Brunswick River,
Brunswick Valley, NSW

RIVER WARRIORS

STATE OF MARINE DEBRIS REPORT

2020

POSITIVE CHANGE FOR MARINE LIFE

RIVER WARRIORS

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happy travels

Cover Image - Brunswick River Mouth © Daniel Jurin

ACKNOWLEDGEMENTS

Positive Change for Marine Life gratefully acknowledges the support of all of our inspring partners for Phase I of the Brunswick River River Warriors initiative and associated Report card.

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EXECUTIVE SUMMARY

With a recent report highlighting that waterways are responsible for a significant proportion of marine debris in our oceans[1], River Warriors focuses on kayak-based surveys to collect, categorise and sort man-made debris on several critical waterways along Australia's east coast. This baseline data is used to help inform innovative approaches, partnerships and outcomes to mitigate waste inputs at their source.

The issue of plastic pollution and marine debris have been gaining increasing attention in Australia. Once thought of as predominantly affecting developing countries - recent changes in China's international recycling legislation, coupled with increasing population growth and associated development have dramatically increased the visibility of the issue. A 2016 United Nations study[2] found that more than 800 animal species were negatively affected by litter in our seas, representing a 23 per cent increase in the total number of species affected since 2012. In Australia, marine debris is recognised as a *Key Threatening Process* by the Australian Commonwealth Government under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999[3]. This *Key Threatening Process* has also been identified as a priority for New South Wales for state ecological health.

Our River Warriors initiative addresses the impacts of marine debris and pollution through a series of kayak-based on-water surveys to collect, record and recycle/properly dispose of marine debris in waterways across New South Wales and south-east Queensland. The River Warriors project on the Brunswick River was met with a groundswell of local public support and interest, which we were able to capitalise on - launching this project phase as a flagship public engagement activity, rather than our traditional method of small, PCFML team-only surveys. This approach not only provided substantially greater support and effort in cleanups and data collection, but also enabled us to directly engage with and educate a large number of stakeholders, including residents and community members. This has created a powerful platform from which future surveys can be based, highlighting a range of issues faced on the waterway, while ensuring local stakeholders are actively engaged in the health of the river from the outset of the project.

River Warriors Brunswick River surveyed 4 transect areas across the lower reaches of the river over an 11-month period. The surveys collected baseline data on type, quantity, source and presence of marine debris, with more than 5,000 pieces of debris collected in total. Three of the surveys were conducted as public engagement activities, with an additional two education activities held as part of the project. More than 50 stakeholders participated in our kayak-based clean-up surveys, representing a diverse range of groups including residents, tourists, local business, schools and local government entities. Our education programs engaged 35 students and teachers

Our northern NSW Coordinator, Dane Marx, collecting waste in mangroves on the Brunswick River.

through direct sessions held in schools in addition to an open, online webinar, which was adapted for delivery whilst schools were under varying degrees of lockdown due to COVID-19.

Weather and tidal conditions, the presence of injured/deceased wildlife and dates and times of collection were incorporated into our results, which highlight ongoing management strategies and community engagement programs as the project moves forward beyond the initial funding period.

This report highlights our findings and aims to serve as a model for determining waterway health based on key variables - giving communities, businesses and governments a framework to improve marine-debris-related threats and ensure cleaner, healthier and safer waterways across Australia.

We would like to thank all of our partners for funding and supporting our River Warriors project on the Brunswick River and for their continuing efforts to help combat marine debris at its source.

For more information on our River Warriors initiative and our work across NSW and QLD, please contact our team via info@pcfml.org.au

POSITIVE CHANGE FOR MARINE LIFE

RIVER WARRIORS

Simon Freeden, owner of River Warriors' partner business,, Byron Bay Eco Cruises and Kayaks, paddling during one of our first surveys on the Brunswick River - Northern Rivers, NSW.

RIVER WARRIORS

BRUNSWICK RIVER

River Warriors aims to develop a culture of stewardship for places of incredible ecological, recreational and economic importance, engaging local stakeholders in practical, hands-on solutions to address marine debris at its source through the creation of long-term behavioural change. This project is our fourth River Warriors initiative and we are incredibly excited to see River Warriors expanding to waterways across NSW and QLD.

The main focus of our River Warriors campaign is to:

1) Run consistent kayak-based surveys from river source to sea collating data on type, quantity, presence and sources of marine debris;

2) Upload data into our ongoing marine debris database, as well as the *Australian Marine Debris Initiative* (AMDI) database in order to keep a record of findings, as well as to feed into and support ongoing research into debris patterns and solutions Australia-wide;

3) Produce our signature *Marine Debris Report Card*. The first of their kind to not only highlight the issue of debris in waterways, but also to develop realistic and ongoing management solutions and a marine debris rating system for waterways;

4) Run community outreach and infrastructure projects to address the issue at its source;

5) Produce ongoing data based on our project findings - highlighting successes and challenges, while determining ongoing actions to ensure that the river can continue to move toward or maintain an 'A' rating.

Some of our volunteers and staff getting ready to embark on the first public survey for River Warriors on the Brunswick River.

The Brunswick River is located in the Northern Rivers region of New South Wales. It meets the ocean at the picturesque coastal town of Brunswick Heads, forming an open, mature, wave-dominated estuary. From the headwaters of the main river, its waters flow past several settlements and agricultural areas with Main Arm, Mullumbimby and Brunswick Heads the major towns en-route to the ocean.

Our team, partners and a range of volunteers assisted us during our public-facing surveys, which in total collected more than 5,000 items, weighing over 760kg!

Man-made waste and debris represent a major concern on the river. It negatively influences the health of the waterway and enters from a variety of land and water-based sources. Whilst localised cleanups are arranged sporadically in response to complaints from local landowners or recreational users - to our knowledge, no consistent monitoring or collection programs had taken place on the river before our program.

PCFML's first river survey was launched back in 2017 on the Brunswick River, after some of our local business partners noticed how much debris was accumulating on the waterway. From this one-off event, we realised that kayak-based surveys could be an effective tool in mitigating marine debris, raising local awareness and connecting people to their waterways. We have since developed a standardised methodology to address the issue, engage the community and provide long-term management solutions. Thanks to the generous support of our inspiring partners, we were able to officially launch an ongoing River Warriors project on the Brunswick River on the 25th August 2019. Some of our key partners in this initiative have included Patagonia, Byron Shire Council, the Australian Government, Byron Bay Brewery, Byron Bay Eco Cruises and Kayaks, Southern Cross Credit Union and Happy Travels. We've also had support from Cape Byron Marine Parks over the course of the project.

Over four separate surveys, the project engaged 56 participants who contributed 258 volunteer hours. PCFML staff, volunteers, partners, local businesses and representatives from a range of user groups collected in excess of 760kg of rubbish and debris from the lower reaches of the river.

This was the first River Warriors project that was trialled as an open, public engagement platform, hence, we standardised our program methodology, in order to allow us to record and analyse the data properly using well-established techniques.

Our methodology, findings and recommendations are listed in this report and serve to highlight the issue of marine debris within the Brunswick River, as well as a range of management solutions in order to address the problem at its source.

Our CEO, Karl Goodsell running an induction for our 2nd public-facing survey on the Brunswick River.

Kayaking on the Brunswick River during Transect 3 of our River Warriors project.

RIVER WARRIORS SURVEY METHODOLOGY

Our team followed a quantitative approach to data collection throughout the surveys – collecting marine debris across 4 transect areas from close proximity to the mouth of the Brunswick River, to Mullumbimby (Figure 1).

These survey areas are listed below:

Survey 1: Massey Green Caravan Park to Old Sewerage Treatment Plant (2.3km);

Survey 2: Mdjimbi Creek Access (1.04km);

Survey 3: Rail Bridge to Queen Street (0.8km);

Survey 4: Mullumbimby Heritage Park to Rail Bridge (1.3km);

****Public Access Difficult:** This stretch was not surveyed due to public accessibility issues. It will be included in future surveys, which aren't public-facing.

Surveys were conducted using kayaks with collection bags, purpose-built tow rafts and litter grabbers. Survey teams consisted of between 14 and 22 volunteers and staff, with an additional staff-only survey carried out post-COVID-19 outbreak by two PCFML staff on a single kayak each. All accessible debris on the surface of the transect areas and along the banks were collected with litter grabbers and by hand.

Post-survey completion, all collected debris was weighed, dumped onto a tarpaulin, sorted, categorised and uploaded into our marine debris database – contributing to PCFML's marine debris records, as well as Tangaroa Blue's *Australian Marine Debris Initiative* (AMDI) Database. Debris was then recycled or disposed of correctly at the local Resource Recovery Centre.

Figure 1. Our four transect areas on the Brunswick River.

In addition to the four aforementioned surveys, we teamed up with Cape Byron Marine Parks to remove an abandoned oyster lease on Simpsons Creek (a tributary of the Brunswick River). Members of the public and other stakeholders raised this as an issue as it was both an eyesore,

a source of pollution, as well as a physical obstruction. This additional survey did not form part of our core data and is marked as *Marine Parks Survey* in Figure 1.

RESULTS

Over the course of 4 kayak-based surveys on the Brunswick River (including the oyster lease removal on Simpsons Creek) the team travelled 5.7km collecting 5,621 pieces of debris, with an overall weight of 762kg. From the surveys, plastic and polystyrene made up 71% of our findings (54% plastic and 17% polystyrene). Glass was our second most common category found at 22% (Figure 2). From these categories, the most common individual items were (1) pieces of fragmented hard and soft plastic, (2) bottles or broken pieces of glass and ceramic, (3) foam insulation and packaging, (4) rope, and (5) plastic drink bottles. In total, 54 volunteers contributed 248 hours over 11 months to collect our baseline data.

Setting out from Mullumbimby for transect 3.

Table 1. Total items collected by overall category (NOT INCLUDING Simpsons Creek Marine Parks survey).

CATEGORY	PIECES
Plastic	2786
Glass & Ceramic	1128
Polystyrene	872
Metal	170
Rubber	96
Cloth	48
Paper & Cardboard	27
Wood	7
Other	7
Total Pieces	**5141**

Table 2. Top 10 most frequently collected items by type (NOT INCLUDING Simpsons Creek Marine Parks survey).

ITEM TYPE	PIECES
Plastic bits & pieces hard and soft (not film)	1635
Glass or ceramic fragments	967
Foam insulation & packaging (whole and remnants)	789
Rope (estimated length in metres)	232
Plastic drink bottles (water, juice, milk, soft drink)	210
Glass beer stubbies & alco-pop bottles	120
Lids & tops, pump spray, flow restrictor & similar	99
Plastic film remnants (bits of plastic bag, wrap etc)	95
Cigarette lighters	81
Foam buoys (whole & fragments)	74
Total Pieces	**4302**

Items of significance: sorting debris from a survey on the Bruns. Plastic drinking bottles are one of the most regularly found items across our survey regions in NSW and QLD.

AN IN-DEPTH LOOK AT OUR FINDINGS

In this section, we examine the overall weight of items found along each transect surveyed, while also taking into consideration how the distribution of different types of debris differed along the river. This helps us to better understand sources and will inform management strategies to mitigate the environmental impacts of the most problematic items.

Our in-depth results give a greater understanding of the proliferation of harmful items such as plastic fragments; polystyrene insulation, pods and packaging; glass and ceramic fragments; rope; plastic drink bottles; glass bottles; plastic film remnants; plastic food packaging and a range of other items in order to address them at their source.

ITEM TYPE, WEIGHT AND SURVEY EFFORT

Our results in Figure 2 highlight the total percentage that each category made up within our overall findings. This figure illustrates how debris collected to date on the Brunswick River is dominated by three main broad categories of waste - plastic, glass and ceramic fragments, and polystyrene. These three categories contributed 93% of the total number of items found, with plastic and polystyrene

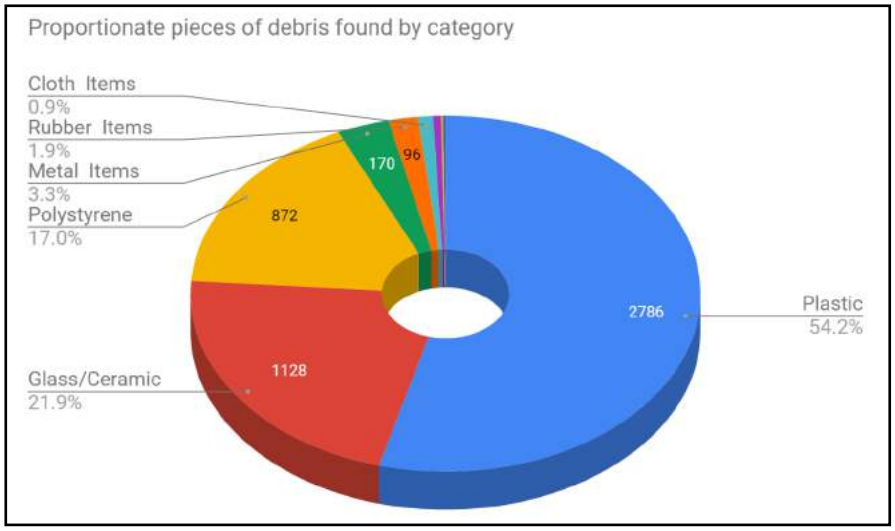


Figure 2. Total debris found - represented as a percentage.

items combined accounting for 71.2% of the total.

In order to compare survey data collected by differing numbers of volunteers and distances, data was standardised both by distance surveyed and number of volunteers involved (Figure 3). This provided a measure of the density of debris collected on each survey. The

pieces of debris collected per km per volunteer hour was highest in Survey 3, and fairly evenly distributed across the other survey areas. Staff specifically noted the presence of litter "hotspots" in transect 3. Survey 3 was also the only survey which was not conducted as a large public engagement survey due to COVID-19 restrictions. This needs to be considered within the results, despite standardisation.

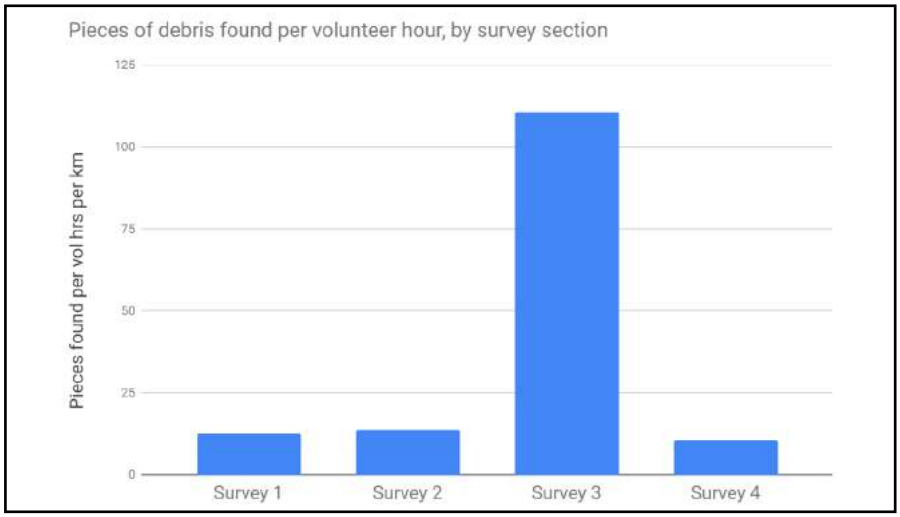


Figure 3: Pieces of debris collected per survey, standardised by volunteer effort and distance of survey length.

ITEMS OF SIGNIFICANCE

Across all surveys, plastic and polystyrene clearly dominated the collected debris, making up as much as 84% of debris collected in Survey 1 (Figure 4). This clearly highlights how significant an issue plastic pollution poses in the environment. Glass and ceramic fragments were also very common in most of the survey sections - characteristic of informal burn piles and land

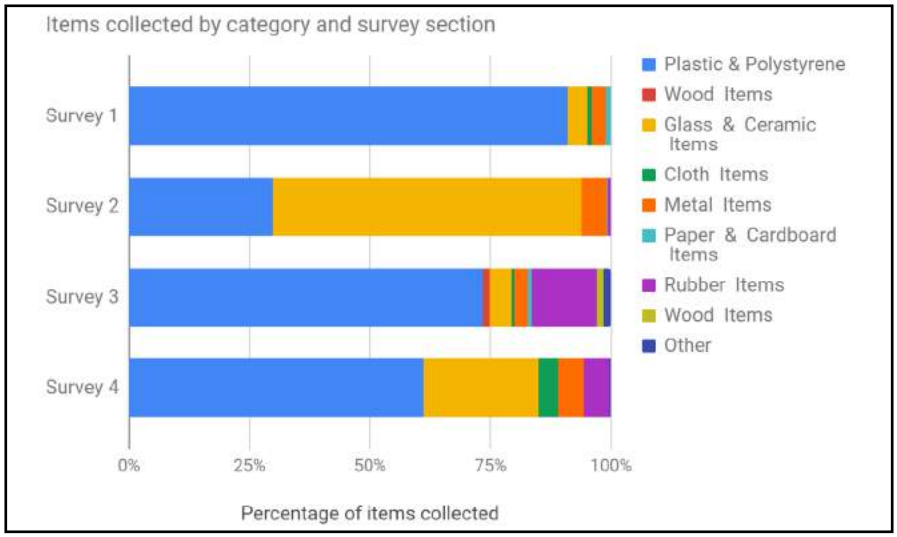


Figure 4. Proportion of debris found by survey section.

dumps, which were noted during the survey.

Soy sauce fish pose an enormous threat to marine life and marine ecosystem health and are often littered in coastal streets and parks, making their way into the Brunswick River and the ocean.

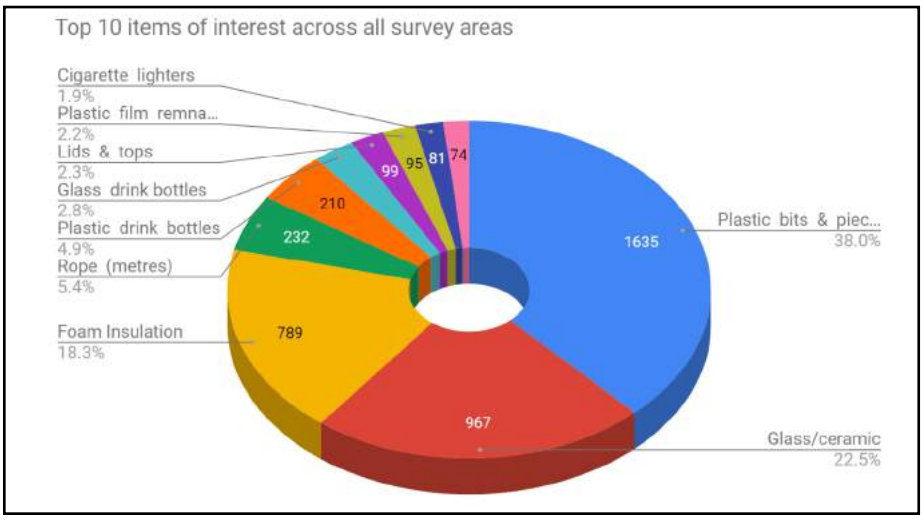


Figure 5. Top 10 items of interest across our 4 survey areas.

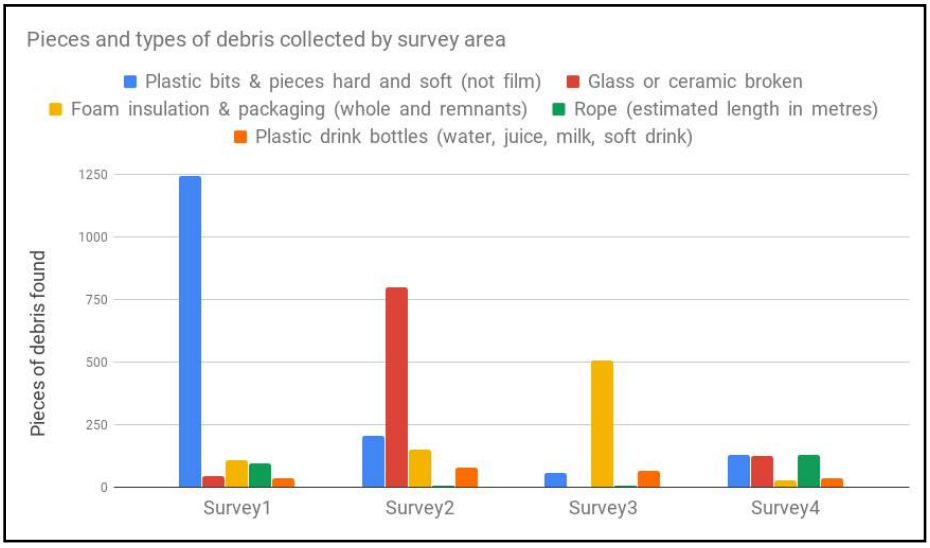


Figure 6. Total pieces collected per survey of the five most common types of debris found.

One of a number of hauls collected from Survey 1 showing rope, foam and a range of other types of debris.

FURTHER INSIGHTS: SECTIONAL ANALYSES & BREAKDOWN OF FINDINGS

Our results reflect that there is a large amount of marine debris and waste present throughout the Brunswick River, and that its sources are highly variable (Figure 6) with a great deal of work still to be done to mitigate the various sources and flows of debris entering the river.

This section of the report explores our findings further and highlights patterns and sources of debris by transect area, as well as identifying hotspots. By examining these patterns in the context of surrounding land management, as well as through observations recorded during the surveys, we are able to identify the most likely source entry points. This guides our management recommendations to help produce long-term solutions across the catchment.

Our volunteer teams driving our work on the Bruns (above) to bring in enormous hauls of debris from the river (below).

Much of what our teams collect are tiny fragments of photodegraded debris, making it an ideal size for ingestion by marine life.

SURVEY SECTION 1

PLASTIC BITS & PIECES, FOAM INSULATION, ROPE, FOAM BUOY FRAGMENTS AND BALLOONS

The Transect Area

Survey section 1 was our closest transect to the mouth of the Brunswick River (Figure 1). It begins where Marshall's Creek enters the Brunswick River which, along with Lacks Creek, drains a large area from the Pocket, Bilinudgel, South Golden Beach and Ocean Shores. Starting at the Reflections Holiday Park Massy Greene reserve and extending over a 2.3km stretch, this section covers either side of the M1 bridge crossing the Brunswick River. Survey section 1's banks are composed of fairly dense riverine vegetation and fringing mangroves, a recreational boat harbour with water access, and two holiday park complexes.

Findings and Potential Sources

Ocean Currents, Overpasses and Recreational Use

Survey section 1 predominantly consisted of plastic bits and pieces

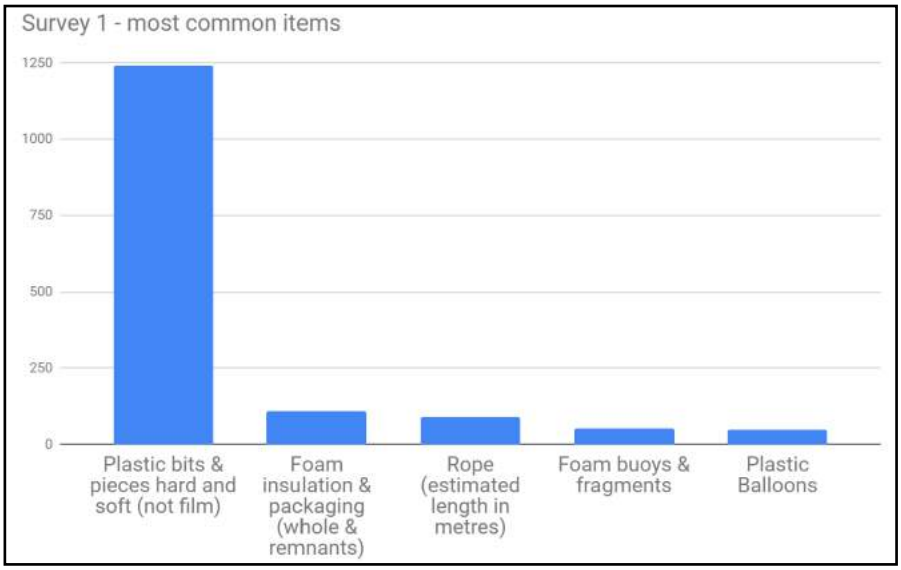


Figure 7: Most commonly found items across survey section 1.

Some of our volunteers getting ready for our inaugural Brunswick River River warriors survey.

(61%), followed by 'foam insulation and packaging' (polystyrene) 5%, as well as rope (5%), foam buoys and fragments (3%) and plastic balloons (2%). Plastic bits and pieces are one of the most frequently encountered types of hard waste found in studies on marine debris[6]. This highlights how significant an issue plastic pollution poses in the marine environment.

This survey section was closest to the estuary mouth, and thus most likely to see high inputs of marine debris from the ocean during high tides. While plastic bits and pieces are commonly found in this environment, the amount of polystyrene from foam insulation & packaging was relatively low. This could be due to strong tides flushing polystyrene out of the mangroves and into the sea.

The survey area crosses the busy M1 overpass, the major highway connecting this stretch of coastal New South Wales to Sydney and Melbourne (south) and Queensland (north). Through observational data and past research from River Warriors initiatives, we know that overpasses serve as significant hotspots for marine debris due to littering, stormwater overflow and/or congregations of people gathering under them who leave their litter behind. The overpass and buoyant items brought in on high tides and storm surges are very likely the two major contributors to the disproportionately high amount of plastic bits and pieces hard and soft throughout this survey area, with more debris than our team was able to retrieve found below the M1 overpass.

Rope was the third most commonly found item across survey section 1, likely from recreational fishing activities including anchors for crab pot fishing. This was also the only survey which had a large number of plastic balloons, most likely linked to 'leakage' from nearby public parks, beaches, recreational areas and residental properties.

Another big haul and successful day on the water during our most popular survey (2 of 4).

SURVEY SECTION 2

GLASS & CERAMICS, PLASTIC BITS & PIECES, FOAM INSULATION, PLASTIC DRINK BOTTLES AND GLASS DRINK BOTTLES.

The Transect Area

Survey section 2 was characterised by thick vegetation on both sides of the bank. In contrast to section 1, there is no major infrastructure along this stretch of the river and access is difficult - either through bush tracks or via the river itself. This significantly limits public access, which could explain the variation in found items across this section of the project.

Findings and Potential Sources

Informal Dump Sites, Litter and River Transported Debris

Survey 2 was dominated by broken ceramic and glass (52%) and glass bottles (5%), most likely due to localised litter from recreational users (fishing hotspot due to deeper waters close to the coast and fringing mangroves). Plastic fragments (13%), foam insulation and packaging (10%) as well as plastic drink bottles (5%) are likely to have been carried into this section from various sources bordering the river

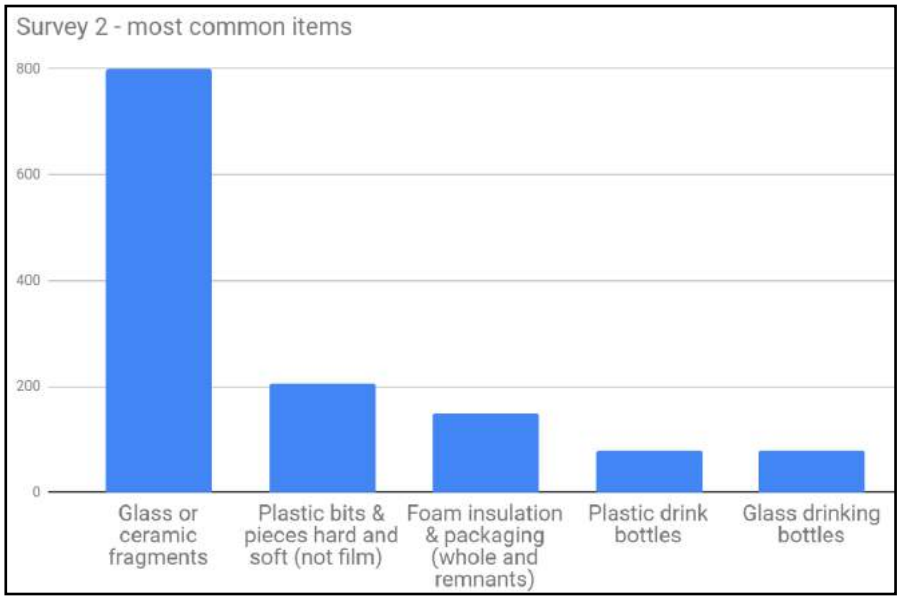


Figure 8: Most commonly found items across survey section 2.

or through tidal ebbs and flows trapping the debris in the mangroves. These sources include stormwater runoff and particular locations where informal dumps (including building materials) and burn pits had been exposed.

For PCFML NSW Coordinator Dane, happiness is found in the most unlikely of places (left). Chris Deimel, our longest serving volunteer, sorts another large haul after our final survey (right).

SURVEY SECTION 3

FOAM INSULATION & PACKAGING, PLASTIC DRINK BOTTLES, PLASTIC BITS & PIECES, PLASTIC PACKAGING

The Transect Area

Accessing long stretches of the river by kayak with large public groups proved challenging. Due to this, a inaccessible section of the river between transect 2 and 3 was left out of the suvey. Due to the onset of COVID-19, we were only able to return at a later stage and conduct a smaller, staff led survey on transect 3 in order to capture supporting data for this stretch. This stretch differs from other survey lengths in that it is predominantly bordered by private freehold land, with small holdings and light agriculture.

Findings and Potential Sources

Urban Leakage, Local Litter and Single-use Food Packaging

Foam insulation and packaging fragments far outnumbered all of the other items found on this stretch of the river - making up 57% of the total number of items collected. Plastic drink bottles accounted for a further 7%, followed by Plastic fragments (6%), lids and tops (6%) and plastic food packaging (5%).

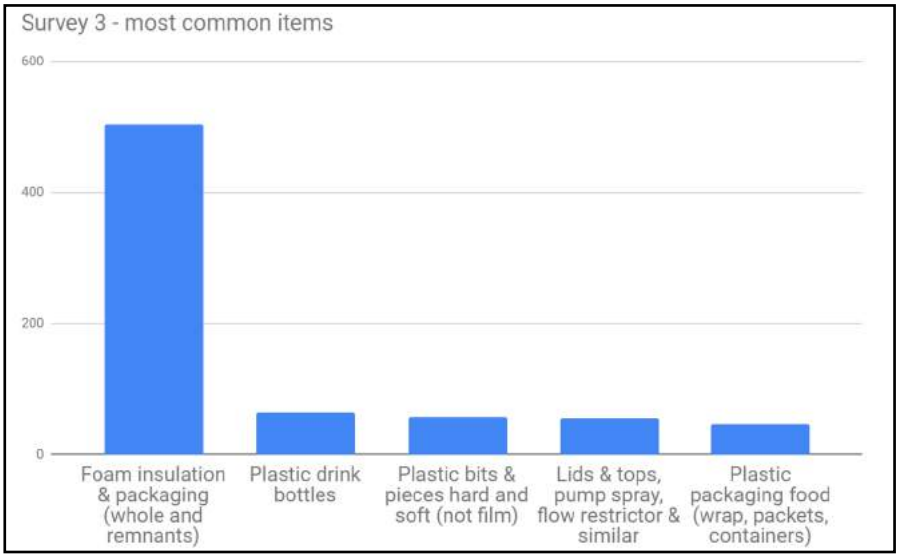


Figure 9: Most commonly found items across survey section 3.

Survey transect 3 is directly downstream from Mullumbimby, so the higher presence of foam insulation from packaging is likely due to the proximity to this urban environment. Foam insulation has unfortunately become ubiquitous with most purchases - either as part of production, retail packaging or used for the transport of goods. Closer investigation of proximity to, and leakage from retail,

Foam insulation like this was the mostly commonly found item across survey section 3.

industrial and building industry environments would assist in clarifying the main sources of this pollution. Similarly, the amount of plastic food packaging is likely due to the higher density of people living nearby - local litter sources (especially direct littering and waste 'leakage') being carried through stormwater drains, as well as people utilising the river and its banks (especially within large cleared agricultural blocks, in which riparian zones and mangroves have been severely degraded or cleared).

It is important to note that the litter collected during survey three was also dominated by a few hotspots, where peak flows had gathered large quantities of buoyant debris and deposited them amongst mangroves and raised flats adjacent to the river. This process could contribute to the far greater representation of buoyant polystyrene and foam insulation found. These hotspots will be included in our interactive maps during Phase II.

SURVEY SECTION 4

PLASTIC BITS & PIECES, ROPE, GLASS & CERAMIC FRAGMENTS, PLASTIC DRINK BOTTLES, FOAM INSULATION & PACKAGING.

The Transect Area

Similar to transect 3, transect 4 was located immediately downstream of Mullumbimby (closer to the heart of town than transect 3). It begins at a boat access ramp in Heritage Park and borders a small light industrial/business complex for a short stretch, before entering mangrove-lined riparian zones with intermittent agricultural degradation and clearing, as well as

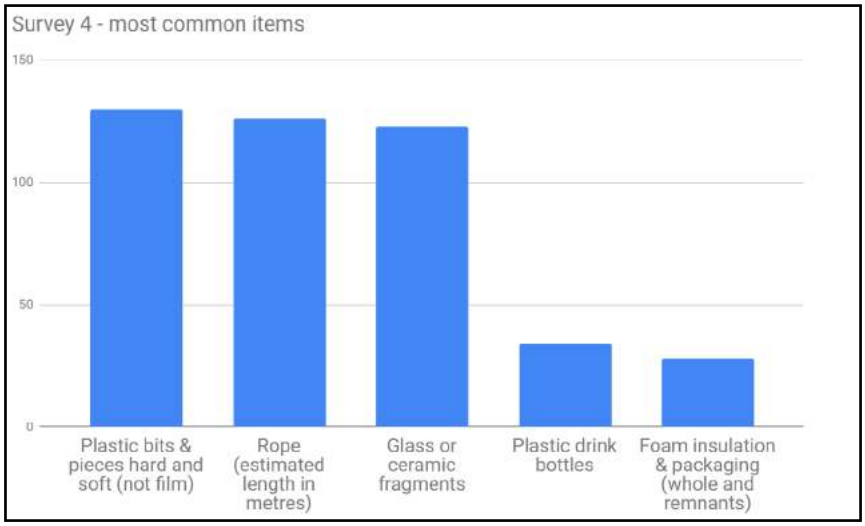
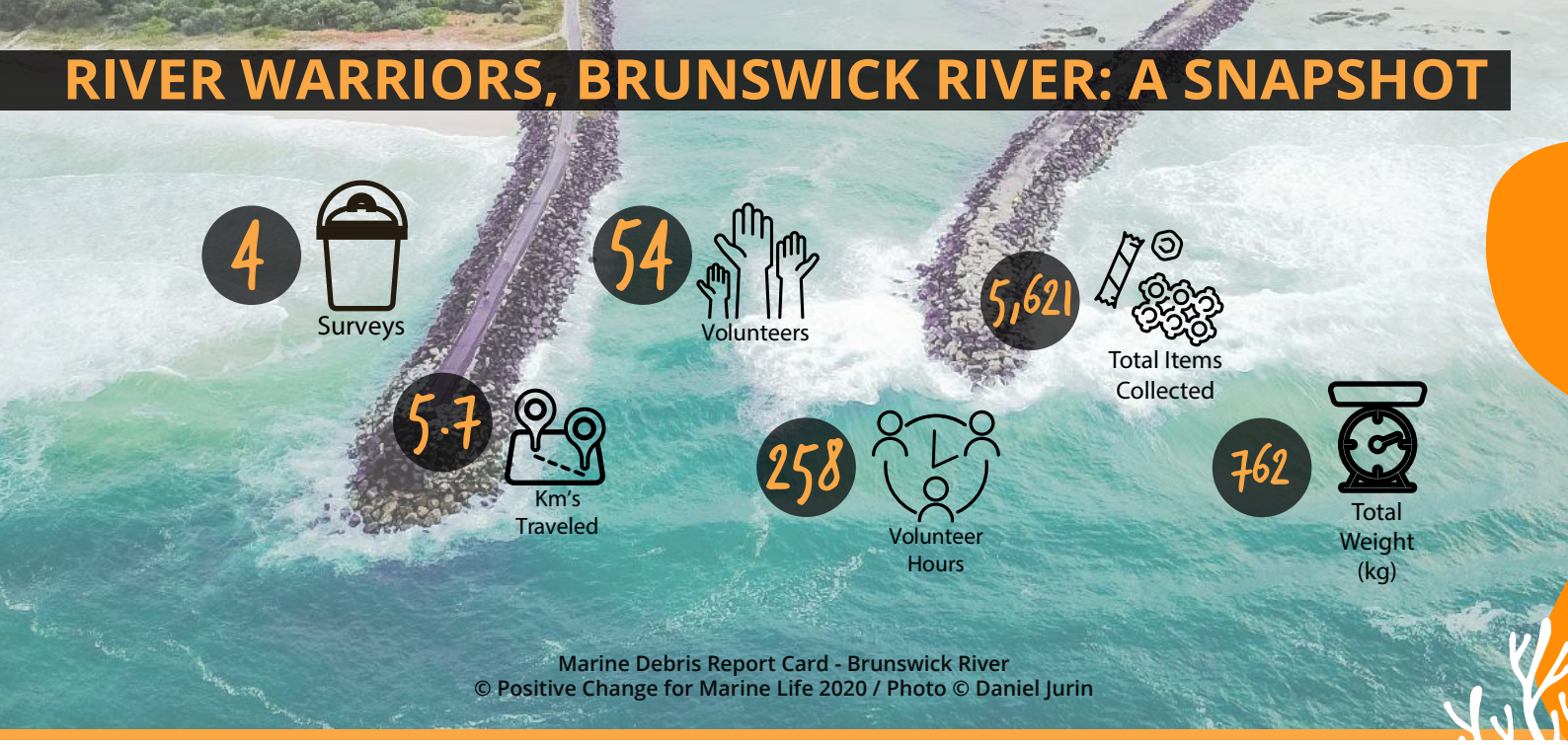


Figure 10: Most commonly found items across survey section 4.



River Warriors Brunswick River, Phase 1: A snapshot.

a handful of large residential blocks that are scattered throughout the area.

Findings and Potential Sources

Urban & Residential Leakage, Recreational Users and Local Litter

Survey 4, unlike all other transects, was not dominated by a single category of debris. Instead, plastic fragments (18%), rope (17%) and glass and ceramic fragments (17%) each represented an almost equal portion of the debris pieces found. This was followed by plastic drink bottles (5%) and foam insulation & packaging (4%).

The transects close proximity to Mullumbimby points to a wide range of urban, residential and light industrial sources. Plastic bits and pieces hard and soft (not film) reflect the close proximity to town, camping and recreational activities across river banks and in parks shadowing the river, as well as littering from recreational users. As in previous survey sections, glass and ceramic fragments found in this section are strong indicators of localised litter and are again most likely linked to campers, partying along the river banks and in nearby parks, as well as fishers/ boat users. Rope is often indicative of recreational river use and flood events (for example fishermen maintaining crab pots in sections), as well as accidental debris caused through flooding events.

ADDITIONAL MARINE PARKS SURVEY

Abandoned Oyster Lease, Simpsons Creek

Alongside our partners from Cape Byron Marine Parks, In addition to the four survey sections mentioned above, we were able to mobilise volunteers and staff to support the clean up of a derelict oyster lease on Simpson's Creek. Consisting primarily of plastic piping, rope, signage and other large debris items, this additional survey removed in excess of 150kg of waste and debris which was photodegrading in the river. This data was kept separate from our main analysis, as it came from a separate and discrete, known source and was not within our transect areas.

Alongside Marine Parks staff, our team found PVC piping, old tyres, mesh and rope from a tributary of the Bruns, Simpsons Creek, during the removal of an abandoned oyster lease.

During our surveys, some of our staff set-up our stall to further engage w internationally.

MANAGEMENT SOLUTIONS

POTENTIAL SOLUTIONS

There is a growing movement towards, and recognition of, the efficacy of grassroots, community-driven approaches to tackle a wide range of social and environmental issues[7]. Our River Warriors project aims to highlight these through the development of three key, inter-connected focus areas, engaging stakeholders, tourists and the broader community to address marine debris in the Brunswick River at its source.

These are adapted for each of our River Warriors projects based upon our findings and include: **Community Outreach, Education & Training, and Supporting Infrastructure.**

COMMUNITY OUTREACH

On-Water and Community Involvement

As a cornerstone of our organisation's approach and ethos, we have seen first-hand the positive impact that data-driven, well-informed, targeted community engagement can create - not only as a tool to effect tangible change, but also to encourage ownership and drive positive shifts in behaviour and community mobilisation. To this end, this phase of the River Warriors project on the Brunswick River was planned very differently to past iterations of the project - as a trial to compare results and measure changes through broader on-water community engagement.

In the past, we ran our River Warriors surveys entirely with our core staff and volunteers (2-4 team members), with strategic public events being created separately and not included in our core data. This project was run instead as a public engagement exercise, inviting local stakeholders and community members to participate, with survey numbers attracting between 14 and 22 participants. We standardised the data collected by the number of volunteers participating and the varying lengths of the transects surveyed so that we could still draw effective management recommendations through our citizen-science-based project approach.

ith the community and highlight our initiatives in Australia and

During the course of our surveys, we engaged with numerous stakeholders and resource users. These groups included fishers, residents living in close proximity to the river, recreational users, business owners, council workers and Marine Parks and Fisheries staff. From our conversations, we found that there was generally a good level of awareness amongst recreational users when it came to the proliferation of marine debris in the river, with most recreational users who we engaged with well aware of the issues when it came to pollution.

This however, presented a stark contrast to the awareness of the majority of residents, tourists and locals who were either unaware of the issue of marine debris in the waterway or were surprised by its extent. This equated to around 30% of total stakeholders spoken to being aware of the issue and 70% being unaware and surprised by our findings.

Every individual and group that we spoke to agreed that much more needed to be done and were happy that action was being taken to address the problem.

Education Programs

We ran two school and general public education programs, as well as education programs for participants at the beginning and end of 3 of our 4 transect surveys. With the challenges that COVID-19 created in delivering the final aspects of our program, we were successfully able to adapt our education materials to an open live webinar platform in order to comply with the stringent restrictions that were put in place during lockdown. Through these activities we were able to directly engage 89 students, teachers and community members. We will continue our education programs during Phase II of this project, specifically focusing on sharing our Report Card and engaging a wider section of the community in the issues affecting the Brunswick River, as well as other waterways in the region.

Running a pre-survey education program with a broad range of participating stakeholders.

Our CEO presenting to year 11's and 12's at the Shearwater school in Mullumbimby (above and below).

EDUCATION & TRAINING

Education and behavioural change are key to eliminating debris entering the Brunswick River in the long-term. Human beings are the source of these issues and therefore the source of the solutions to them. During Phase II of the project, post-community outreach surveys, we will be running *Source to Sea* education and training programs with six target stakeholder groups (identified during this Phase of the project) in order to shift perceptions around consumption and highlight the threats that our most found items are having on marine and freshwater environments. This will include on-ground research and fact finding missions into the businesses and industries responsible for the issue (expanding on the findings of this report) and then working with those stakeholders to address the issue at its source. We aim to do this through educating and training business staff, enhancing recycling and waste disposal and, most importantly, working towards replacing environmentally harmful items

with sustainable, low-impact alternatives (source-reduction). The latter will be achieved through our other locally-aligned campaigns, especially our *Leave No Trace* (formerly *Don't Be A Sucker*) campaign.

The educational component of our program will also extend to the promotion of our *Marine Debris Report Card* throughout communities in the catchment area (especially those closest to the river), as well as through media outlets across the region.

Voting Booth Bins are a great way to engage the community in 'doing the right thing' when it comes to littering and can be designed with fun questions or as a way to vote for a local charity to share in funds donated by local businesses.

SUPPORTING INFRASTRUCTURE

Addressing the issue of marine debris is incredibly challenging without proper infrastructure in place. Prevention and disposal of litter before it can make its way to a waterway or the ocean is vital in keeping the sea plastic free, that's why we see infrastructure as a core focus area to support our community outreach and education/training programs. Educational signage is a great start, as well as fishing line, cigarette butt or other waste item-specific bins. Innovative and engaging alternatives to traditional waste bins such as "voting-booth bins" are also a great avenue to explore.

Initiatives that are educational, fun and inclusive can be a great way to enable the community to think twice before they litter, especially when coupled with a positive message, rather than an authoritarian one. As part of Phase II of the Brunswick River River Warriors project, we will be looking to install recycled, locally made educational

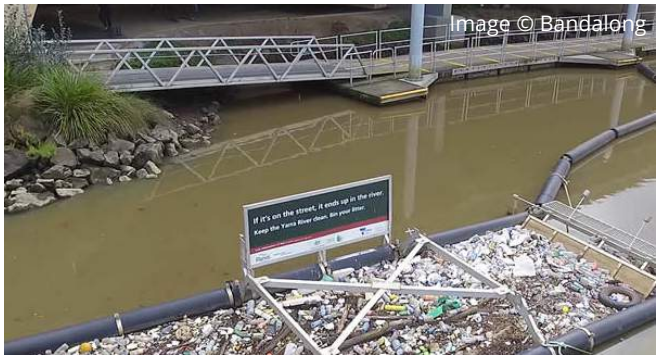
Litter traps, nets and booms are a great solution to reducing marine debris from waterways and the ocean. Coupled with source-reduction and circular economic solutions, they are vital to stopping the flow of marine debris.

signage and voting booth bins in marine debris hotspots across our (extended) survey areas (especially targeted to items that were in highest abundance such as fishing rope and plastic items).

Throughout many of the parks, underpasses and sections of road bordering the river, we noticed either a significant lack of bins, including cigarette and recycling bins (none present across all areas that we surveyed). While these can be costly for local councils, we believe that they are vital to preventing litter from entering the environment. Our work in other shires across Australia and internationally has shown that ample, easy to use bins can create significant positive outcomes (alongside adequate community education and outreach). During Phase II, we will be exploring opportunities for these bins to be funded/installed alongside our educational signage in high debris areas and hotspots.

Over the past decade, research and development of booms, nets and traps to capture litter has significantly improved. We have engaged with a number of businesses who specialise in these areas in order to explore realistic debris capture devices and solutions to trap litter from stormwater drains, high-flow areas and highway overpasses. Our goal is to implement these practical mitigation solutions during the final stage of the project (Phase III).

Observations during surveys and interviews with user groups and stakeholders clearly highlight that heavy rain and flooding events have a significant impact on debris flows, adding large amounts of debris from roads, stormwater drains, industrial areas and properties within proximity to the river. We will explore the development of a marine debris flood plan, alongside council and the debris mitigation management groups that we engage during Phase II and III of the project. This will include community education prior to and during storm season, specialised litter traps and booms, as well as proactive cleans to curve the flow of debris into waterways and the ocean during these events. Obviously, the flow of debris will continue if not addressed through the supply chain. Our source reduction campaigns compliment River Warriors and together, create a holistic approach to marine debris and pollution.



Litter reduction prevention tools iike nets, traps and booms can greatly reduce debris from flowing into waterways and the ocean.

On-water engagement programs are a great way to connect people to nature, creating a sense of environmental stewardship that continues well beyond the life of the programs.

FINAL THOUGHTS AND NEXT STEPS...

Most people associate pollution with developing countries, which often lack the infrastructure and resources to manage their waste. Australia is the lucky country - with an incredibly high standard of living, good education, public services and a relatively small population. Despite this, it's clear from our findings that marine debris is an enormous problem that has gotten way out of hand. If we are struggling to tackle this issue now, what will the future hold, especially given our projected population growth and our terrible track record when it comes to recycling?[8]

On average we found **945 pieces of debris per kilometre** during our surveys on the Brunswick River. This is a concerning statistic and the highest number that we have found so far across our 4 River Warriors locations. It is also one of the key factors influencing the rating that the river scored in our Marine Debris Report Card. Despite this, we need to realise that work in the marine debris mitigation space is still in its infancy and that over the past decade alone we have had some great successes in terms of addressing the issue on a regional, state and national level.

We have the knowledge, resources and ability to address marine debris, yet these results reflect the low priority that it has been given in the past. A great deal of work is still needed to be done, however, we believe that projects like our River Warriors initiative can develop a model of 'best practice' to present to governments, industry, the community and other stakeholders in order to identify positive ways to move forward and tackle this issue at its source. The project also assists in creating 'River Champions'. Local people who will continue to care for their waterways and local marine environments, encouraging others to do the same.

Through these surveys and consistent engagement with stakeholders and our project partners, broader impacts on ecosystem health have been encountered not just on the Brunswick River, but

Everyone gets in on the action.

across all of the waterways in which we work. Many of these are not being addressed and include pollution, bank erosion, habitat loss and declining water quality.

Thanks to the initial funding by our generous sponsors, as well as on-ground support from local partners, we have developed a robust new framework for the River Warriors project, which will begin incorporating these new variables into a broader ecosystem health approach during Phase II. With a portion of initial funding already being secured for this purpose, we are excited to explore where this new direction will take the project as we move towards addressing a range of ecosystem threats on the Brunswick River and beyond!

We are currently seeking partnerships with various businesses and government bodies to provide further support to make up the resource gap that we have for Phase II of the project, however, we are confident that we will fulfill our resource requirements and aim to move the project into this new phase immediately after we wrap-up phase I.

It is clear that an integrated, ecosystem approach to catchment management is required to achieve tangible and long-lasting rejuvenation of healthy waterways and subsequently, healthy oceans. We are incredibly excited to launch Phase II of this project, which marks a new direction for our River Warriors project and will assist in moving the Brunswick River toward an "A" rating in terms of marine debris health, whilst exploring riparian and mangrove degradation, habitat loss, and other parameters within the catchment area.

REFERENCES

1: Export of Plastic Debris by Rivers into the Sea. Schmidt et al. Environmental Science & Technology. 2017.

2: Marine debris: understanding, preventing and mitigating the significant adverse impacts on marine and coastal biodiversity. BFS Dias - CBD Technical Series, 2016 - cabdirect.org

3: Australian Government - Department of Agriculture, Water and the Environment. Key Threatening Processes. https://www.environment.gov.au/biodiversity/threatened/key-threatening-processes/harmful-marine-debris

4: New South Wales Department of Planning, Industry and Environment. NSW Water Catchment Snapshots, Brunswick. https://www.industry.nsw.gov.au/water/basins-catchments/snapshots/brunswick

5: NSW National Parks and Wildlife Service, Brunswick Heads Nature Reserve. https://www.nationalparks.nsw.gov.au/visit-a-park/parks/brunswick-heads-nature-reserve/learn-more#FB5B81F47B9B46F4BA838DE36EA2E183

6: Environmental Monit Assessment. A review of citizen science and community-based environmental monitoring: issues and opportunities. Conrad & Hilchey 2010.

7: Environmental Monit Assessment. A review of citizen science and community-based environmental monitoring: issues and opportunities. Conrad & Hilchey 2010.

8: China's recycling 'ban' throws Australia into a very messy waste crisis. The Conservation Online News Article. Downes & Dominish, 2018. https://.theconversation.com/chinas-recycling-ban-throws-australia-into-a-very-messy-waste-crisis-95522

MARINE DEBRIS REPORT CARD

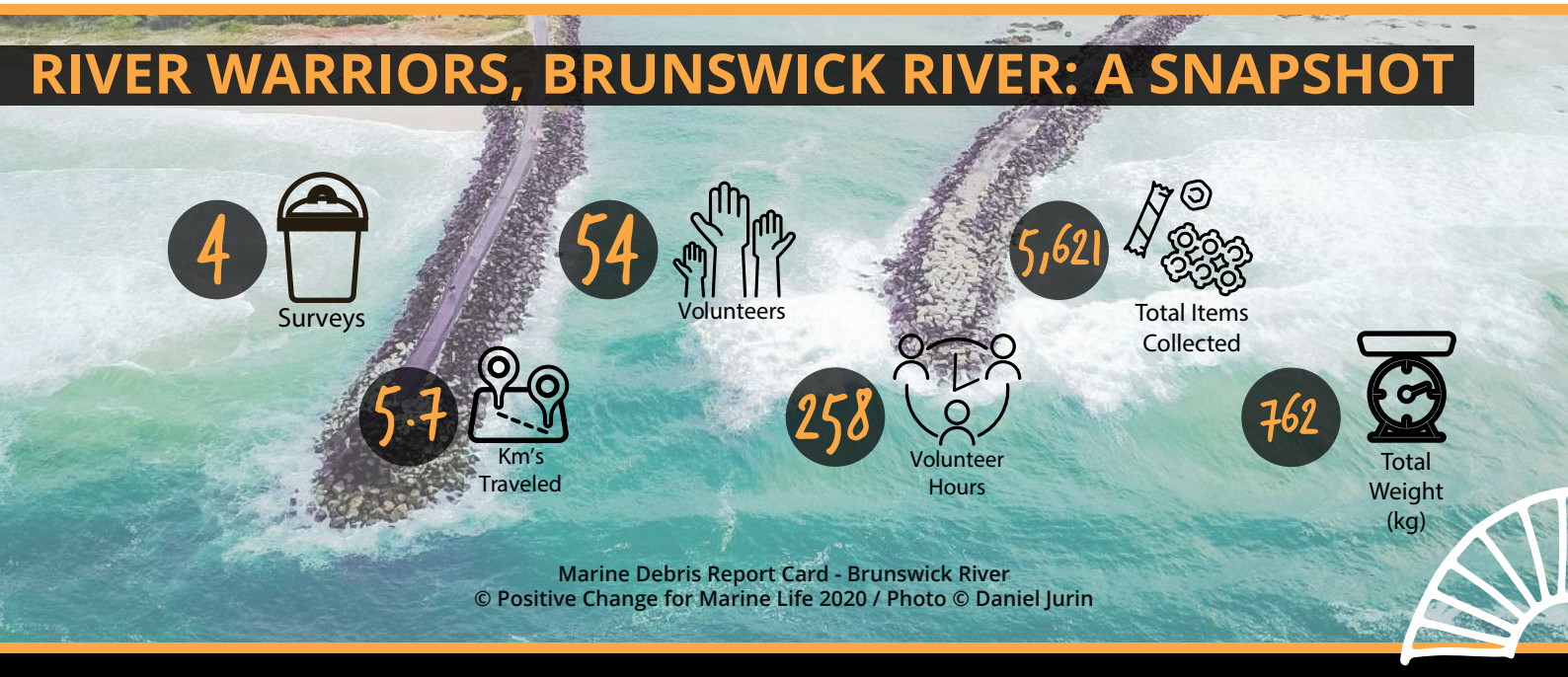
2020

Brunswick River, Brunswick Valley, NSW

INTRODUCTION

The issue of plastic pollution and marine debris has been gaining increasing attention in Australia. Once thought of as predominantly affecting developing countries - recent changes in China's international recycling legislation, coupled with increasing population growth and associated development have dramatically increased the visibility of the issue. With more than 800 animal species negatively affected by litter in our seas, marine debris is recognised as a *Key Threatening Processes* at the Federal level and at state levels in New South Wales and Queensland.

Our *River Warriors* initiative addresses the impacts of marine debris and pollution through a series of kayak-based on-water surveys to collect, record and recycle/ properly dispose of marine debris in waterways across New South Wales and south -east Queensland. Due to strong public support - this phase of the River Warriors project on the Brunswick River was launched as a flagship public engagement activity, rather than through team only surveys. This approach not only provided greater support in cleanups and data collection, but also enabled us to directly engage with and educate a large number of stakeholders, including residents and community members. Over 11 months we conducted 4 surveys and engaged 89 stakeholders directly, of which 54 contributed 258 volunteer hours on the water. We were able to remove 5,621 pieces of debris weighing 762kg over just a 5.7km stretch of the river.



FINDINGS

Our data reflects that plastic and polystyrene (foam) dominated our findings, making up 71.2% (54.2% plastic and 17% polystyrene) - Figure 1. The most commonly found individual items were, in decreasing order: Plastic fragments (hard & soft), Glass or ceramic fragments, Foam insulation & packaging (whole & remnants), Rope (length), and Plastic drink bottles.

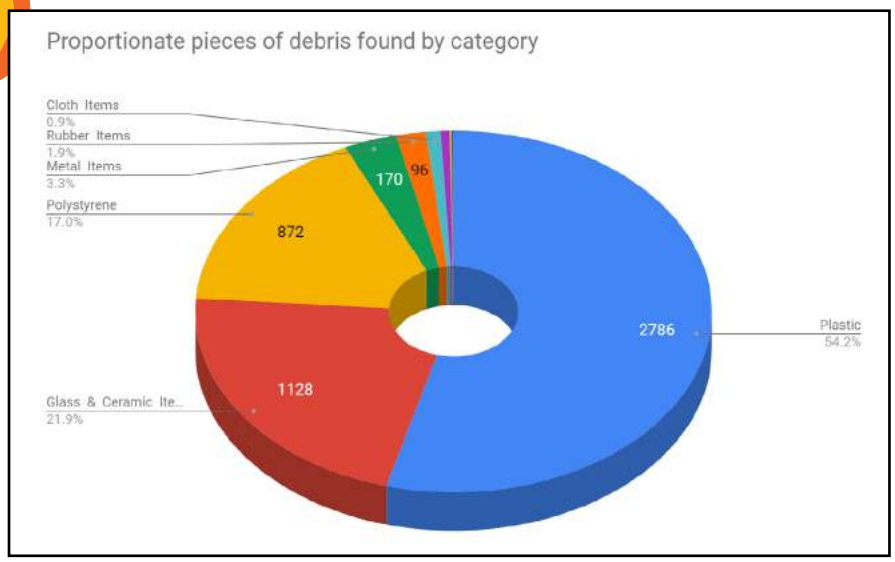


Figure 1. Total debris found - represented as a percentage.

Our Report Card ranking takes into account 3 key variables to determine a grade between A (best) and F (worst). It aims to mitigate problem items through community outreach, education, training and supporting infrastructure (explored during Phase II and III of the program).

TOP 5 ITEMS FOUND

Plastic Fragments

Glass & Ceramic Fragments

Foam Insulation & Packaging

Rope

Plastic Drink Bottles

Key Report Card Variables

Source of debris	Quantity of debris	Type of debris
No major source	<20 pieces per km	<10% plastic/foam found
1-2 unmitigated sources	20 - 100 pieces per km	<25% plastic/foam found
3-4 unmitigated sources	100 - 300 pieces per km	<50% plastic/foam found
4-5 unmitigated sources	300 - 600 pieces per km	✓ <75% plastic/foam found
✓ 6+ unmitigated sources	✓ >600 pieces per km	>75% plastic/foam found

REPORT CARD SCORE

F+

While an F+ may seem like a poor result, work addressing waste and marine debris is still in its infancy. Phase II and III of this project will engage stakeholders across the region to mitigate debris at its source and ensure that the Bruns can move towards an A rating!

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