

Institution: Loughborough University		
Unit of Assessment: C24 Sport and Exercise Sciences, Leisure and Tourism		
Title of case study: Advancing regulatory frameworks within Para sport: Ensuring sport is practiced in a manner that respects fair play and protects the health of the athletes globally.		
Period when the underpinning research was undertaken: 2012 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
1. Prof Victoria Goosey-Tolfrey	1. Professor in Applied Disability Sport	1. 2007-present
2. Dr Barry Mason	2. Senior Research Associate	2. 2011-present
3. Dr Ben Stephenson	3. Research Associate	3. 2018-present
Period when the claimed impact occurred: 2014-2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words)		
<p>Para sports are uniquely positioned to play a key role in the promotion of health for individuals with a disability across the spectrum from development to elite. Para sport related research at Loughborough University's Peter Harrison Centre for Disability Sport has included biomechanical, technical, physiological, thermoregulatory, and qualitative insights to better understand classification, policy, and athlete health. The research 1) led to the International Paralympic Committee's decision to establish new Para sport events at the Paralympic 2020 (to be hosted in 2021) and Commonwealth Games 2022; 2) enabled more athletes in more countries to participate, increasing the number of competitions and funding opportunities, and 3) improved knowledge and, with the development of monitoring and evidence-based policy guidelines, significantly reduced heat related illness in Para athletes globally.</p>		
2. Underpinning research (indicative maximum 500 words)		
<p>The International Paralympic Committee (IPC) requires that sports included in the Paralympic Games must have an evidence-based classification system. Paracanoe is a relatively new sport where athletes with physical impairments compete in two events, that can be distinguished by using different boats (Para-kayak or Para-Va'a). Para-kayak is contested in a kayak propelled with a double-blade paddle and Para-Va'a is contested in a Polynesian outrigger canoe and is propelled using a single-blade paddle. In 2015 the IPC stated: <i>"Whilst we consider the new classification system adopted for Para-kayak as robust, we have some reservations about the validity of the classification system proposed for Para-Va'a. More research is needed and we believe that there is insufficient time for this to be completed and fully implemented ahead of the first qualifying event for next year's 2016 Paralympics."</i></p> <p>Following this statement, Peter Harrison Centre for Disability Sport (PHC) team members (Prof Tolfrey and Dr Mason) were awarded funds from UK Sport enabling them to join Dr Bjerkefors (Swedish School of Sport and Health Sciences) and the International Canoe Federation (ICF) to collaborate. The project (R1) described how athletes with different impairments paddle compared to able-bodied athletes. Detailed insights into the cohort of Para-Va'a athletes in collaboration with ICF classifiers formed the basis for creating the new evidence-based classification system, the first of its kind. The research was extended (R2)</p>		

to establish the inter-rater reliability of this new sport-specific classification system, demonstrating that a robust system existed when used by different classifiers.

Since 2012, the PHC have collaborated with industry partners (UK Sport, English Institute of Sport, McLaren Applied Technologies) and Para Sport governing bodies to develop a novel radio-frequency indoor tracking system (ITS). The ITS accurately (within 0.2-2%) and reliably (~2%) quantified the activity profiles of indoor wheelchair sports, never previously available (**R3**). Being at the forefront of this world leading technology and knowledge, the International Wheelchair Basketball Federation (IWBF) approached Dr Mason to develop a 3x3 version of their sport. Wheelchair basketball is typically a 5x5 sport, however a variety of 3x3 formats were emerging worldwide. Multidisciplinary research including the ITS revealed that players covered more distance at higher speeds during full-court 3x3, although no differences in technical activities or physiological responses were revealed between formats. Qualitative data suggested that players, coaches, and stakeholders perceived the full-court format not as inclusive as a half-court format. Subsequently this evidence-based data (**R4**) was used by the IWBF to inform their decision that half court 3x3 would be the version they supported moving forward.

In addition to policies within classification and game formats, the PHC have performed a series of studies examining the health and wellbeing of Para-athletes during and preparing for competition. Specifically, Dr Stephenson's research displayed significant thermal strain during competition and a high incidence of self-reported heat illness symptomatology in a large group of paratriathletes, relative to findings in able-bodied athletes. Almost 80% of the paratriathletes displayed core temperatures $\geq 39.5^{\circ}\text{C}$ with 8 athletes reaching extremely dangerous levels ($\geq 40.0^{\circ}\text{C}$). Notably, core temperature differences were dependent on athletes' race classification and wetsuit use (**R5**). This work provided supporting evidence for the environmental challenges faced by paratriathletes suggesting that that heat acclimation protocols are warranted. In a novel, heart rate-controlled heat acclimation study (**R6**), paratriathletes displayed positive thermoregulatory adaptations yet only partial heat acclimation, when compared to the able-bodied triathletes.

3. References to the research (indicative maximum of six references)

R1 Rosén, J.S., Arndt, A., Goosey-Tolfrey, V.L., Mason, B.S., Hutchinson, M.J., Tarassova, O., Bjerkefors, A. (2019). The impact of impairment on kinematic and kinetic variables in Va'a paddling: Towards a sport-specific evidence-based classification system for Para Va'a. *J Sports Sci*. Sep;37(17):1942-1950. Doi: 10.1080/02640414.2019.1606763.

R2 Rosén, J.S., Goosey-Tolfrey, V.L., Tolfrey, K., Arndt, A., Bjerkefors, A. (2020). Interrater reliability of the new sport-specific evidence-based classification system for Para Va'a. *Adapt Phys Act Q*. 37(3):241-252. Doi: 10.1123/apaq.2019-0141.

R3 Rhodes, J., Mason, B.S., Perrat, B., Smith M.J. and Goosey-Tolfrey, V.L. (2014). The validity and reliability of a novel indoor player tracking system for use within wheelchair court sports. *J Sports Sci*. 32(17): 1639-1647. Doi: 10.1080/02640414.2014.910608.

R4 Mason, B., van der Slikke RMA, Hutchinson M.J., Berger M.A.M and Goosey-Tolfrey V.L. (2017). The effect of small-sided game formats on physical and technical performance in wheelchair basketball. *Int J Sports Physiol Perform*. 13(7):891-896. Doi:10.1123/ijsp.2017-0500. PMID: 29252106.

R5 Stephenson, B.T., Hoekstra, S.P., Tolfrey, K., Goosey-Tolfrey, V.L. (2020). High thermoregulatory strain during competitive paratriathlon racing in the heat. *Int J Sports Physiol Perform*. 15(2): 231-237. Doi: 10.1123/ijsp.2019-0116. PMID:31172833.

R6 Stephenson BT, Tolfrey K, Goosey-Tolfrey VL. (2019). Mixed active and passive, heart rate-controlled heat acclimation is effective for Paralympic and able-bodied triathletes. *Front Physiol*. Sep 20;10:1214. Doi: 10.3389/fphys.2019.01214. eCollection 2019.

The quality of the underpinning body of research is evidenced by competitively awarded charity grants in excess of £2.5M, including by National Governing Bodies within sport. The

research has achieved international recognition with Prof Tolfrey being awarded the prestigious International Paralympic Committee Paralympic (IPC) Scientific Award in 2017.

4. Details of the impact (indicative maximum 750 words).

Members of the PHC at Loughborough University have engaged in strategic, high profile capacity building in Para sport. The work undertaken by the PHC team has altered practices by the English Institute of Sport (EIS) and national governing sporting bodies. It has been implemented across the UK leading to successful sporting performance achieved by GB athletes [2014-2020] (e.g., European, World and Paralympic medallists) [S1].

“The Paralympic Games in Rio 2016 saw the British Team collect medals across more categories than any other nation, this could not have been delivered without the support this Para sport research at Loughborough University has given us”.

Jonathan Riall (British Paratriathlon Head Coach) [S1]

Consequently, international collaborations with key stakeholders within the sports of Paracanoe, wheelchair basketball in addition to Paratriathlon have ensured that the PHC are at the forefront of innovation, improved knowledge, and policy change.

This has led to the following impacts:

1. New Para sport events established at Paralympics and Commonwealth Games

Paracanoe: New event at the Tokyo Paralympics 2020

Information detailing how athletes within the discipline of Para-Va'a with different impairments paddle compared to able-bodied athletes was used as a basis for creating evidence-based classification systems [R1, R2]. This new classification system was approved by the International Paralympic Committee (IPC) in 2017, resulting in Para-Va'a being accepted at the Tokyo Paralympic Games. The IPC announced that three new events (men's and women's VL2 and the men's VL3), bringing the total to nine Paracanoe events, would be included on the Tokyo 2020 programme [S2] and the sport at the Paris Paralympics in 2024.

“This was a major and significant achievement. Without this collaborative research involving the PHC at Loughborough University it would not have been possible. Along with strong world-wide participation growth in the discipline - more and more athletes are turning to our sport, more countries are involved, and the standard of competition has grown enormously, it was a monumental step in achieving inclusion in the Paralympic Games in Tokyo”. **John Edwards (Chair ICF) [S3]**

Wheelchair basketball - New event at the Commonwealth Games 2022

After the success of the 3x3 running version of basketball becoming a vehicle for promotion of the game of basketball throughout the world, PHC engaged in strategic and high-profile dissemination activity with the International Wheelchair Basketball Federation (IWBF) at their 2018 quadrennial forum. Research from the PHC has helped characterise the technical, physiological, and self-perceived insights of the 3x3 format of wheelchair basketball [R3, R4]. These data have directly contributed to the development of the 2019 official IWBF 3x3 wheelchair rules and were instrumental with informing the IWBF that half court 3x3 wheelchair basketball was the most appropriate (and subsequently the chosen) format to be included at world major events. For example, for the first time '3x3' wheelchair basketball will be included at the Commonwealth Games in 2022 [S4].

2. Increased participation in, and funding for, Para sport

Paracanoe: Increased number of sport participation worldwide and level of funding in the UK

Within Paracanoe there are now two events, using different boats. Since the boat used for Va'a is more stable than a kayak then it opens it up the sport to a different range of disabilities.

“Already, canoe clubs across the country are introducing athletes to both boats (the kayak and Va'a). This has opened the sport up to a different range of disabilities as well. Some disabilities are better suited to Va'a and I have seen new athletes transition into the sport. This was a hugely exciting piece of research for British Canoeing as has enabled more sporting opportunities for children and young adults.” **Emma Wiggs (Rio 2016 Paralympic Gold medallist) [S5]**

As a direct consequence of the IPC announcement in 2017, UK Sport subsequently increased its funding by 27% (£800K) directly to British Canoeing [S6].

“I know first-hand that this additional funding provided by UK Sport has allowed me to purchase two boats which are housed at the Nottingham high performance centre which has raised our profile as a real contender on the International stage. To end up with our second boat in Tokyo as three new events is hugely significant.” **Emma Wiggs (Rio 2016 Paralympic Gold medallist) [S5]**

Wheelchair basketball - Increased sporting opportunities globally

“Introducing and developing 3x3 as the second discipline in wheelchair basketball is extremely important to allow us to continue to grow our sport across the world. The release of the rules is a further milestone in our strategic plan to establish the discipline of 3x3 in the wheelchair game and widen our network of athletes, supporters, and stakeholders”. **IWBF President, Ulf Mehrens [S7]**

Although 3x3 wheelchair basketball is still in its infancy, following the conclusion of the PHC research, early data from the IWBF have indicated that 30 Commonwealth nations now have a 3x3 programme and have registered an interest in competing at the inaugural 2022 Commonwealth Games. Nine of these nations were not previously IWBF member nations. All 30 nations have a men's programme, with 16 also having developed a women's programme. Therefore, the 3x3 format resulting from our research has served to increase the number of nations participating in wheelchair basketball. These statistics are currently only available to Commonwealth nations and with plans to expand the sport into World Championships the scope to increase participation worldwide is also anticipated [S7].

3. Improved knowledge and policy guidelines for better health and safety within Paratriathlon athletes

The PHC research characterised the thermoregulatory responses during competitive Paratriathlon races in Italy and noted the added strain when wearing a wetsuit in high water temperatures [R5]. This race-specific data related to the incidence of heat-illness has improved the health and safety of athletes during competition in warm climates. The International Triathlon Union (ITU) changed their policy around wetsuit use in their regulations in 2019, which depend totally on water temperature one hour before the start of the event. This has enhanced and altered the healthcare and practical advice given to all athletes and coaching staff within the sport of Paratriathlon (e.g., upper water temperature limit for wetsuit use as documented in the ITU Competition Rules, 2018-19, [S8]).

“The research collaboration with PHC was instrumental in our decision to adjust the upper water temperature limit for wetsuit use in Paratriathlon with the work highlighting the level of thermoregulatory strain previously faced by athletes when swimming in warm water” **Dr Sergio Migliorini (ITU Medical Committee Chair) [S9]**

A major impact of this work in just one racing season (2019-20) with the Paratriathlon in-competition medical records suggesting that improved athlete health is already evident.

“After the introduction of the new rules we have had less cases of swim failure and heat related illness in Paratriathletes, improving the safety of the swim leg in Paratriathlon races.” **Dr Sergio Migliorini (ITU Medical Committee Chair) [S9]**

The reach and dissemination of this impact have occurred at international symposia and debates have been conducted around heat acclimation [R6]. The latter event led to the knowledge translation of PHC research via a web-based document to support athletes preparing for competitions in warm environments (e.g. Tokyo Paralympic Games) which was based on and highlighted our research findings [S9]. Dr Stephenson who led much of this work at the PHC has been working on the British Triathlon’s heat and humidity strategy to prepare for the conditions at the Tokyo Paralympics with two other practitioners. This programme of work was awarded UK Sport’s ‘*practitioners team award*’ in recognition of making a significant contribution to the high-performance community in 2020 by improved knowledge and altered coaching practice [S10].

5. Sources to corroborate the impact (indicative maximum of 10 references)

	Details	Impact
S1	Triathlon magazine ‘Britain’s pioneering approach to elite Paratriathlon training’ and ‘The true partnership’ article written by Jonathan Riall (GB Paratriathlon Head Coach).	Improved knowledge, Altered coaching practice
S2	Announcement by the International Paralympic Committee of Paracanoe Va’a inclusion in Tokyo events programme (4 th Sept 2017).	New Paralympic event
S3	Letter from John Edwards: Member Board of Directors / Chair International Canoe Federation (ICF).	New Paralympic event
S4	The Peter Harrison Centre for Disability Sport (PHC) to present at International Wheelchair Basketball Forum (IWBF) IWBF are proud to announce the publication of the approved 2019 3x3 official wheelchair basketball rule	Policy change
S5	Letter from Emma Wiggs (Paralympic Paracanoe Gold Medallist) corroborating the significance of the PHC research	New Paralympic event, Increased investment, Increased sporting opportunities
S6	Paracanoe UK Sport historical funding Rio and Tokyo Cycles	Increased investment
S7	Letter from Charlie Bethel (IWBF) corroborating the significance of 3v3 format worldwide.	New Commonwealth Games 2022 event
S8	International Triathlon Union (ITU) Competition Rules (updated June 2019).	Policy change
S9	Letter from Sergio Migliorini (MD) ITU Medical Committee Chair ITU Beat the Heat educational material to safeguard athletes competing in the heat for Tokyo	Policy change, Improved healthcare guidelines during competition, Capacity building, International influence
S10	PLx 2020: UK Sport High performance conference - Support staff/Practitioner who has made a special impact (British Triathlon team – inc. Dr Ben Stephenson).	Improved knowledge, Heat and humidity practice policy