

OURJ Oregon Undergraduate Research Journal

Volume 10, Issue 1, Winter 2017





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Cover Art—“Bamiyan Valley and Buddha”

Dorothy Rooney

Collected and curated by Barbara Jenkins*, University of Oregon Libraries

This rare winter photograph of Bamiyan, Afghanistan (1960) was taken by an American who lived in Kabul during the early 1960s. The Buddha statues were carved into the sandstone cliffs during the 5th century; the left side of this image shows the larger Buddha statue. The Taliban destroyed the Bamiyan Buddhas in March, 2001. This image is part of a large Afghanistan photograph archive from the 1950s and 1960s that I have collected, curated and digitized. The creation of the archive was the focus of my sabbatical research project during summer, 2016.



*Barbara is the UO Libraries Coordinator of Outreach and Special Projects. She is also the subject librarian for Psychology, Religious Studies and Judaic Studies. She has been one of the OURJ faculty advisors since its beginning and has led the Library’s Undergraduate Research Award program for many years.



Letter from the Editor

Sandra Dorning, Marine Biology*

Dear readers,

The past few months have been a tumultuous time for our campus and our country. It is precisely this period of unrest and transition that, I believe, necessitates the publication and celebration of UO undergraduate research. May the accomplishments of these students inspire faith in the next generation to explore, study, and critically *question* the world around them. And let their work implore readers to view society from a new perspective.

Just the same, OURJ has experienced its own transition during the process of publishing this issue. The editorial board here wishes a fond farewell to our previous Editor-in-Chief, longtime editor Aidan Grealish, and wishes her the best in her future endeavors. I have assumed this position eager to more inextricably link OURJ to the climate of research on this campus, and to foster a collaborative spirit in both research and the editing process. Speaking of collaboration, I must thank OURJ faculty advisors Barbara Jenkins and Kevin Hatfield for their guidance and support in my first months as Editor-in-Chief and for their valuable contributions to this issue. I also want to thank our small but mighty editorial board for their dedication and hard work throughout the entire publication process.

At OURJ, we aim to publish the best undergraduate research on this campus, knowing that out of a large selection of excellent student work, we can publish only a few pieces each time around. In this issue we present a stunning diversity of research endeavors, from an analysis of zombies in literature to a study of plastic accumulation on Madagascar beaches. We are also proud to feature an editorial by Terry Hunt, Dean of the Clark Honors College, who imparts wisdom on the research process inspired by his work on the island of Rapa Nui.

Thank you readers, for your continuing support of undergraduate research and the authors we feature in this, our 10th issue of OURJ. Enjoy!

*Sandra is a senior in the Clark Honors College planning to graduate with a degree in Marine Biology and a minor in Political Science this spring. She has been on the OURJ editorial board since spring 2014, and has served as Editor-in-Chief since November 2016. She is currently writing her honors thesis on the ecology of an invasive ascidian species in Oregon's Coos Estuary. Please direct correspondence regarding this issue of OURJ to ourj@uoregon.edu.



Guest Editorial—“The Long Road to Knowledge”

Terry L. Hunt, Ph.D., Professor of Anthropology and Dean of the Robert D. Clark Honors College

As you may know I am an archaeologist, who, over the summer, will be taking some of our Clark Honors College students to study abroad on Easter Island. The native inhabitants call their island Rapa Nui, a tiny speck in the South Pacific famous for its stone statues, or *moai*, that have stood for centuries. Much of my work has focused on the so-called mysteries of Rapa Nui: why were so many of these statues created, and what is the story of the people who created them? I have spent several years of my career attempting to find answers to these questions.

When I first traveled to Rapa Nui to conduct archaeological research, I expected to help confirm the widely-accepted story of how the island’s inhabitants hastened their own destruction by deforesting the island, triggering war, famine, and cultural collapse. Instead, I found evidence that just didn’t fit the popular narrative. As I looked more closely at data from earlier archaeological excavations and at some similar work on other Pacific islands, I realized that much of what was claimed about Rapa Nui’s prehistory was mere speculation. I went on to discover that the downfall of the Rapanui people was actually a consequence of European contact, with their newly introduced diseases and enslavement of the native people. It was near genocide, not “ecocide” that caused the demise of the Rapanui.

If I had never traveled to the island and conducted research for myself, I would have carried on believing the accepted scholarship that others had proposed. Derek Bok, a president emeritus of Harvard, stated that many students enter college with “ignorant certainty”: certain that they know everything or, if not, that there is one straightforward answer to any given problem. He goes on to hope that, as graduating seniors, students exit full of “intelligent confusion.”

The world is an impossibly complex place, and only the naïve among us expect answers that are black and white. When you conduct original research as an undergraduate student – research that no one else has done before – you are contributing directly to expanding human knowledge. The results you get and answers you find may not be clear-cut, may require interpretation and analysis based on context and nuance. You may be required to deduce and extrapolate to find the answers you seek, and at the end of it all may discover that you have even more questions than you started with.

Through the experiential learning that research provides you are also developing the skills to be an independent thinker and researcher; to discover for yourself, instead of taking answers for

granted. Cultivating “intelligent confusion” can be a method for approaching life and living, both in and out of the classroom or research laboratory.

Author Barbara Kingsolver said that “wisdom is like frequent flyer miles or scar tissue; if it does accumulate, that happens by accident while you’re trying to do something else.” You can’t go out searching for wisdom, but it finds you, as you work, as you learn, as you become someone more interesting than you imagined. Don’t trust other people’s word for answers, go out and find the evidence for yourself. Acquire new knowledge. Through creativity, passion, and hard-work you can and will develop your own compass – trust it.



Meet the Editorial Board

AINSLEY TAYLOR

Ainsley is a biochemistry and biology double major, and a student of the Clark Honors College. Caffeine ensures she exists among the living, while her goal of entering medical school guarantees her relationship with the undead. OURJ has helped Ainsley refine her management and organization skills.

JOCELYN TAYLOR

Jocelyn is a senior in the Clark Honors College working towards a biology degree with a pre-medical focus. She interested in physical therapy as a career and is currently waiting to hear back from schools she applied to for entry. Other interests of hers include horses, hiking, mixology, and brushing up on her lack of movie watching. One day, Jocelyn hopes to befriend a pug and welcome him into her family.

ALLISON ZHOU

Allison is a junior in the Clark Honors College studying biology with a neuroscience emphasis. She has been on the OURJ editorial board since winter 2016. She is a research assistant in the UO's Learning Lab, a developmental psychology lab, and her research interests include language acquisition and cognitive development in children. Allison also works for the American English Institute. In her free time she enjoys hiking, cooking, and traveling.



A Radical Take on Zombie Apocalypse: Dominic Mitchell's *In the Flesh*

Finch Byrd*, Comparative Literature

ABSTRACT

Traditionally, the genre of zombie apocalypse has relied on a number of tropes: zombies' inhumanity, mindlessness, decaying bodies, and capability to create new zombies with their bite. These tropes stem from societal opposition to disability, as well as from fear of non-heteronormative reproduction and the Freudian death drive. Most zombie literature is not outwardly critical of these tropes, but instead plays on them to portray zombies as an ultimate horror, a type of being that is other than and inferior to humans, that can—and should—be killed indiscriminately to prevent the destruction of western society as we know it. However, one zombie narrative, Dominic Mitchell's BBC miniseries, *In the Flesh*, stands out above the rest as distinctly aware and radically critical of these tropes. In the series, the living majority's medicalization and re-terming of undeath as "Partially Deceased Syndrome" creates an allegory for disability. "Zombies" are given agency in the series, and the series' protagonist is a young, gay undead individual. Sentient and sympathetic zombies combined with notions of disability and queerness pose a radical challenge to the conventional (read: conservative) tropes of the zombie genre.

Dominic Mitchell's BBC miniseries, *In the Flesh*, is a radical take on the traditional zombie apocalypse genre. The show centers on Kieren Walker, a teenage boy and resident of the fictional village of Roarton, Lancashire, England. Kieren, according to the medical theory established in the show, suffers from Partially Deceased Syndrome (PDS)—that is, he is essentially a zombie, who arose from the dead during "The Rising." The Rising could be termed a zombie apocalypse: even though it did not entirely obliterate society, it resulted in widespread unrest, a struggle for survival, and fundamentally changed villagers' day-to-day lives. The show follows Kieren as he returns home from a rehabilitation center for PDS sufferers and differs from other zombie narratives because the main character is a zombie himself. Zombies in the show have agency, thus radically altering the conventional dynamics between zombies and non-zombies (henceforth, "the living").

*Finch Garland Byrd is in its third year at the University of Oregon. It is a student in the Robert D. Clark Honors College, is majoring in Comparative Literature with focuses in Philosophy and German, and will be minoring in Disability Studies after the program officially launches in Fall 2017. Finch is also interested in feminist, queer, post-structuralist, anarchist and leftist theory, modernism, postmodernism and surrealism. It is passionate about social justice, which, along with its own disabilities and experiences as nonbinary/transgender and bisexual, provides a theoretical framework for its writing. Please direct correspondence to finchb@uoregon.edu.

As Sarah Juliet Lauro and Karen Embry reveal through their analysis of the figure of the zombie in “A Zombie Manifesto: The Nonhuman Condition in the Era of Advanced Capitalism,” the zombie is a distinctly radical figure, based on the destruction of existing social models of power. However, no matter how much conventional representations of zombies may recognize this potential, and indeed some seem to—for example, in George A. Romero’s *Dawn of the Dead*, zombies are representative of “...capitalist drone[s]”—none actualize it, because overall, the historical genre of zombie apocalypse is conservative. It champions the structures that the zombie exists to destroy (Lauro and Embry 87). In the average zombie apocalypse narrative, zombies are dehumanized: They are portrayed as a threat to individualism, as grotesque—that is, affirming the societal fear of disability and death, and as a threat to reproductive futurism as defined by Lee Edelman (2). Consequently, their progressive potential is staunchly opposed by unrelenting violence against them. Contrary to this conventional narrative, *In the Flesh* disapproves of the hatred and violence of the living, and portrays zombies sympathetically. *In the Flesh* challenges the tropes of the traditional zombie apocalypse genre: “Zombies” are given agency in the series and clearly defined as disabled individuals—they are diagnosed as “Partially Deceased Syndrome” (PDS) sufferers by their living counterparts, and choose the labels “undead” and “redeemed” for themselves. Furthermore, Kieren, the series’ protagonist, is himself a young, gay PDS sufferer. Sentient, sympathetic zombies and notions of disability and queerness combine in the series as a radical challenge to the conservative tropes of the zombie apocalypse genre.

Lauro and Embry argue that by simultaneously occupying the states of life and death, or subject and object, the figure of the zombie disrupts traditional power dynamics:

[The zombie’s] threat to stable subject and object positions, through the simultaneous occupation of a body that is both living and dead, creates a dilemma for power relations and risks destroying social dynamics that have remained—although widely questioned, critiqued, and debated—largely unchallenged in the current economic superstructure. (Lauro and Embry 90)

They draw upon the history of the zombie, beginning with the Haitian “zombi,” which they argue is both representative of slavery and slave rebellion, another dual occupation of object and subject positions, and discuss how the zombi has been appropriated into western culture as the “zombie,” a figure of endless consumption (98-99). However, Lauro and Embry also point out that while the western zombie is certainly a capitalist figure, it is yet again subject and object at once, in that it “...represents the new slave, the capitalist worker, but also the consumer, trapped within the ideological construct that assures the survival of the system” (99). The rise of zombies in western zombie apocalypse narratives can thus be seen as a workers’ rebellion, but one that does not truly provide escape, just as the zombi’s slave rebellion did not free the zombis from their bodies or object position. The zombie, according to Lauro and Embry, is inherently a radical figure. It has simultaneously occupied positions of oppression and rebellion both historically and contemporarily, enabling it to upend societal constructs of power.

Though Lauro and Embry make the radical potential of the zombie explicit, they also reveal the societal fear of this radicalism, which is intrinsically connected to capitalism, ableism (the

societal marginalization and oppression of disabled people) and heteronormativity. Zombie apocalypse fiction is, of course, a horror genre, and so presents the zombie as something to fear; thus, traditional works of the genre display all the radical potential that Lauro and Embry point to in a distinctly negative light. As a result, the historical zombie apocalypse genre can be said to be generally conservative—i.e. interested in the preservation of present society’s structures. Lauro and Embry’s essay points to a number of tropes of the zombie genre that present the zombie in such a negative light. First, the zombie is a threat to individualism: Lauro and Embry note that “...fear heightens our awareness of ourselves as individuals because our individuality is endangered in life-threatening situations,” and that the zombie’s lack of consciousness and ability to spread that lack of consciousness by turning others into zombies exacerbates that fear (89). Lauro and Embry also mention that individualism is chiefly a capitalist imperative, that capitalism “...depends on our sense of ourselves as having individual consciousnesses to prohibit the development of a revolutionary collective and to bolster the attitude that drives it: every man for himself” (106). The traditional zombie apocalypse genre is highly profitable and thrives on the preservation of individualism in order to present zombies as something to be feared: To a paying audience in capitalist society, there is nothing more frightening than the prospect of losing one’s individuality. Secondly, Lauro and Embry note the way zombies embody the societal fear of disability and death, saying that “[the] vulnerability of the flesh and the instinctual fear of its decay, as well as the dissolution of consciousness—all things that happen as we approach death—are suggested in the monstrous hyperbolic of the zombie as living corpse” (101). Lauro and Embry then go on to elaborate how zombies emulate the way society perceives the minds and bodies of the disabled, writing that “The mentally ill [sic] have historically been portrayed as having a consciousness that is morally suspect or a total lack of subjectivity,” and that “Even the lumbering gait of the cinematic zombie, which probably is meant to reflect rigor mortis and advanced decay, looks like a muscular disorder” (103). It is not the simple emulation of mental and physical difference, or of closeness to death that elicits fear. Rather, the zombie apocalypse genre reaffirms the societal oppression of disabled people by not only portraying, but also by vilifying, mental and physical difference. Robert Bogdan et al. explain this in their essay, “The Disabled: Media’s Monster,” writing that “[by] linking ugliness and physical and mental differences with murder, terror, and violence, the media creates, at the same time as it perpetuates, society’s prejudices—prejudices that result in fear of the handicapped [sic] and, ultimately, in their systematic, intentional exclusion from society” (32). Zombie apocalypse media does precisely what Bogdan et al. describe by portraying zombies, figures with physical and mental differences from the living (who are figured as “normal”), as inherently evil and worthy of fear. So, the zombie apocalypse genre is conservative in that it vilifies non-normative physical and mental states, thus affirming extant power structures wherein individuals who do not fit the normative mental/physical profile are disabled by society.

Finally, the zombie apocalypse genre also portrays zombies negatively, as a threat to reproductive futurism. Reproductive futurism, as defined by Lee Edelman, is the notion that children—the heteronormative ideal—are the future of humanity. This futurism defines politics and is in direct opposition to queerness, which represents the Freudian death drive. Edelman writes that:

...politics, however radical the means by which specific constituents attempt to produce a more desirable social order, remains, at its core, conservative insofar as it works to affirm a structure, to authenticate social order, which it then intends to transmit to the future in the form of its inner Child. (2-3)

In the way that Edelman points out the heteronormativity, and thus conservatism, of politics, so too is the zombie apocalypse genre conservative for posing the zombie's threat to reproductive futurism as a decidedly negative, horrific scenario. In the traditional genre, heteronormative reproduction is defeated by a reproductive method that destroys, rather than ensures, the future of humanity. Lauro and Embry write, "[the] zombie's reproductive drive...is either an unconscious urge or a mere side effect of its own hunger, for it is through its bite that the zombie reproduces itself" (99). The horror of the zombie's reproduction is firstly that it does not create new life: it negates reproductive futurism by not producing children. Instead, already living people are transformed into zombies; the living are eliminated, thus ending their (generally, hetero-) sexual reproduction. Secondly, it is horrific in that the zombie's asexual reproduction is in fact more effective in creating sheer numbers than the living method of sexual reproduction. This disproves the efficiency of heteronormative reproduction for ensuring the future of humanity and enables an actual zombie apocalypse that overtakes society. Thirdly, zombie reproduction joins the reproductive drive with the death drive, what Edelman argues reproductive futurism works against, in that the reproductive drive of zombies eliminates the living and replaces them with figures of death. Just as the loss of individuality and the disability of zombies are vilified, the asexual reproduction of zombies is also presented as a horror. Thus, the genre affirms the present societal imperatives of individuality, the oppression of the disabled, and reproductive futurism. The biggest factor that informs this conservatism is the perspective of the genre, that is, the protagonists of the zombie apocalypse genre are not the ringleaders of the zombie apocalypse—instead, they fight against the zombie hordes for society's preservation. Almost all representations of zombies fall into these conservative tropes in one way or another. In some cases, the radical potential of the zombie may be acknowledged in some way (for example, positioning the zombies as "capitalist drones" in George A. Romero's *Dawn of the Dead*, as Lauro and Embry discuss), or the zombies may win at the end of the film. The politics of identification in the traditional zombie film, however, generally end with the audience positioned against the zombies. At some point in the typical narrative, the audience is inclined to identify with the zombies as they overtake rude, selfish, or generally unsavory characters. This moralizing role of the zombie is also decidedly conservative, however, and the fact remains that at the end of the traditional zombie film, there are still "good" humans worthy of viewer identification: the zombies remain the villains, positioned against the future of humanity. This politics of identification negates any possibility of radicalism or movement away from societal power structures.

In the Flesh, however, rejects most of the conservative tropes of its genre, and affirms the radical potential of the zombie that Lauro and Embry define. Most conducive to this effect is that the audience is made to identify with the "zombies" of the series, who are given agency. In fact, the "zombies" are given so much agency that they are not termed as "zombies" at all—in this paper, they will henceforth be referred to as "the undead," as this is their preferred term in the show.

Both “zombie” and “rotter” are used pejoratively and are akin to slurs in the show—“rotter” is used persistently throughout the series, and in Episode 1 of Season 2, Kieren teases his best friend, Amy Dyer, about having “...come back a zombie Buddha,” only for her to recoil at the word, which, like “rotter,” serves to dehumanize and vilify the undead. When he apologizes and substitutes “Partially Deceased,” she exclaims, “That’s even worse, that’s the name the living gave us! We are the undead, we are the redeemed, got it?” Amy, at this point, has joined with the radical Undead Liberation Army (ULA), a sort of undead cult that operates under a model based off of Christianity—in which there is one “Undead Prophet” and 12 disciples—to offer an explanation for the Rising and to fight for the rights of the undead in a society poised against them. The viewer, however, has not been given much insight into the ULA’s practices; in fact, what has been shown of them is decidedly unsympathetic to their cause. For example, at the beginning of the aforementioned episode, ULA affiliates terrorize a train full of people by taking a drug called “Blue Oblivion” and going “rabid,” that is, returning to their unmedicated state in which they attack people for sustenance. So, as Amy corrects Kieren’s language, the viewer is just as in the dark as he is, wondering why Amy has taken sides with the ULA. However, at the end of the episode, Amy’s boyfriend and undead disciple, Simon Monroe, is introduced. From Simon’s introduction forward, Kieren and the viewer are simultaneously exposed to the ways Kieren, Simon, and the other undead are oppressed in a society that caters to and normalizes the living. As the show further exposes Simon and his views, both Kieren and the viewer become sympathetic to him; that is, as Simon and Kieren become closer and eventually become romantically involved, the viewer, in a sense, shares Kieren’s experience. As the series goes on, it exposes the cruelty of the living, too: The living’s understanding of the undead’s oppression does not advance, but Kieren’s understanding—and simultaneously the viewer’s—does. Proof of this is Kieren’s living sister, Jem. If, after her initial trauma-induced hostility in Season 1, she seems standoffish, though perhaps willing to understand her brother, in Episode 4 of Season 2, she is downright hostile during dinner with her family and Simon. In the final episode, she is again poised to shoot Kieren just as she nearly did during the Rising. Only after disaster strikes does she admit that “[she needs] help,” near the end of the episode. Most of the other living characters develop similarly, portrayed unfavorably as Kieren feels increasingly betrayed by his family and their friends. Thus, the agency of the undead, and the narrative unfolding from Kieren’s perspective are essential. The show portrays the living’s mistreatment of and violence towards the undead as unacceptable, contrary to the usual zombie narrative, in which the heroes are the living—the very people who kill the undead indiscriminately.

Another factor informing the radicalism of *In the Flesh* is the way it handles the issue of disability. Unlike traditional zombie media, which perpetuates the othering and oppression of disabled people by coding zombies as disabled via their physical and mental differences, then posing those differences as horrific, *In the Flesh* makes explicit reference to disability by medicalizing the condition of undeath, terming it “Partially Deceased Syndrome.” Andrea Hollomotz, in her paper, “Disability, Oppression and Violence: Towards a Sociological Explanation,” describes how people with mental or physical differences (what Hollomotz terms “impairments”) are considered to be inherently “vulnerable” to violence due to their differences, but asserts that it is actually socially imposed disability, “...the disadvantage or restriction of

activity caused by the political, economic and cultural norms of a society which takes no or little account of people who have impairments and thus excludes them from mainstream activity,” that allows this violence to take place (Hollomotz 479). In *In the Flesh*, so-called “PDS sufferers” are considered inherently lesser by the society they exist in, which caters to living people: Repeatedly throughout the series, cruel treatment of the undead is excused with two primary claims. The first implies that the living have a greater right to exist than the undead by suggesting that the undead will destroy humanity if they are not killed. Alex, an undead individual at the PDS treatment center in Episode 1 of Season 1 perhaps says it best, to Kieren: “If you hadn’t of fed on [a living woman], you would have rotted away yourself. You shouldn’t feel guilty,” and when his response is met with a sigh from the counselor leading the group, he says, “What? They killed us too, during the Rising. They blew our heads off without a second thought. Oh, now, that’s defending humanity. That’s okay, that’s not murder. That’s- That’s being a hero! While they get medals, we get medicated.” The second claim is that the undead cannot feel anything and are not real people, so therefore killing them is acceptable. This is made clearest in Episodes 3 and 5 of Season 2. Maxine Martin, Roarton’s Member of Parliament (MP) and representative of the pro-living party, Victus, uses laws to make the undead second-class citizens and excuse cruel treatment of them by reinstating the Human Volunteer Force (HVF), an army of living volunteers that Jem belongs to, which kill many undead both during and after the Rising. After Martin’s laws are introduced, Kieren cannot leave the country, the undead are forced to work under the “Giving Back Scheme,” and any progress that Roarton made in accepting the undead is effectively stanchied. The substantial effect of Martin’s laws on limiting the undead’s societal reception and ability to function normally in society demonstrates how, as according to Hollomotz, disability is a social condition.

While *In the Flesh* clearly understands that zombies are a figure representative of disability, the way the show deconstructs the genre’s traditional demonization of those who do not meet societal standards for mind and body does not end with mere acknowledgement of the genre trope. Rather, the Undead Liberation Army—and particularly the character of Simon Monroe—represent a disability rights movement poised against the pathology paradigm of disability. As disability rights advocate Lydia Brown writes in their article, “The Crisis of Disability is Violence: Ableism, Torture, and Murder,” under the pathology paradigm, “[any] deviation from [the singular, normative template for human existence] is evidence of deficiency, defect, or disorder, and must be ameliorated, hidden, or eliminated altogether” (33). Rejecting the pathology paradigm, then, upends the social construction of the normative mind and body in a way that grants agency to all bodies, and indeed this is what the ULA does by rejecting both professional medication as well as the makeup and contacts undead individuals are expected to wear to fit in. In Episode 3 of Season 2, Kieren is forced under the Give Back Scheme to work with Simon in a PDS clinic, where he witnesses employees mistreating a couple of so-called “rabids.” Simon, operating against the pathology paradigm, intends to set them free, but Kieren stops him, feeling that they are a danger and should receive treatment. Later in the episode, however, the incident seems to change Kieren’s mind: He prevents another undead man, Freddie Preston, from being shot after he forgets to take his medication and subsequently becomes rabid. Inspired by Simon, Kieren sees Freddie not as a problem, but instead as somebody who deserves to exist, and so gives

him a chance to live. Thus, rejection of the pathology paradigm grants agency to those who are unmedicated and refuse the societal imperative for assimilation. Furthermore, not categorizing individuals' bodies and minds as "abled" or "disabled" effects the destruction of the categories themselves, and thus begins an end to the oppression of disabled people: If there is no normative mind/body, there is no "other," and no accommodation is considered a "special need." In this sense, while Lauro and Embry assert that the zombie is a distinctly negative figure, whose radical potential lies only in its ability to destroy existing systems, characters in *In the Flesh* do mobilize positive political strategies—most notably coalition-building in the case of the ULA—to further their goals, which *are* ultimately negative: the destruction of the living's power over the undead as embodied by the medical-industrial complex. By being aware of and making obvious the trope of disability in the zombie apocalypse genre, as well as by dismantling the pathology paradigm of disability, *In the Flesh* disrupts the social system of devaluing and disabling the physically and mentally different.

A third way the series might be considered radical is through its embrace of the rejection of reproductive futurism. The rejection of reproductive futurism, as discussed previously, is another hallmark of the traditional zombie apocalypse genre. However, the genre traditionally vilifies the zombie hordes' asexual reproduction, furthering of the death drive, and subsequent rejection of reproductive futurism. *In the Flesh*, conversely, glorifies this rejection: Neither sexual nor asexual reproduction occurs in the series—Season 1, Episode 2 disproves the undead's ability to reproduce via bite, and sexual reproduction simply does not occur in the show. Furthermore, the few children that do appear in the series are either very minor characters, quickly killed, or deceased for the duration of the show. In Season 2, Episode 1, Ken Burton, Kieren's former neighbor, and the child with him (relation unknown) die in a undead terrorist attack; in Episode 2, Jem shoots and kills 16-year-old Henry Lonsdale; and in Episode 6, the long-awaited second Rising doesn't happen, much to the dismay of MP Martin, who was hypocritically hoping for the resurrection of her child brother. The few children that do survive (teenagers) are perhaps the future of Roarton, but an unfavorable one; the classroom scenes in Episode 2 of Season 2 make clear that they are being instilled with the dehumanizing ideas that oppress the undead. As the show aligns the viewer with Kieren and the other undead, if the high school children are a representation of reproductive futurism, they are a distinctly negative one. Additionally, Kieren himself is gay, and the two most developed relationships in the show are between two men—Rick and Kieren, then Simon and Kieren—who express no interest in creating a family. Heterosexual relationships in the show take one of three forms: strife-stricken (as with Kieren's parents, as well as with Bill and Janet Macy and with Freddie Preston and his former wife), a pairing of HVF members and thus a dangerous alliance (as with Jem and Gary), or else ending when one partner dies (as with Ken Burton's widow), suggesting that heterosexual relationships (and thus, heterosexual reproduction) are not viable in the show's diegesis.

While *In the Flesh* is radical in the sense that it counters the conservative tropes of the zombie apocalypse genre, its ideology is not wholly radical. The most glaring contradiction to its seemingly radical sentiment is the character of MP Maxine Martin, the only person of color who plays a major role in the narrative. Martin is hell-bent on eradicating the undead from Roarton,

but also has a secret agenda that aligns with the Undead Liberation Army's: to cause the second Rising by killing the first risen of the undead, and to consequently revive her little brother. In the final episode of the show, she does go through with her plan, but presumably kills the wrong person, as the second Rising does not occur—though it remains unclear whether it would have happened regardless. The victim is a beloved friend of Kieren's, and tragedy strikes the show's protagonists. By making one of the few people of color in the show such a blatant villain, operating on her own selfish principles, the show vilifies people of color, perpetuating the social system of racism. Furthermore, the chatter near the end of the episode about MP Martin possibly having been committed (to a mental institution) potentially negates much of what the rest of the series does to work against the demonization of disability by suggesting that murderers are just mentally disabled, when in fact, disabled people are far more likely to be the victims of violence than the perpetrators of it (Hollomotz 478, Insel). While certainly not offering an excuse for this contradiction, Lydia Brown's article offers something of an explanation when they write: "Even in otherwise progressive and radical spaces, ableism is allowed not merely to proliferate, but to prosper...as though one set of marginalized identities is worthy of empowerment and validation and another can simply be discarded as undesirable" (33). Although Brown refers here to the vilification of disability, it is possible that in a narrative so concerned with disability, justice, and queerness that people of color would be the scapegoat on which oppression is blamed. Brown offers no explanation for why such scapegoating occurs, but the simplest explanation is that it is easier to blame any sort of oppression on another oppressed group than it is to wrestle with the larger systems that perpetuate it—for example, capitalism. That is, because capitalism—and all kyriarchy—is so engrained and naturalized in the collective consciousness, the course of least resistance is to pick a party to blame for oppression, rather than confronting, analyzing, and offering alternatives to the systems themselves. One real-world example of this is seen in the presentation, "The Trouble With Transgender," written by influential radical feminist Cathy Brennan (alias "Badhbh Catha"). In the text, she argues that the process of gender transition supports capitalism, because "Acquiring stuff, whether it be clothes or makeup or actual body parts, is essential to transgenderism." Thus, in Brennan's view, "Transgenderism as an ideology fits into capitalism perfectly" (Catha). What Brennan does here is scapegoating: She blames transgender people in particular for enabling capitalism, failing to realize that every action by anyone living in capitalist society is ensnared in the economic system. Capitalism itself makes "acquiring stuff" "essential" to anybody. This is how it persists; even a cursory analysis of the system would tell Brennan that, but real analysis is too difficult—it is much easier to put the blame on members of an oppressed group who are forced to pay for their very survival. Brennan's argument—and potentially the treatment of MP Martin in the show—is a reactionary response disguised as radical, allowing oppression to continue under the pretense of abolishing it.

Another consideration is that the series' representation of queerness—particularly Kieren's sexuality and relationships—may not disrupt heteronormativity as much as it seems to. Thomas Crisp, in his essay, "From Romance to Magical Realism: Limits and Possibilities in Gay Adolescent Fiction," argues that "...many titles [of gay young adult literature] rely upon homophobia and homophobic discourse to provide readers with a sense of 'realism,'" and that doing so "...simultaneously implies that homophobia is too large an issue to confront and is ultimately bad,

but inevitable behavior” (339). Crisp argues that these works ultimately affirm heteronormativity by normalizing homophobia. *In the Flesh* seems to do this: In Season 1, Episode 2, Kieren faces homophobia, first from Gary, who makes a joke about “lezzes” (lesbians, derogatorily) at the school Amy attends, and tells Kieren that he should have gone there too, because he’d “...fit right in [because of his sexuality].” Amy seems disgruntled, but does not confront Gary’s joke, and Rick, Kieren’s former boyfriend, laughs at the joke, presumably so as to not mark himself as gay. Secondly, Kieren faces homophobia from Bill Macy, Rick’s father. Bill is in denial about many aspects of his son’s identity—he refuses to acknowledge that he is undead, and through Rick and Kieren’s conversations in the same episode, it is revealed that the two hid their relationship, presumably because Bill did not accept his son’s sexuality. Episode 3 of Season 1 provides further evidence for this: When Bill refers to Amy as Kieren’s “girlfriend,” Rick begins to speak up, but is cut off as his father orders him to kill Kieren for his defense of the undead. Later in the episode, even as Rick removes his contact lenses and cover-up and refuses to kill Kieren, asserting that he is undead as well, he disguises the romantic nature of his relationship with Kieren, only referring to him as his “best mate.” Bill, apparently convinced that Rick is not his real son, kills him and leaves his body outside of Kieren’s house. After finding Rick’s body, Kieren comes to Macy’s house and while condemning Rick’s murder, asserts that Bill’s dislike for him stems from his homophobia. As Macy realizes what he has done and leaves the house, Ken Burton kills him, but not for his homophobia—rather, as revenge for killing Burton’s wife in the pilot episode and for his general hatred for and mistreatment of the undead. After Episode 3, though, the show never readdresses the issue. Kieren moves on, eventually meets and dates Simon, and nobody objects to their relationship—at least not on the grounds that they are of the same gender. In this sense, *In the Flesh* recapitulates the scenario that Crisp identifies: Homophobia is a natural part of Kieren’s life; he must simply steel himself and overcome it on a personal level. Even though Bill, the main source of homophobia, is ultimately removed from the equation, homophobia in the series others Kieren’s sexuality for the sake of the realism noted by Crisp. In this way, the series reasserts heterosexuality as a norm.

Finally, despite all its radical ideals, the series simply does not provide a solution: At the final bar scene, the living reveal that they are still disgusted with the undead, and the undead reveal that they are disgusted with the living. Though the show certainly disrupts the conservative premises of its genre and offers a radical version of the zombie apocalypse, nothing destroys the oppressive social systems within the show’s diegesis; radical change never occurs. Perhaps this is because the undead of the show cannot get past their individuality; that is, they are too much subject, in Lauro and Embry’s terms—the biggest example of this is when Simon breaks away from the radical ULA to protect and be with Kieren. Thus, while the show is certainly radical in comparison to others of its genre, it is not completely radical in the way that it leaves conventional power structures intact at the end of the series. The series, however, opens a new chapter in the history given by Lauro and Embry; it embraces the radical potential of the undead instead of presenting it as a horror.

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The Threshold of the Sublime: Standing in Awe and Fear in José María Heredia’s “En el Teocalli de Cholula”

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ABSTRACT

My research explores the interactions between humans and nature as they appear in Cuban writer José María Heredia’s prose poem “En el Teocalli de Cholula.” I argue that María Heredia engages with the sublime by presenting a simultaneous awe and fear of nature. This analysis centers around a close reading of the selected poem and draws from Edmund Burke and Immanuel Kant’s conceptualizations of the sublime and contemporary, eco-critical approaches of Allen Carlson and Noël Carroll. Burke distinguishes between the beautiful and the sublime in *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, but Kant provides a more critical and complex definition of the sublime in *Observations on the Feeling of the Beautiful and Sublime*, a more acute definition I use in my reading of María Heredia’s poem. In “Appreciation and the Natural Environment” Carlson offers three, near-emotionless, ways of viewing the aesthetics of nature while Carroll adds the importance of emotion to Carlson’s preferred model of appreciation in *Beyond Aesthetics: Philosophical Essays*. From this paper, readers will come to recognize that if they were to stand and look onto el Teocalli de Cholula, they too would be in the presence of the sublime. This research is significant as it crosses temporal and geographical boundaries to better understand the unique human experience of the sublime.

The interaction and relationships between humans and nature are timeless. Nature provides, sustains, and predicts how humans live. There are unexpected and certain times when nature is stunning – capturing and recounting these moments is nearly impossible, though some artists and writers can capture the sublime: an awe-inspiring excellence. The German Romantic painter Caspar David Friedrich exposes sublime elements of nature in his landscape paintings, especially in the well-known work *Wanderer above the Sea of Fog*. José María Heredia is a poet who similarly attempts to recreate the indescribable experience of nature. In this paper, I will draw from Edmund Burke and Immanuel Kant’s conceptualizations of the sublime from their 18th century Enlightenment texts and pair these conceptualizations with the contemporary, eco-

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critical perspectives of Allen Carlson and Noël Carroll. I will apply these conceptualizations and arguments in my close reading of José María Heredia's prose poem "En el Teocalli de Cholula." In brief, I will argue that María Heredia engages with the sublime by invoking a simultaneous awe and fear of nature. Furthermore, readers of the poem will come to recognize that if they were to stand and look onto el Teocalli de Cholula, they too would be in the presence of the sublime.

Cuban-born José María Heredia (1803-1839) died young and full of passion. After the Cuban government exiled José María Heredia from the country in 1823, accusing him of an alleged plot against Spain's colonial government, he spent the rest of his short life living and working in Mexico and America (Glover 78). María Heredia's works fall into the Romantic era of South American literature because of their distinctive tropes, which Glover articulates as: "the exaltation of passion over reason, a fascination with ruins, the importance of nature, [and] the preeminence of the individual ego" (78).

María Heredia published "En el Teocalli de Cholula" in 1822. The Náhuatl definition of *teocalli* is "house of a god" and in Spanish, it is defined as a "templo de los antiguos nahuas de México." Translated to English, teocalli is a temple for the Nahua people's ancestors who settled in what is now modern-day Mexico and El Salvador. One town that these natives occupied was Cholula; it is surrounded by large volcanoes and sits in the modern-day state of Puebla, Mexico. Nature, in the form of volcanoes, encompasses both the temple and the town of Cholula; the temple, a man-made object, literally sits in nature. The accrued human history, especially the battles fought and rulers' reigns, in the natural area surrounding the temple and the title "On the Teocalli of Cholula" draws attention to the interaction between nature and humankind, and presents the temple as the subject of the poem.

In this paper, I will explore the continuous interplay between humans and nature through a reading of María Heredia's poem. First, I will contextualize my approach through an in-depth investigation on what the sublime is and how we as humans experience it, with reference to 18th century philosophers Edmund Burke and Immanuel Kant. Second, I will present a close reading of María Heredia's poem to examine how the ebb and flow pattern of the magnificent (awe) and hostile (fear) descriptions of nature suggest a sublime encounter when a human views el Teocalli de Cholula. Third, I will explore and apply Allen Carlson and Noël Carroll's contemporary works surrounding the appreciation of nature to demonstrate how María Heredia involves something larger than the sublime, that is, the idea that humans must appreciate the nature that surrounds us because our interaction with nature determines how we as a species will continue to live.

Before delving into a possible sublime experience in a text, we must establish a clear definition of the sublime. For this definition, we turn to two 18th century philosophers, Edmund Burke and Immanuel Kant; Burke makes the distinction between the beautiful and the sublime and Kant expands Burke's definition and explores different occurrences of the sublime.

In his 1757 work *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, Burke defines the difference between the beautiful and the sublime. Burke argues that experiencing both the beautiful and the sublime come from the feelings of pain and pleasure.¹

Throughout his work, Burke associates beauty with love “or some passion similar to it” and the sublime with danger (162). Burke discusses how pain and pleasure can both have positive effects: “pain and pleasure, in their most simple and natural manner of affecting, are each of positive nature, and by no means necessarily dependent on each other for their existence” (44). Of course, the sublime is not an experience of pure and extreme pain, but rather it is an encounter with something just near it (60). The sublime is different from the merely beautiful. Burke defines the sublime as “whatever is fitted in any sort to excite the ideas of pain and danger, that is to say, whatever is in any sort terrible, or operates in a manner analogous to terror, is a source of the sublime, that is it is productive of the strongest emotion which the mind is capable of feeling” (58-9).

We see the pain and the pleasure of the sublime in “En el Teocalli de Cholula” as the narrator is experiencing it. Stanza five provides a source of the narrator’s familiarity with the sublime. María Heredia writes how “the shadow from Popcatépetl slowly/reached out and spread forth resembling/a colossal phantasm. The shaded arc/finally touched me, covering me,/its grandeur grew and grew until at last/it veiled the earth in its cosmic shade” (68-73).² The narrator feels excitement when the black shadow of the volcano covers him, a kind of terror, as Burke would say, but the volcano is too sublime for him to look away.

In his 1764 work *Observations on the Feeling of the Beautiful and Sublime*, Kant works with the juxtaposition of the beautiful and the sublime; Kant argues that one must feel beauty to feel the sublime and must know the sublime to know beauty.³ Kant elaborates upon Burke’s definition of the sublime by articulating how the sublime and the beautiful need each other in order to exist. While Burke shows the beautiful and the sublime as distinct, for Kant, the beautiful and the sublime entail one another. Kant gives examples of what the sublime is and what the beautiful is, as shown here:

The finer feeling that we will now consider is preeminently of two kinds: the feeling of the sublime and of the beautiful. Being touched by either is agreeable, but in very different ways. The sight of a mountain whose snow-covered peaks arise about the clouds, the description of a raging storm, or the depiction of the kingdom of hell by Milton arouses satisfaction, but with dread; by contrast, the prospect of meadows strewn with flowers, of valleys with winding brooks, covered with grazing herds, the description of Elysium, or Homer’s depiction of the girdle of Venus also occasion an agreeable sentiment, but one that is joyful and smiling. (14-6)

In short, “the night is sublime, the day is beautiful” (16). Kant even separates the sublime into three distinct categories: the terrifying – “accompanied with some dread or even melancholy,” the noble – “quiet admiration,” and the magnificent – “beauty spread over a sublime prospect” (16).

“En el Teocalli de Cholula” thus also plays with Kant’s understanding of the sublime with the narrator’s continued description of Popocatépetl in stanza five. The narrator knows and expresses that he is in the presence of the sublime; as Kant describes, “the sublime must always be large” whereas the beautiful is usually small (17). María Heredia writes, “I turned my eyes to the sublime

volcano,/which, visible through a foggy curtain/in the western sky, was outlining/the contours of its immense design” (74-7).⁴ This concise application of the sublime in María Heredia’s work is only the beginning.

In summary, in this prose poem, José María Heredia employs an ebb and flow pattern between magnificent and hostile descriptions, correlating to the awe and fear of nature; this pattern distinguishes the simply beautiful from the sublime. This characteristic factor showcases the interplay among the beautiful, the sublime, and the resulting emotion, as Kant suggests. The give and take relationship between humans and nature that María Heredia forms suggests whoever views el Teocalli de Cholula will be in the presence of the sublime. The following section of this paper will delve into the give and take relationship through an analysis of selected passages.

The second half of the first stanza begins to show the ebb and flow pattern characteristic of María Heredia’s “En el Teocalli de Cholula.” This passage provides both outstanding and intimidating imagery; in addition, this passage also introduces the juxtaposition of humans and nature. By examining specific capitalization, key vocabulary, connotation, and metaphor, readers find that the experience of viewing el Teocalli de Cholula is sublime.

This first passage illuminates the distinction between humans and nature with the descriptions of the “Indian” and “Nature” with a capital N. María Heredia introduces the Indian by writing, “the Indian/happily watches them turn to hues/of light purple and gold” (16-8).⁵ Though the English translation capitalizes the word “Indian” and some readers may find this of significance, the reason that this happens is simply because of translation. In English, words for naming a certain set of people – such as the Native Americans or Indians – are capitalized; this capitalization is not done in the Spanish language and in the original version it is written “el indio” (16). However, the English translation also capitalizes the word “Nature” (Spanish: la naturaleza). María Heredia writes that the sun “saw Nature deeply moved and stirred/to teeming life by its sweetly gentle heat” (22-3).⁶ This is an unusual capitalization in the English translation, and because it is in the first stanza, it draws attention to the natural element that will exist throughout the poem. While these words are not capitalized in the original version, it is an appropriate choice for the English translation because of the weight the María Heredia places on the Indian, thus human, and Nature. By contrasting the Indian with Nature, María Heredia creates two distinct camps that each of his carefully selected words will fall into: humans and nature. However, these two categories are not opposing; they are different, but intertwined just as Kant would say the beautiful and the sublime are intertwined.

The descriptions of the awe of nature in this first passage are wonderful and allude to a metaphoric young, virgin heir or heiress. Through specific word choice in his description of the volcanoes, the fields, and the sun, María Heredia executes this extended metaphor. First, María Heredia writes about the mountains: “Eternal snows crown the heads/of purest Iztacihuatl, Orizaba/and Popocatépetl” (12-4).⁷ Here, María Heredia uses the words “crowned” and “purest” which both suggest that the volcanoes, representative of nature, are both royal and untainted. Then, María Heredia describes the fields as “fertile” and “[turning] to hues/of light purple and gold” (16-8).⁸ “Fertile” shows that, along with nature being pure, it is also able to produce just as

a queen or king can produce another ruler for an empire. “[Turning] to hues/of light purple and gold” creates an image of the clothes and jewelry a queen or king would wear as purple is traditionally a color of royal value. Finally, María Heredia writes that the sun pours out its golden light (19, 21) from the sky.⁹ This is another use of metaphoric language that alludes to royalty; the rays of the sun, which are golden and pour out across the land, look very similar to a King or Queen’s crown. The metaphoric language and allusion created with the description of the volcanoes, fields, and sun magnificently illuminate the awe of nature, as nature is a being that encompasses everything humans could need.

On the other hand, hostile imagery appears in this passage with repetition and metaphoric language. First, the repetition of “eternal” snow and ice, appearing in the beginning and end of the passage, creates a cold and undesirable feeling towards nature. In the beginning, María Heredia writes “Eternal snow crowns the heads of” three famous volcanoes: Iztaccíhuatl, Orizaba, and Popocatepetl (12-4).¹⁰ This excerpt generates the idea that the mountains are cold and unwelcoming to visitors because even during spring, summer, and fall there is snow in sight and the visitors can feel the chilly weather. The repetition continues when María Heredia writes that the western sun pours its golden light onto “eternal ice” (19-21).¹¹ The contrast between the grand sun and the eternal ice creates unfriendly imagery; the sun has golden light, but shines onto ice. The eternal snow and ice produce a hostile environment, and show the fear of nature that humans have because very few people can survive in this location. The repetition of the word “eternal” also creates fear and anxiety. Repetition of “eternal” constantly draws attention to the infinite nature of the situation the narrator is in, stimulating fear and anxiety. These feelings only add to the pain that one might have or experience in the presence of el Teocalli de Cholula. The fear that María Heredia shows his readers contributes to the sublime feeling that humans feel in the presence of el Teocalli de Cholula. The beautiful and the dangerous work together here to create Kant’s conceptualization of the terrifying sublime. The seemingly infinite expanse of the moment, facing so much ice and snow when looking upon el Teocalli de Cholula instills a sense of “dread or melancholy” that Kant says are necessary to experience a sublime encounter (16).

María Heredia uses another piece of hostile language when he alludes to the force of winter as a higher power. After his description of the volcanoes, María Heredia writes that “winter,/with its destructive hands, never touches/their [the mountains’] extremely fertile fields” (14-6).¹² This excerpt shows the sublime by contrasting the beautiful volcanoes and fields with winter’s “destructive hands.” Volcanoes themselves are sublime because they also have the capacity to kill – both humans and nature – when they explode. The use of winter as a juxtaposition to el teocalli de Cholula in María Heredia’s poem creates the sublime. Kant would say that summer and spring are simply beautiful, just as the day is beautiful, and that winter is sublime, just as the night is sublime. Winter instills fear as it watches with its destructive hands, but the volcanoes invoke beauty because of the “extremely fertile fields” that grow on their sides; readers can envision a sublime scenario from this short excerpt.

Through multiple layers of comparisons and levels of analysis we know that the interaction between humans and nature is sublime. By first analyzing the use of magnificent and hostile descriptions, we find that nature must have pleasurable qualities for it to be beautiful and added

painful or terrible qualities to make it sublime. There are fertile and pure fields but only because there are also places with eternal snow and ice. As we see in the writing about contact between the Indian and Nature, it is the interplay between humans and nature that is truly sublime.

The third stanza introduces the first-person narrator who can be seen as an opposing figure or foil to el Teocalli de Cholula, which makes the relationship between humans and nature all the more apparent. Without the first-person narrator, there would be nothing sublime about this poem. Furthermore, without a human history and human perspective of nature, the natural element cannot be sublime. With the presence of a first-person, human narrator, readers know the human history that exists with el Teocalli de Cholula and therefore can experience it as sublime. The third stanza begins with “I found myself sitting atop the famous/pyramid of Cholula. Stretching out/at my feet was the vast unmatched plain/inviting my eyes to a sumptuous feast” (42-5).¹³ The narrator seems to be a foil to the el Teocalli de Cholula because he is the human among nature.

In addition to the first-person narrator, the immediate juxtaposition of the beautiful fields and the events that occurred in these fields in the third stanza of “En el Teocalli de Cholula” reflect a turning point in the poem. The fields are a direct part of the ebb and flow pattern María Heredia uses throughout his poem, and this juxtaposition demonstrates that it takes both humans and nature to create a sublime interaction. María Heredia refers to these cornfields in the third stanza as “beautiful” (48).¹⁴ It is important that nature itself is what highlights the positive aspect of this stanza because it sets the stage for this land to be sublime. Furthermore, the actions taken on this land, for example murder and colonization, instill the slight fear that creates a sublime experience.

Without this fear and accompanying feelings of melancholy, the fields and el Teocalli de Cholula would be solely beautiful. These hostile descriptions are found in immediate juxtaposition to the description of the lovely fields and make three appearances: “barbarous oppression,” “blood of men,” and the inundation of “ancient superstition and by war” (47-51). First, María Heredia writes that it was in the fields where “barbarous oppression once reigned” (47).¹⁵ The close-knit contrast between the beautiful fields and the negative events that occurred there speaks directly to the awe and fear that nature instills in people; these fields provide both a striking place to view nature and an open space where oppression can rise up and rule. Additionally, these rich cornfields were “manured/by human blood” (49-50).¹⁶ This addresses the interplay of the awe and fear of nature; in order for the people to have something beautiful, such as the cornfields, they must pay for it with something awful, such as the bloodshed of fellow man. The war that María Heredia speaks of may be representative of the colonization of South America by the Spanish and Portuguese. Because the Cuban government exiled María Heredia from Cuba, he may have felt the need to empathize with the native people who built el Teocalli de Cholula by representing it in a sublime light. This may have stemmed from his perceived similarity with the native people as his government mistreated him just as the Spanish colonizers did the natives. With this knowledge, the experience of the fields and el Teocalli de Cholula can be more than extraordinary. These examples show on a grander scale that one standing in the fields before el Teocalli de Cholula is in company with more than simple beauty, but in the presence of the sublime.

Now that we know in the presence of el Teocalli de Cholula one experiences a sublime place, we must consider how one can appreciate the nature that provides so much for humans. For this we turn to two contemporary authors, Allen Carlson and Noël Carroll. Carlson writes about three models of appreciation that viewers apply to nature and Carroll builds on Carlson's work by attaching emotion to appreciation.

In his work "Appreciation and the Natural Environment," Carlson discusses how to appreciate the nature that surrounds humans. Carlson presents three ways (models) of appreciation: object, landscape or scenery, and environmental; ultimately he argues that the environmental model is the most effective way of appreciating nature.

Carlson offers these models of appreciation because traditional modes of appreciation as applied to "art cannot be applied to the natural environment without at least some modification" (268). For Carlson, the object model of appreciation applies to objects that are "self-contained aesthetic units" such as sculptures (268). Eventually, Carlson concludes that the object model is not an acceptable way of appreciating nature because "in either case [removed object or not] the object model does not provide a successful paradigm for the aesthetic appreciation of nature" (269). Here, Carlson explains that you cannot appreciate nature by removing it from its home; for example, you cannot fully appreciate a piece of driftwood that sits on your mantel because the driftwood is no longer on the beach. The next model that Carlson discusses is the landscape, or scenery, model which landscape painting exemplifies. In this model, "when aesthetically appreciating landscape paintings [...] the representation of the object and its represented features" is the focus (270). Yet, Carlson once again concludes that this model is an inappropriate manner in which to appreciate nature given that the landscape "model requires the appreciation of the environment not as what it is and with the qualities it has, but rather as something it is not and with qualities it does not have" (271). The landscape model was used often during the time of Caspar David Friedrich where painters represented nature in the way they saw it, not how it actually was; therefore, it cannot be a true appreciation of nature. The third, and preferred, way of appreciating nature is Carlson's environmental model. Carlson defines the environment as "the setting in which we exist as a 'sentient part'; it is our surroundings [...] If any one part of it becomes obtrusive, it is in danger of being seen as an object or a scene, not as our environment" (271). Carlson decides that this model is the way to appreciate nature and we must do so by "[experiencing] our background setting in all those ways in which we normally experience it, by sight, smell, touch, and whatever. However, we must experience [it] not as unobtrusive background, but as obtrusive foreground!" (272).

Carlson's environmental model of appreciation reflects the narrator's perspective, that is, the view, thoughts, and feelings of the narrator in María Heredia's poem, and allows contemporary readers to relate to "En el Teocalli de Cholula." We find that the narrator of the poem seems to use the environmental model to appreciate el Teocalli de Cholula especially when the narrator takes in the entire setting from a high vantage point where a "vast unmatched plain/invit[ed his] eyes to a sumptuous feast" (44-5).¹⁷ The narrator takes in the plains as a whole and sees them as an obtrusive foreground.

In his chapter “On Being Moved by Nature: Between Religion and Natural History” from his work *Beyond Aesthetics: Philosophical Essays*, Carroll proposes – mainly in response to Carlson – a refined way to appreciate nature. Carroll’s main focus is the emotional connection – what he describes as being emotionally aroused – that humans have with nature in order to appreciate it (369). Carroll writes, “The emotions aroused by nature that concern me can be fully secular and have no call to be demystified as displaced religious sentiment. That is, being moved by nature is a mode of nature appreciation that is available between science and religion” (370). Whereas Carlson tries to secularize the appreciation of nature because emotion puts too much emphasis on the object and landscape models, Carroll emphasizes the importance of the emotion in appreciation. Carroll sees the significance of the environmental model, but argues that we must have emotions and feelings towards the environment one is viewing in order to truly appreciate it.

Indeed, the first-person narration in “En el Teocalli de Cholula” demonstrates the human arousal of emotion that Carroll argues cannot be forgotten when we appreciate the nature that surrounds us. The combination of immersing the reader in the surrounding fields while looking onto el Teocalli de Cholula and María Heredia’s diction accentuate the environmental model of appreciation that Carlson advocates as the most effective way of appreciating nature. María Heredia’s poem reveals both pain and pleasure as positive emotions like Burke illustrates, but the poem distinguishes between the beautiful and sublime – how they entail one another – in the manner that Kant philosophizes. Even though Friedrich and María Heredia were contemporaries, having produced *Wanderer above the Sea of Fog* and “En el Teocalli de Cholula,” respectively, within five years of each other, they represent the sublime in radically different ways. Friedrich paints in the manner traditional to the Enlightenment period wherein the sublime excites feelings of danger, and the landscape model confines the sublime – just as the frame confines the painting itself. María Heredia, by contrast, builds past the Enlightenment, and even the Romantic, ideas of the sublime, composing a piece that allows even present-day readers to contemplate their appreciation and therefore their relationship to nature. Readers, and hence humans, must have an emotional appreciation for nature as it will be nature that governs how we will continue to live on this Earth.

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NOTES

¹ The most relevant sections are: "Pain and Pleasure," "Of the Sublime," and "Of Beauty."

² Original: "con lentitud la sombra se extendía/del Popocatepec, y semejaba/fantasma colosal. El arco oscuro/a mí llegó, cubriome, y su grandeza/fue mayor y mayor, hasta que al cabo/en sombra universal veló la tierra" (68-73).

³ The most important section from Kant is his first section, "On the distinct object of the feeling for the sublime and the beautiful."

⁴ Original: "Volví los ojos al volcán sublime,/que velado en vapores transparentes,/sus inmensos contornos dibujada/de occidente en el cielo" (74-7).

⁵ Original: "Los mira el indio en púrpura ligera" (17).

⁶ Original: "y vio a naturaleza conmovida/con su dulce calor hervir en vida" (22-3).

⁷ Original: "Nieve eternal corona las cabezas/de Iztaccíhuatl purísimo, Orizaba/y Popocatépetl" (12-4).

⁸ Original: "Los campos fertilísimos" (16) "en púrpura ligera/y oro teñirse" (17-8).

⁹ Original: "Del sol en occidente... vertió su luz dorada" (19-21).

¹⁰ Original: "Nieve eternal corona las cabezas/de Iztaccihual purísimo, Orizaba/y Popocatepetl, sin que el invierno" (12-4).

¹¹ Original: "Del sol en occidente, que sereno/en hielo eterno y perennial verdura/a torrentes vertió su luz dorada" (19-21).

¹² Original: "sin que el invierno/toque jamás con destructora mano/los campos fertilísimos" (14-6).

¹³ Original: "Hallábame sentado en la famosa/Cholulteca pirámide. Tendido/el llano inmenso que ante mí yacía,/los ojos a esparciarse convidaba" (42-5).

¹⁴ Original: "bellos campos" (47).

¹⁵ Original: "reina alzada/la bárbara opresión" (47-8).

¹⁶ Original: "Con sangre de hombres" (50).

¹⁷ Original: "el llano inmenso que ante mí yacía,/los ojos a esparciarse convidaba" (44-5).



Do You Know Where Your Research is Being Used? An Exploration of Scientific Literature Using Natural Language Processing

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ABSTRACT

In a complex and dynamic field, such as computer science, it is of interest to understand what software resources are available and the usage and purpose of these resources. We demonstrate the feasibility of automatically identifying resource names from scientific literature in arXiv's database and show that the generated data can be used for exploration of software and topics. While scholarly literature surveys can provide some insights on what is being used by researchers, large-scale computer-based approaches to identify methods and technology from primary literature is needed to enable systematic cataloguing. Further, these approaches will facilitate the monitoring of usage in a more effective method. We developed a software tool using Natural Language Processing to determine if articles relate to the technology and methods of question. We then evaluated a trend of technology and methods used in each specific area of science. As we continue to expand this software, we will also analyze the researchers' sentiment about the technology and methods to quantify funded research.

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1. INTRODUCTION

With expanding databases of scientific articles, there is rapidly growing access to publications on specific scientific topics. Hucka and Grahams (2016) suggest in their article “Software search is not a science, even among scientists,” that the best approaches when searching for software ready to use are: “(i) search the Web with general-purpose search engines, (ii) ask colleagues, (iii) look in the scientific literature.” These dated technology search methods can be painstaking and arduous. These laborious searches cannot cover the amount of articles a program can parse through. We aimed to determine if there was a method to finding trends of technology usage by analyzing large data from these databases.

Recently, linguistic machine learning has been implemented to draw inference across large data sets (Bird et al., 2009). Scientific databases can be incorporated into large sets of collections from a given number of articles by using various methods for text extraction and filtering. Linguistic machine learning can be used to understand connections between documents within a given dataset. We decided to use natural language processing to explore and infer the prevalent technologies and methods used in various disciplines of science.

2. NATURAL LANGUAGE PROCESSING OVERVIEW

Bird et al. (2009) describe natural language processing (NLP) as the ability of a computer program to understand human speech as it is spoken. Natural language processing is a field of artificial intelligence and computational linguistics concerned with the interactions between computers and natural languages. Modern NLP is based on machine learning, especially statistical machine learning. The programming paradigm of machine learning differs from most prior attempts at language processing. Up to the 1980s, most NLP systems were based on complex sets of hand-written rules (Jones, 2001). Starting in the late 1980s, however, there was a revolution in NLP with the introduction of machine learning algorithms for language processing. This was due to the steady increase in computational power over time (Jones, 2001). Machine learning calls for using general learning algorithms, often grounded in statistical inference. The main idea is to automatically learn such rules through the analysis of large corpora of typical real-world examples. A corpus is a set of documents (or sometimes, individual sentences or strings) that have been hand-annotated with the correct values to be learned. The accuracy of the analysis can vary depending on the format of the data. The cleaner the data and corpus, the better the desired output.

3. METHODS

To obtain the data, we first parsed through arXiv.org search results for our topics of interest. arXiv.org is a major online hub where researchers pre-publish their articles while their papers get peer-reviewed. The four topics we considered were galaxy evolution, Hawkes processes, T-cell receptor genomes, and natural language processing itself. We downloaded PDF articles, then sorted them, extracting text using PDFminer (Shinyama, 2014) and Python (van Rossum, 1991). We decided to extract only the first 100 articles from the topic searches because of the limited computing capabilities available: Windows 10 desktop (specification: i7 core processor and 32GB RAM); a Windows 10 laptop (specification: i5 core processor and 6GB RAM); and a MacBook Pro

(specification: i7 core processor and 8GB RAM). Once we converted the PDFs to text, we applied filters to the text to remove non-alphanumeric characters and any lines that were less than seven characters. Once the documents were cleaned in this manner, we used the Natural Language Toolkit (“Natural Language Toolkit,” 2016) to parse the text, giving us the parts of speech of each word, a frequency distribution of n-grams containing predefined interesting words, and lists of words similar to the user-defined interesting words. N-grams take an interesting word and use it as a center point in the string of a given length n . Table 1 contains the interesting words we found that generated an output of comprehensive results. This optimization came after testing a list of words used when describing data.

Table 1: Interesting words used for n-grams

Dictionary of Interesting Words
simulation, software, code, analysis, using, program, analyzed, scripted, automated, description, implements, function, modifies, operated, pipeline, helps, allows, manipulate, processed

We decided to use n-grams of length 15 because the average length of a sentence is 6-7 words giving us roughly the sentence on either side of the interesting word. Once that was done, we traversed the collection of n-grams, only taking the noun phrases from the n-grams and counting the occurrences of each noun phrase. The counted noun phrases became the basis for the generated word clouds, which visualize the hierarchical significance of the word to the corpus of data related to the discipline being examined.

4. RESULTS

We found that each data set produced a variety of similar words. A few similar words included function, method, and analysis. These words had relatively high frequencies compared to the more unique words related to the data sets. We suspect that because these words are in our interesting words dictionary, they typically occur close to the other interesting words in our corpus. This would affect the frequency of the higher words due to commonality of the interesting dictionary words. Interesting results we found included: Gadget (a galaxy imaging technology), Velvet (an assembly program), and morphological (a method dealing with the structure of things). Both the technologies and the method extracted pertain heavily to each field: Hawkes processes, galaxy evolution, T-cell receptor genome, and natural language processing. We did not know the technology Gadget before we searched the database. This output signifies that our method of extraction will produce additional technology that may not be known to the user.

4.1 OUTPUT FREQUENCIES

Our first target was analyzing publications on Hawkes processes. Table 2 displays the top thirty noun frequencies as a result of our analysis. Figure 1 shows these words sized by the frequency of words within the document set.

Table 2: Top 30 words and frequencies generated with search phrase: Hawkes process

Word	Number of Occurrences
Hawkes	815
Rate Function	349
Large Deviation Principle	113
Lemma	109
Exciting Function	107
Point Processes	99
Eq	95
Theorem	90
Poisson	82
Fig	78
Residual Analysis	78
Hawking	74
Ix	70
Black Hole	67
Intensity Function	58
Correlation Function	54
Conditional Intensity Function	54
Contrast Function	51
Excitement Function	51
Consider	49
Genome Analysis	42
Numerical Simulations	44
Simulation Study	44
Morphological	42
Partition Function	42
Exponential Function	40
Distribution Function	39
Cost Function	39
Kernel Function	38
Wienerhopf	38
Fourier	37

Our second target was analyzing publications on galaxy evolution. Table 3 displays the top thirty noun frequencies as a result of our analysis. Figure 2 shows these words sized by the frequency of words within the document set.

Table 3: Top 30 words and frequencies generated with search phrase: galaxy evolution

Word	Number of Occurrences
Luminosity Function	332
N-body	145
Fig	128
Schechter	101
Exciting Function	107
Point Processes	99
Eq	95
Galaxy Luminosity Function	72
Galaxy Evolution	71
Galaxy Formation	70
CDM	67
Phylogenetic Analysis	65
Body Simulations	63
Numerical Simulations	60
Initial Mass Function	54
Cosmological Simulations	53
Astrocladistics	52
Mass Function	49
Stellar Mass	45
Transfer	45
Eagle	45
Local Density	39
Compact Galaxies	39
Gaussian	37
Cladistic Analysis	36
Gadget-3	36
Radio Galaxy Luminosity Function	36
Star Formation	36
Cluster Galaxies	33
Correlation Function	33
Bright End	33

Our third target was analyzing publications on T-cell receptor genome. Table 4 displays the top thirty noun frequencies as a result of our analysis. Figure 3 shows these words sized by the frequency of words within the document set.

Table 4: Top 30 words and frequencies generated with search phrase: T-cell receptor genome

Word	Number of Occurrences
Monte Carlo	244
Eq	244
Fig	119
TCR	82
DNA	71
RNA	68
SNPS	59
Chipseq	59
Numerical Simulations	58
Partition Function	54
Ligand Concentration	53
Methods	52
Correlation Function	52
MC	50
Gillespie	46
RNAseq	44
Microarray Analysis	43
Maximum Likelihood	41
Bayesian	39
Simulation Study	39
Velvet	39
Data Analysis	38
SNP	37
Stochastic Simulation	36
Cluster Size	36
Covariance Function	35
Dierent Values	30
Greens	28
Phylogenetic Analysis	27
Quantitative Analysis	27

Our fourth target was analyzing publications on Natural Language Processing. Table 5 displays the top thirty noun frequencies as a result of our analysis. Figure 4 shows these words sized by the frequency of words within the document set.

Table 5: Top 30 words and frequencies generated with search phrase: Natural Language Processing

Word	Number of Occurrences
Cost Function	260
Figure	159
Morphological Analysis	118
Empirical Cost Function	114
NLP	102
Proceedings	101
ASP	88
Function F	79
Syntactic Analysis	76
English	75
Eq	74
Language	71
Function Node	70
X Language	58
Fig	56
Sec	54
Cost Function C	52
Y Subject Language	47
Sigmoid Function	47
Lexical Analysis Graph	46
Function Approximation	44
Empirical Cost Function C	42
Sentiment Analysis	41
Semantic Analysis	41
Morphological	40
Activation Function	39
Pair Subject Language Code	37
Recursive Function	36
Machine Learning	35
Teller Machine	34

a single string or in ASCII characters, forcing us to eliminate that document. In the future, we will seek more reliable means of extracting text from PDFs.

6. CONCLUSION

The results of our analysis demonstrate that we can evaluate trends of technology and methods in various disciplines. This information lays the groundwork for building a network of software used by various researchers to evaluate the effectiveness of National Science Foundation and other agencies' funding of different software projects. From these initial results, we are planning on continuing to improve the software to extract common methods and tools used in research in any given discipline from the literature, with the hope of connecting researchers to tools that they might not know about, or informing the development of future software packages to better address the needs of their users.

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Quantitative Analysis of Debris and Plastic Pollution on Beaches in Northern Madagascar

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ABSTRACT

Marine pollution, with the majority originating from land based sources, poses a significant threat to species in marine and coastal ecosystems. By understanding the make-up of the beach debris, more effective and targeted education and awareness programs can be developed to reduce marine pollution originating from land based sources. In this study, beach debris was recorded, quantified and classified, from three mostly sandy beaches in the northern Diana Region of Madagascar. At the time of this study there were no published reports about debris on Malagasy beaches, thus this paper provides original insight into debris composition and distribution in the region. The debris was observed and classified using transect methods and charts developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) complimented by visual observations. CSIRO has performed similar studies before, therefore the use of their methods made for easier data collection and allowed for ease of comparison for future studies. The abundance of debris per square metre varied between the beaches, which shows a predicted increase with usage. The beaches that had a high number of observed visitors also had a higher quantity of debris. Plastic debris density remained relatively stable between the beaches. A total of 1216 pieces of debris was recorded, with 758 pieces being of plastic, distributed at an average of 0.158 pieces of debris per square metre and 0.109 pieces of plastic per square metre. The highest total quantity of debris and plastic litter was found at Ramena followed by Ampasindava and Baïe de Sakalava.

1. INTRODUCTION

Plastics are typically strong, lightweight, and cheap materials with high durability and utility whose usage has increased rapidly over the past three decades (Andrady, 1990; Derraik, 2002; Hanseb, 1990; Laist, 1987). The majority of human-made marine debris is made up of plastic (Reisser et al., 2013), and since their introduction to the consumer market less than 60 years ago they have become an increasingly critical global pollution issue, as well as the most common form of marine debris (Zettler et al., 2013). The global annual production of plastics was estimated at 245 million tons in 2013 (Zettler et al., 2013) and at 280 million tons in 2011 by Reisser et al. (2013) after having increased rapidly from 1.7 million tons in 1950.

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Marine debris is known to affect more than 267 species by entanglement or ingestion, including species such as fish, seabirds, turtles and whales. Plastic marine debris has also been found to cause economic losses, such as in the case of plastic bags blocking water intakes and propellers being entangled in abandoned fishing gear (Allsopp et al., 2006; Sheavly, 2005).

There are two main sources from which plastics end up in the marine environment: rubbish dumped at sea or land-based rubbish such as waste water systems, rubbish carried by the wind, and recreational litter left behind on beaches (Coe et Rogers, 1997; Ryan et al., 2009). This last category makes up approximately 80% of the plastic debris that ends up at sea (Cooper et Corcoran, 2010). In lower-income countries, some of the major factors of beach pollution are beach visitors (recreational users and tourists, coastal inhabitants, and recreational activities) due to a high usage of plastics, along with littering behaviour and poor waste management (Jayasiri et al., 2013).

Beach surveys are considered the easiest and most inexpensive way to study large-scale trends in marine debris (Barnes et al., 2009; Ryan et al., 2009). Therefore, as a lower-income country with a long coastline, the island of Madagascar is an attractive subject for such a study. The beaches Ampasindava, Ramena and Baïe de Sakalava were chosen to give a varied geographical coverage of the coastal area in Northern Madagascar near the city Diego-Suarez. The beaches are located in bays, or have a similar geographical outlook, and are referred to as having enclosed or semi-enclosed structures. These structures are beneficial to this study as these types of sites are found to have higher densities of debris than other sites (Coe et al., 1997; Jayasiri et al., 2013).

At the time of the study no research was published in regards to beach debris on Malagasy beaches. Therefore, this study attempts to provide original investigations into the quantity and composition of Malagasy beach debris to determine if there are differences in the type and quantities of litter observed between the beaches, and if this is correlated with usage of the beaches.

2. MATERIALS AND METHODS

2.1. STUDY AREA

The beach of Ampasindava is located 36km west of Diego-Suarez (Antsiranana) on the west coast of Madagascar facing the Mozambique Channel. Ramena is located 18km to the northeast of Diego-Suarez, within Baïe Antsiranana, on the east coast of Madagascar, and Baïe de Sakalava is on the east coast of Madagascar, facing the Indian Ocean 17.5km to the east of Diego-Suarez (Figure 1).

Ampasindava measures a little over 2km in length, of which approximately 1.22km was studied. Ramena is approximately 3km, 1.27km of which was studied, and Baïe de Sakalava measures 1.5km, 1.01km of which was studied.

Ramena is located in one of the world's largest bays, Baïe Antsiranana, and has an enclosed structure whereas the other beaches have semi-enclosed structures.

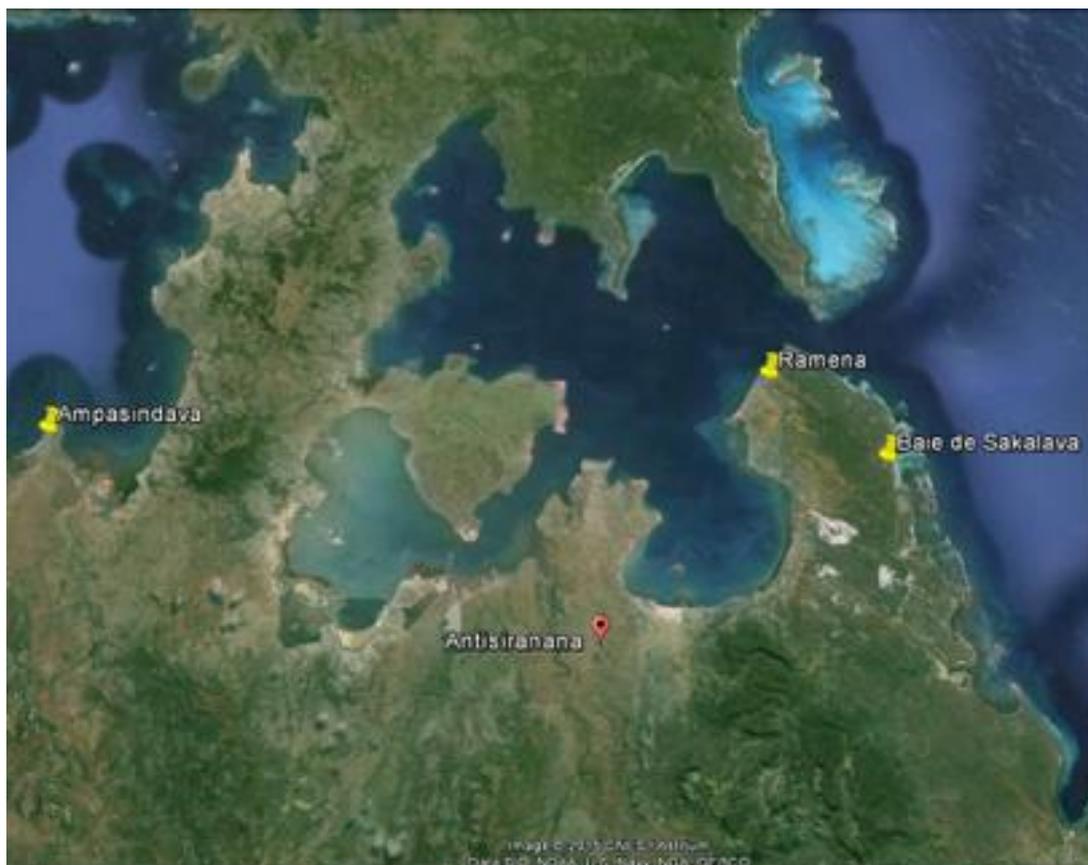


Figure 1: A close-up of the area studied, with a red pin marking Diego-Suarez (Antsirananana) and yellow pins representing the beaches studied.

2.2. BEACH TRANSECT

To study the frequency and quantity of macro plastic debris, ten transects were performed each day for three consecutive days at each one of the chosen beaches, with a total of 30 transects per beach and 90 transects in total. Pieces smaller than 1cm² were not included. The study was done +/- 2h of low tide, as this gave the longest transects, collecting data using the Beach Litter Survey Methodology and Marine Debris Beach Survey Data Sheet developed by CSIRO.

A GPS was used to record the coordinates at the start point of the transect, then a measuring tape was run perpendicularly to the shoreline into the backshore and at least 2m into vegetation where possible. Another GPS reading was noted at the end point of the transect along with the length of the transect, type and color of the substrate, and other beach characteristics, such as beach gradient, physical structure of backshore, beach shape (concave, straight or convex), and direction when facing water was recorded. The transects were located near the beach access point; at Ampasindava and Ramena, transects were performed on both sides of the access points, and at Baïe de Sakalava they were located to the north of the access point. A method of randomisation was used to select the distance between each transect, in order to avoid selection bias by choosing areas of the beach with particularly high or low debris quantities.

At each transect the type and color of all rubbish found within 1m to each side of the transect line was noted and classified (see Transect Survey Data Sheet in Appendix). Every transect was also divided into 10 intervals, starting at the seashore with interval 1/10 and ending in the backshore with interval 10/10. The first piece of rubbish encountered within

each interval was noted as a sample (if there was no debris within an interval this was noted). These samples served to estimate how the debris was distributed about the intervals along the length of the transect.

2.3. VISUAL OBSERVATIONS

Visual observations were performed at each beach to compliment the transect survey data. These records included beach usage, proximity to and number of people, proximity to village or other buildings, wind speed and direction, and weather (See Marine Debris Beach Survey in Appendix). Other factors that were recorded include, but are not limited to, personal encounters and cleanliness of the beaches.

3. RESULTS

Between the 10th and the 23rd of April 2015, a total of 90 transects were executed on the beaches of Ampasindava, Ramena and Baïe de Sakalava in the Diana Region in Northern Madagascar.

By a method of randomisation, the average distance between the transects performed at Ampasindava was 56m, while at Ramena this number was 72.6m, and Baïe de Sakalava was 85.4m. The average transect length, measured in distance from seashore to backshore, was 39.85m, at Ampasindava, 43.85m at Ramena and 40.10m at Baïe de Sakalava.

3.1. RUBBISH COMPOSITION

A total of 1216 pieces of beach debris were recorded (Table 1). Of these, 62.34% (n = 758) of the recordings were plastic debris while the sampled plastic had an average estimated size range of 2-8cm² (standard error = size class 3.4±0.283, Table 3).

Ramena had the highest rubbish count (51.48% of total) followed by Ampasindava (30.59%), while Baïe de Sakalava had the lowest amount of debris (17.93%).

Table 1. Total abundance of beach debris, within various categories, at all beaches individually, and a summarised total.

Debris type	Beach:			Total
	Ampasindava	Ramena	Baïe de Sakalava	
Plastic	257	293	208	758
Cloth	52	15	1	68
Glass	13	33	0	46
Metal	15	71	2	88
Rubber	0	0	0	0
Foam	11	6	4	21
Timber	0	0	0	0
Cigarette butts	4	23	1	28
Paper	14	171	2	187
Other	6	14	0	20
Total	372	626	218	1216

Plastic made up 69.1% of the debris recorded at Ampasindava, 46.8% at Ramena, 95.4% at Baïe de Sakalava, and a combined total of 62.3%.

The combined majority of recorded plastic were hard plastics at 48.02%, followed by film-like plastics (14.64%) and plastic string/twine or rope (12.27%) (see Table 2).

Table 2. Total abundance of various categories of plastic at the individual beaches, including a summarised total.

Plastic Type	Beach			Total
	Ampasindava	Ramena	Baïe de Sakalava	
Hard plastic	119	81	164	364
Plastic bags	15	60	4	79
Film-like plastics	61	48	2	111
Other soft plastics	22	51	11	84
Plastic packing straps	3	0	0	3
Net	3	4	0	7
Fishing line	10	3	4	17
String/ twine/ rope	24	46	23	93
Total	257	293	208	758

The majority of the sampled plastic ranged from $>1\text{cm}^2$ to 2cm^2 at Ampasindava, from $4\text{-}8\text{cm}^2$ at Ramena, and from $>1\text{cm}^2$ to 4cm^2 at Baïe de Sakalava (see Table 3). Samples smaller than 1cm^2 were not recorded.

Table 3. Sizes of sampled plastic debris, collected randomly at 10 intervals within each transect length, classified as size classes 1-6.

Size class	Beach			Total
	Ampasindava	Ramena	Baïe de Sakalava	
1 = 1cm^2	21.25%	1.30%	10.94%	11.31%
2 = $1\text{-}2\text{cm}^2$	23.75%	18.18%	26.56%	22.62%
3 = $2\text{-}4\text{cm}^2$	18.75%	15.58%	26.56%	19.91%
4 = $4\text{-}8\text{cm}^2$	15.00%	28.57%	18.75%	20.81%
5 = $8\text{-}16\text{cm}^2$	8.75%	18.18%	3.13%	10.41%
6 $> 16\text{cm}^2$	12.50%	18.18%	14.06%	14.93%

3.2. RUBBISH PER SQUARE METRE

The standard deviations for the average rubbish per m^2 represent the variance in transect lengths. This variance was due to interruptions by seawalls, buildings, etc.

The average rubbish distribution at Ampasindava was 0.157 pieces per m^2 , 0.23 pieces per m^2 at Ramena, and 0.088 pieces per m^2 at Baïe de Sakalava, totalling an average of 0.158 pieces per m^2 (Figure 2).

The average distribution of plastic was 0.109 pieces per m^2 at Ampasindava, 0.106 pieces per m^2 at Ramena, and 0.084 pieces per m^2 at Baïe de Sakalava, totalling an average of 0.1 pieces per m^2 (Figure 2).

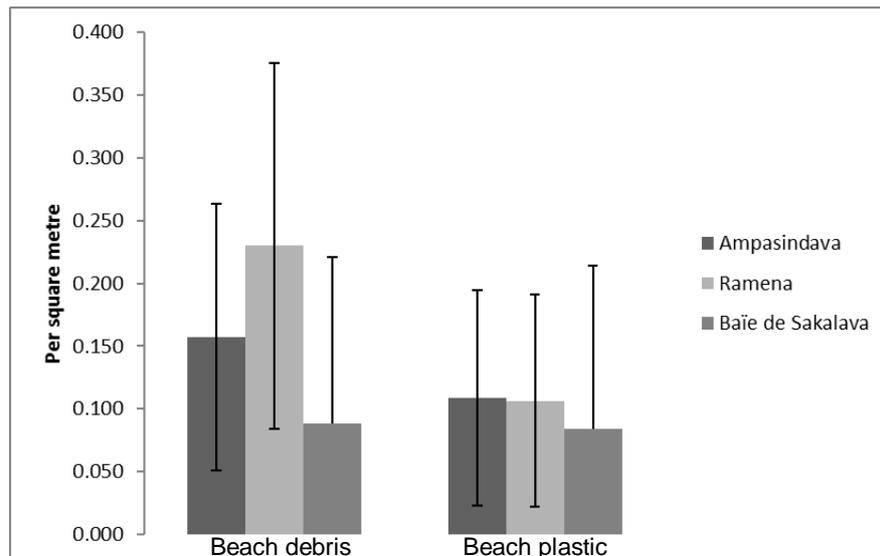


Figure 2: Bars represent the average concentration of all debris (right), and plastic (left) per m² for each individual beach. The error bars represent the standard deviation of the concentration at each transect on each beach.

3.3. DISTRIBUTION OF DEBRIS WITHIN INTERVALS

The sampled debris, recorded at each transect interval in distance from seashore to backshore, had a summarized peak (7.4% of debris) at interval 9/10, corresponding to the wrack-line, the area just above mean high tide where debris is deposited. This was closely followed by interval 10/10 (7.1%), at the backshore (Figure 3). There is also a slight peak near interval 1/10 (2.7%), which corresponds to the seashore.

Ampasindava had an overall peak (8.33%) at the end of the transect length and into the backshore at interval 10/10. Ramena had two peaks; one peak appeared at interval 1/10 at the seashore (6%) and another one at interval 9/10 at the wrack-line (9%). Baïe de Sakalava had a peak (6%) at interval 9/10, corresponding with the wrack-line (Figure 3).

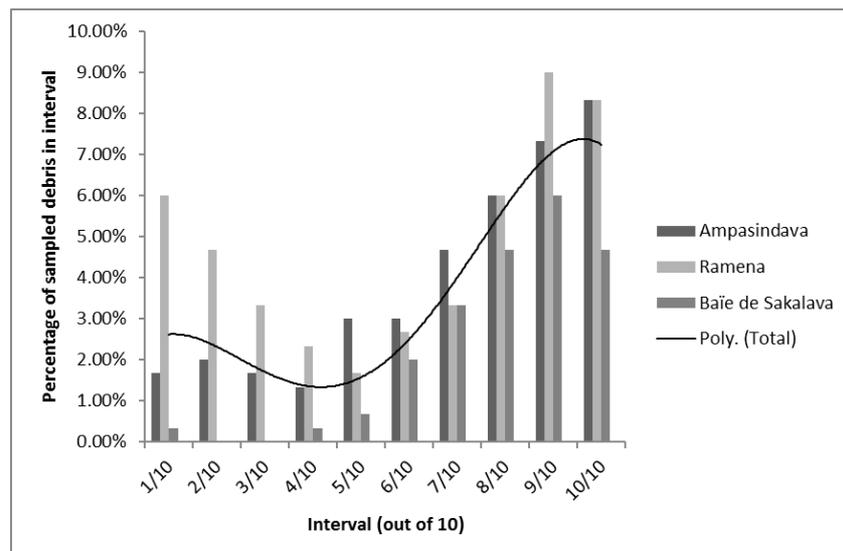


Figure 2: Proportion of total debris located at various 1/10th intervals beachwise. X-axis represents each of the 10 intervals in distance from the seashore (1/10th) to the backshore (10/10th), making up the total length of the transect. Y-axis represents the percentage of sampled rubbish located within each interval. The trendline, *Poly. (Total)*, displays the average distribution of all three beaches combined.

The sample plastic had a summarised peak at the backshore (24.4% of sampled plastic), interval 10/10, followed by interval 9/10 (23.5%). The plastic at Ampasindava (23.8% of sample) and Ramena (28.8%) was mostly located at the backshore, interval 10/10. There was a slight variance at Baïe de Sakalava where the majority of plastic was recorded at the wrack-line (26.6%), interval 9/10 (Figure 4).

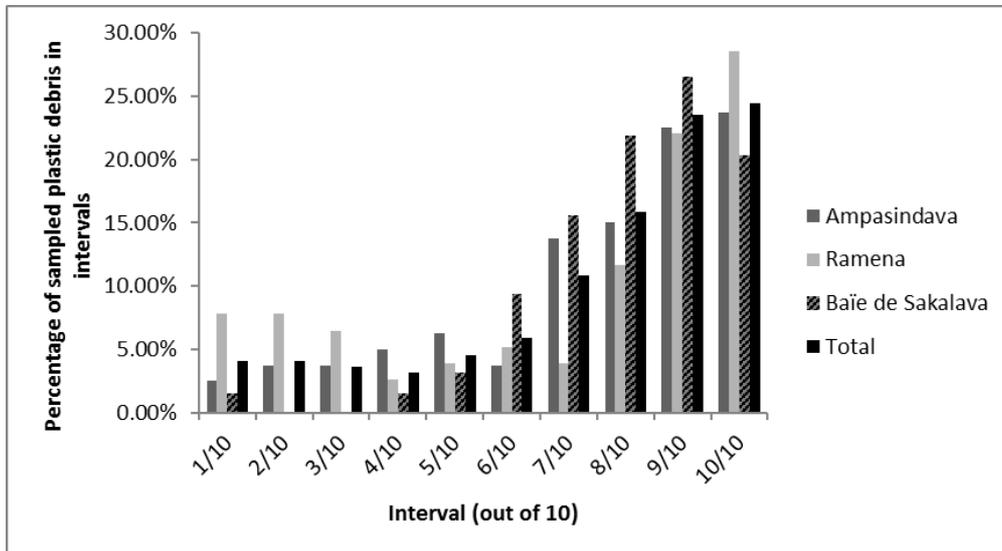


Figure 3: Proportion of sampled plastic debris distributed along the transect length at intervals 1-10, where 1/10th is the seashore and 10/10th is the backshore.

3.4. COLOR DISTRIBUTION

The most frequently recorded color of plastic was white at 30.08%, followed by blue/purple (26.12%), and clear/translucent (16.36%). The remaining 27.44% of the sampled plastics were other colors (Figure 5).

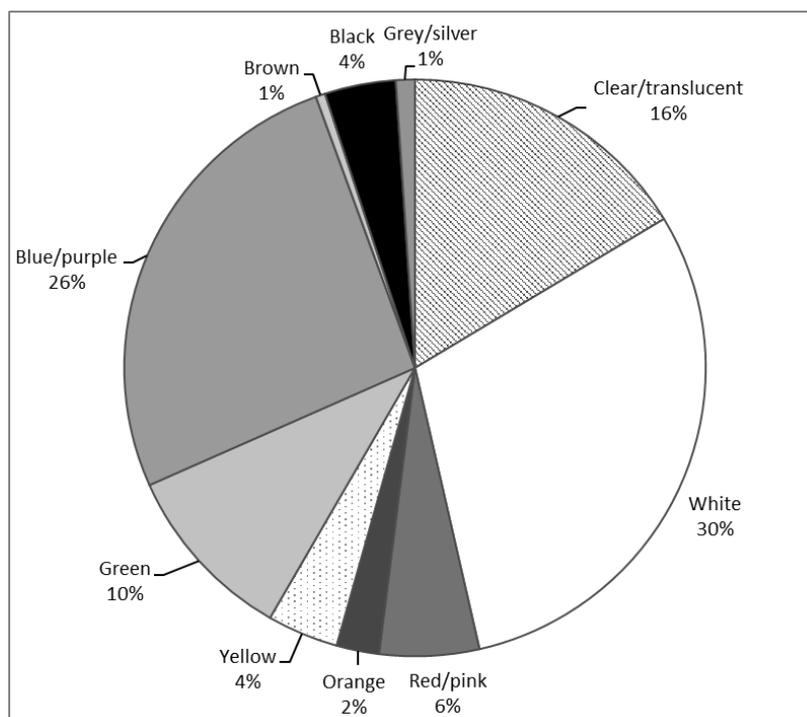


Figure 4: Color distribution of all recorded pieces of plastic in total of all three beaches combined.

3.5. A NOTE ON BEACH CLEAN-UPS

A beach clean-up was reported to have been executed by the locals at Ampasindava the 8th of March 2015 and an annual clean-up at Baïe de Sakalava was scheduled for the first week of May 2015 by a local kite surfing organization. No organized beach clean-up effort had been performed at Ramena over the past two to three years (according to people in the area). It is likely that these clean-ups had a decreasing effect on the debris quantity. According to Derraik (2002), and Garrity and Levings (1993), the beaches cleaned in Panama regained approximately half of their original debris quantity after three months. It is therefore likely that the impact of these clean-up activities on the cleanliness of the beaches, and therefore the results of this study, is smaller than first expected.

4. DISCUSSION

4.1. LOCATION

The distribution of plastic debris varied depending on the beach (Figure 3) and seemed to correspond with the usage by visitors. In general, the majority of rubbish had a peak closest to the shoreline, at the 1/10th interval, with a gradual build up towards another peak at the debris line or beginning of backshore, the 9/10th interval. Overall, the general trend for the debris recorded at the backshore seemed to originate from the nearby inhabited areas due to poor or lacking rubbish disposal sites and infrastructure, unconscious or conscious dumping, and dispersal by wind (personal observations, Gjerdseth). These findings correspond to others' findings that plastic rubbish globally increases due to lack of recovery, recycling and disposal sites (Moore et al., 2008; Reisser et al., 2013). At Ampasindava, a few locals (n= 6) stated that a common practice of waste management was to make a pile of it at the edge of their property to be left or burned. These piles were then vulnerable to dispersal by terrestrial winds, carrying a portion to the beach, which is a likely reason why the concentration of debris was higher at the backshore.

There was minimal difference in debris distribution at various intervals at Ramena (Figure 3); at high tide all debris was semi- or fully submerged in water and some was left behind at the wrack-line as the water retracted and some carried out with the tide. Restaurants were also observed sweeping their rubbish down to the tideline in the mornings, leaving it there for the tide. Beachgoers were observed leaving rubbish behind, and on two occasions the author observed individuals dumping the contents of rubbish bins directly into the ocean (personal observations, Gjerdseth). These factors all contribute to the quantity and distribution of debris at the beach.

The majority of rubbish noted at the transect intervals ranged from 2cm² to 8cm² (Table 3), which supports the claim that smaller pieces of rubbish are more easily dispersed by the wind, as described by Moore et al. (2008) with regard to shopping bags that become airborne and end up in distant waterways and seas.

4.2. COMPOSITION

Plastic debris accounted for 62% of the total recorded debris was categorised as plastic, a trend that corresponds with Derraik (2002) who found that the majority of marine litter on a global scale was made up of plastic. Hard plastics made up 48.02% of the total plastic recorded, a proportion that correlates to findings by Moore et al. (2001) who surveyed beaches in California and found hard plastics among the most abundant. Other frequent rubbish categories include film-like plastics and fishing equipment, which corresponds to findings by

the Marine Conservation Society (2014) who report plastic pieces, fishing line, and wrappers as the most frequent plastic items found in their beach clean-ups in England, Scotland, Northern Ireland, and Wales.

Of the plastic found on Ampasindava, Ramena, and Baïe de Sakalava 72.56% were classified as clear/translucent, white, and blue/purple (Figure 4). This percentage corresponds to Reisser et al. (2013) who reported that the majority of plastic (93%) found in their study was white, transparent or blue. These results also coincide with reports on marine plastics, which state that the plastic debris is affected by the feeding ecology and ingestion in various ecosystems, and that some species of birds are known to select foods using color vision, or choose foods of specific shapes and colors (Derraik, 2002; Reisser et al., 2013; Shaw and Day, 1994). It is therefore likely that the percentage of plastic colors such as red/pink, orange, yellow and green are lower due to a higher probability of being eaten by animals because of their resemblance to certain foods.

Another factor affecting the color distribution of the debris is that some items are normally produced in certain colors. Items such as fishing gear often come in colors that camouflage the gear in the environment. Of the plastics recorded in this study, fishing line (along with string and rope) made up 15.44%, with the majority being colored blue, green or clear. The colors could also be bleached due to weathering, especially if the material has been exposed over a longer time period.

Hard plastic and plastic bags made up the majority of the plastic rubbish found at Ramena (48.1%). This category includes items such as plastic bottles, cups and plates, likely left behind by beach users (personal observations, Gjerdseth). This agrees with observations by Jayasiri et al. (2013) with regard to plastics usage and littering behaviour of beach users in developing countries.

At Baïe de Sakalava there was some debris recorded near a seawall by the access point that appeared to have been recently disposed of, but the majority of litter seemed weathered; pieces of debris had bleached color, more porous structure, were fragmented pieces with smoother edges, etc. This lack of fresh rubbish might be due to the annual beach clean-ups; the weathered plastic might have been brought in by the ocean at high tide and left at the wrack-line. Further research is needed to support this claim.

4.3. QUANTITY

The highest quantity of rubbish, in total and quantity per m², was observed at Ramena, while the lowest quantity was at Baïe de Sakalava (Figure 2). Baïe de Sakalava had the lowest beach usage, had steep commute fares due to limited access, and had few permanent inhabitants in close proximity to the beach (personal observations, Gjerdseth). With these variables, the low quantity of rubbish per m² was expected. Barnes (2005) found that accumulation rates of marine debris varied depending on the beach usage and proximity to urban settlements, and other factors such as wind, ocean currents and region. Ramena had higher settlements and number of beach visitors than the other beaches, which is likely to have impacted debris count. This is supported by Jayasiri et al. (2013) who found number of visitors, usage and proximity to city centre to be some of the most important contributors to debris quantity and distribution. The high quantity of debris at Ramena may also be affected by the variance in geography between the beaches. Ramena is located within Antsiranana Bay and has an enclosed structure, whereas Ampasindava and Baïe de Sakalava are less confined and have semi-enclosed structures. This variance in geography is likely to have affected the rubbish concentration on the beaches; it might be higher in Ramena due to the accumulation effect in bays (Coe et al., 1997; Jayasiri et al., 2013).

In their 2014 beach clean-up report, the Marine Conservation Society (2004) found 2,457 pieces of rubbish per kilometre, equivalent to 6.04 pieces per m², with a majority stemming from “public/general dumping” including items such as plastic bags, bottles and cans, food containers, party poppers, and balloons. Allsopp et al. (2006) reported that the highest quantities of rubbish per m² of shoreline were found in Indonesia with up to 29.1 pieces per metre of shoreline, equivalent to 846.81 pieces per m², as well as Sicily with up to 231 pieces per metre, equivalent to 53,36 pieces per m². Barnes and Milner (2005) reported an average of 1.14 debris items per metre, or 1.3 per m², in their research using samples of shore stranded debris from 16 locations, ranging from Antarctica (via the Faeroe Islands, Caribbean, Canary Islands, South- and Mid- Atlantic, UK, and Iceland) to the Arctic. The findings in this study (0.158 pieces per m²) are low in comparison to other beaches surveyed in comparable studies (Figure 2). The average of 0.1 pieces of plastics per m² recorded in this study are low in comparison to findings by Jayasiri et al. (2013) who noted an average of 68.83 items of plastic per m² in their beach study. The reason for these relatively low concentrations on the beaches surveyed might be due to a smaller number of beach visitors and coastal inhabitants, although further research is needed.

A situation was identified that may affect the data gathered. A few individuals (n=5) encountered at Ramena and Ampasindava stated that the concentration of rubbish was high due to a recent Easter celebration. They claimed that the beach had received a high number of visitors for the holiday, many of whom had left behind their rubbish after the festivities (Easter Monday was the 6th of April 2015). This may have affected the debris recorded in this study.

5. CONCLUSION

Based on the data collected in this study, there was a positive correlation between the frequency and quantity of usage of a beach and the amount of debris recorded.

The majority of debris recorded was plastic debris of clear/translucent, white, and blue/purple color, which is similar to other reports on marine debris.

There is a high probability that the debris will enter the ocean, as a majority of debris was located close to the seashore or at the wrack-line, implying a possibility of being transported with the tides.

A major contributor to the quantity of man-made debris was poor or lacking disposal opportunities and/or practices. Addressing this deficiency could have a significant local impact. Since the majority of the plastic and man-made debris recorded originated from land-based sources, awareness of the issues surrounding plastic pollution and its consequences could help reduce the quantity of debris ending up on the beaches. On a larger scale, given the increased usage of plastic, its lifecycle should be analysed more thoroughly. A larger scale policy that targets non-biodegradable material, such as plastics, with a focus on recycling and reduction of excessive use, is likely to have a positive impact on the reduction of beach and marine plastics.

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8. APPENDIX

METHOD BY CSIRO

MARINE DEBRIS BEACH SURVEY DATA SHEET

(Official use only)		Beach number (unique identity code):	Survey Area (A, B, C, D, E, F, G):
SURVEY AREA CODE: A = Cape Tribulation – Bris; B = Bris – Melb; C = Melbourne – Streaky Bay; D = Streaky Bay – Perth; E = Perth – Broome; F = Broome – Darwin; G = Around Tasmania			
MARINE DEBRIS BEACH SURVEY			
Survey Guidelines:			
<ul style="list-style-type: none"> • Complete one Beach survey form per site and one transect data form for each transect at the site. Record all coordinates in WGS84 datum only. • Minimum of three transects and minimum of six per site. <ul style="list-style-type: none"> ➢ Minimum of one transect located within each major habitat type (transects proportional to habitat type). ➢ Transects located at least 50 m from beach access point (ideally not located both sides of access points, unless different habitat types). ➢ Transects located at least 25 meters apart (ideally 50 meters). ➢ Transect to include two meters into continuing backshore terrestrial vegetation. 			
SURVEYOR DETAILS			
Organisation:	Organisation responsible for survey.		
Surveyor name:	Name of chief surveyor.		
Contact number:	Contact number for surveyor.		
Access point location:	Latitude:	Latitude and longitude of access point where you enter the beach (dd.dddd).	
	Longitude:		
GPS accuracy:	Accuracy (meters) of GPS at time of reading.		
SITE DETAILS			
State / Territory:	State or territory in Australia beach is located.		
Beach name:	Unique name of beach , if known.		
Survey date:	Date survey undertaken (dd/mm/yyyy).		
Current weather:	Clear	Rain/Storm	Overcast Drizzle
Wind speed:	0	1	2 3 4 5
	Circle Speed estimate: 0: calm (flat ocean) 1: light breeze (wavelets, <10km/h , <6 knots) 2: moderate breeze (small waves braking crests, 10-25km/h, 6-20 knots) 3: strong breeze (waves and many white caps, 25-49km/h, 21- 26 knots) 4: high wind (white caps and airborne spray, 50-65 km/h , 27-35 knots) 5: gale (high waves, foam and spray present, 65-85 km/h, 35-45 knots)		
Wind direction: (compass)	N	NE	E SE S SW W NW N/A
Wind direction: (relative to shore)	onshore	offshore	sideshore side-on side-off
Date of last clean up:	If known.		
Number of humans:	Time of day (00:00):	Number of people counted in the visible area measured by instantaneous count. Visible distance is length of shore with a clear and unobstructed view.	
	Visible distance (m):		
	No. of people:		
Comments:	For example: entangled fauna, recent storms, shipwrecks, boat ramp in close proximity, coastal erosion or other conditions that may affect the survey.		

TRANSECT DATA SHEET

Transect Data	
Beach Name:	Name of surveyor(s):
Transect Number:	No. of surveyor(s):
Transect width (m):	Transect Number ____ of _____
Transect start:	Latitude: Longitude: GPS Accuracy: Start Time (00:00): <i>Latitude and longitude recorded in decimal degrees (dd.dddd). Accuracy (in meters) of the GPS at time of reading. Record Start Time of Transect</i>
Transect end:	Latitude: Longitude: GPS Accuracy: End Time (00:00): <i>Latitude and longitude recorded in decimal degrees (dd.dddd). Accuracy (in meters) of the GPS at time of reading. Record End Time of Transect</i>
Photo numbers:	Start of Transect: End of Transect: <i>Number of photo, taken from transect start and end point.</i>
Transect length (m):	<i>From waters edge to two meters into continual terrestrial vegetation (meters).</i>
Distance to dominant debris line (m):	<i>Distance from water edge to major debris line (in meters) at time of survey. Example 23 meters. If no obvious debris line use NA.</i>
Beach gradient:	1 2 3 4 5 <i>Difference in elevation from start to end of transect. 1 = < 1 m (less than hip height) 2 = 1-2 m (hip to head height) 3 = 2-4 m (1-2 body length) 4 = 4-8 m (2-4 body lengths) 5 = > 8 m (more than 4 body lengths)</i>
Substrate type:	Mud Sand Pebble / Gravel Boulders Rock slab Mangrove <i>Major substrate type.</i>
Substrate colour:	White / cream Yellow Orange Brown Black Grey Red <i>Predominant colour of substrate.</i>
Backshore type:	Cliff Seawall Urban building Forest / Tree (> 3m) Shrub (< 3m) Dune Grass - tussock Grass - pasture Mangrove <i>Physical structure of backshore, where beach meets terrestrial vegetation.</i>
Beach exposure or shape:	Concave (cove) Straight Convex (headland) <i>Shape of beach where survey is conducted. Based on 25m each side of transect.</i>
Aspect:	N NE E SE S SW W NW <i>Direction when you are facing the water.</i>
Comments:	<i>For example: transect-related comments such as backshore flora, crossing paths, photo information, etc.</i>

TRANSECT SURVEY DATA SHEET

Transect debris (type and colour): Record one mark (e.g. IIII) for each piece of rubbish larger than 1 cm ² in size, within 1 metre each side of the transect line. If you find items other than those listed, add details to bottom of table.											Size classes: Sample debris type and size class at ten intervals along each transect.				
Rubbish Type	Colour of debris										Sampling Interval	Distance from water (m)	Size Class	Type / colour	
	Clear / translucent	White	Red / pink	Orange	Yellow	Green	Blue / purple	Brown	Black	Grey / silver					
Plastic	Hard plastic											1			
	Plastic bags											2			
	Film-like plastics (glad wrap and chip bags)											3			
	Other soft plastics											4			
	Plastic packing straps											5			
	Net (estimate size)											6			
	Fishing line											7			
Cloth	Non-plastic (string, twine, rope)											8			
	Glass											9			
Metal	Fish hook											10			
	Metal (hard)														
	Metal (soft, tinfoil)														
Rubber	Balloon														
	Other rubber items														
Foam	Polystyrene (foam, from esky's buoys etc.)														
	Other foam														
Timber	Wood (posts, beams, ship hulls)														
	Cigarette butts														
Paper	Paper														
Other															

1. Divide the total transect length by 10 to determine sampling interval, e.g. if transect is 35 m, interval = 3.5 m.
 2. At each interval record the type and size of the first piece of rubbish encountered. If no rubbish is detected within the interval draw a line through the box and continue to next interval, e.g. if no rubbish is found within the second interval (3.5-7m), but six pieces were detected in the third interval (7-10.5m) mark a line in the box for sample 2, and record the size and type for only the first item detected in sample 3