrometer and Spotlight 400 imaging FT-IR microscopy system was made possible under a Research Partnership Agreement between the Greenpeace Research Laboratories and PerkinElmer. We also wish to thank David Santillo at Greenpeace for his continued support and access to the FTIR system.The research into the coding on plastic items was undertaken by SD at the University of York (Archaeology). We are grateful to Jerry Aylmer, Brendan Godley and Denise Hardesty for commenting on an earlier draft of this paper, and to two anonymous referees for their perceptive and helpful remarks.

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FIGURES

1 - Sea lion with a plastic bag, in Galápagos. (Photo: Adam Porter)
2 - The remote high impact beach of Bahia Rosa Blanca on San Cristobal island. (Photo: John Schofield)
3 - Surface collection of a representative sample of the items present on the beach. (Photo: Adam Porter)
4 - The eight objects selected for storytelling, from the sample from Bahia Rosa Blanca. (Photos: Adam Porter)
5 - Discussing the white round detergent container, in the narrative workshops. (Photo: Adam Porter)
6 - Notes from the narrative workshops. (Photo: John Schofield)
7 - Conducting ATR scanning. (Photo: Adam Porter)
8 - The shoe sole, and its wear patterns. (Analysis and illustration: Sean Doherty)
9 - Image from the ATR analysis of the shoe. The graph shows the top five spectra hits, and the hit we selected as best match is at the top. The search score is the % match to the library spectra. The graph shows the spectra (orange = the shoe and black = the PE library spectra). (Analysis and illustration: Adam Porter and Jen Jones)