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Advancing sport ecology research on sport and the natural environment

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ABSTRACT

Sport and the natural environment have an intimate relationship threatened by global warming and climate change. Individual sport organizations and events to the collective global sport sector must address climate change on two primary fronts – (1) reducing their impact on the natural environment resulting in climate change to sustain the environments individual sport organizations and events taking place and (2) sustaining sport from changing environments due to climate change. This paper examines previous research from these two fronts, and gaps are identified that can inform future research to advance our understanding of environmental sport management or sport ecology topics. The paper then discusses practical and measured responses to climate change using examples from other disciplines beyond sport management to enhance these research lines and inform industry practice. As the sport sector advances, a fourth wave of the sport environmental movement is emerging where sport organizations encounter internal and external pressures to resolve contradictions in their stated environmental values and organizational operations (e.g. short-haul flights, carbon-intensive sponsors). The paper concludes with recommendations across these two fronts to engage fans and participants in meaningful climate action with demonstrative results.

KEYWORDS

Sport and the environment; sport ecology; environmental impacts; climate adaptation; environmental sustainability

Climate change is causing dramatic and rapid changes in our surrounding environments, resulting in fluctuations in weather patterns, precipitation, and temperatures, among other issues (Stott, 2016). As noted by the United Nations Security Council, these changes adversely affect life on the planet. The IPCC's (2022) 6th Assessment reports that climate change will negatively impact the abundance and availability of natural resources needed for survival, resulting in decreased yields in worldwide food production and famine (Rosenzweig & Parry, 1994; Schmidhuber & Tubiello, 2007). Rising ocean sea levels threaten global commerce and international trade by threatening access to global seaports and the livelihoods of those on the seashore worldwide (Hanson & Nicholls, 2020). Climate change will result in forced migration, putting additional stress on nations to accommodate climate change refugees (Berchin et al., 2017). This increased pressure and

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demand for precision natural resources will likely result in increased international tensions that could lead to armed conflict (Abel et al., 2019) and the prospects for such a war unseen in modern history (Coats, 2018). Moreover, we are in the sixth mass extinction, where species of animals, flora, and fauna will cease to exist because of human activities resulting in climate change (Ceballos et al., 2018).

Like the mass extinction, scholars (Ebi et al., 2021; Scott et al., 2015) caution that sports are threatened, endangered, and on the brink of extinction. In December 2022, the International Olympic Committee (2022) delayed the selection of the 2030 Winter Olympic Games host because of concerns regarding the stability of winter weather and snowpacks. This comes after the 2022 Beijing Games featured over 90% artificial snow for outdoor events (Wang et al., 2023). Summer sports are also threatened due to increased temperatures, raising the propensity for heat-related illness and death (Driscoll et al., 2008; Hollander et al., 2021). Sport practitioners echo the impacts of climate change on winter and summer sports. IOC President Thomas Bach noted that climate change's effects "raises the question of how much time is left for the World Cup, Olympics or Paralympic Games". Athletes have also amplified their voices and concerns about these impacts on their sport and the collective inaction to address it. Féderation Internationale de Ski (FIS) athletes wrote to FIS Council members noting their "sport is threatened existentially and urgently" while demanding that FIS act to "lead in the fight against climate change" (Athletes, 2023, p. 1).

Despite these concerns, the collective *inaction* of the sport industry is summarized as "despite knowing that the consequence of not taking environmental issues seriously enough could be cataclysmic, responses to sport-related environmental issues have still been shown in many cases to be surprisingly weak, hollow, and half-hearted" (Wilson & Millington, 2020, p. 2). Sport practitioners across the sport sector are seemingly at a loss for what to do to respond to climate change (Casper et al., 2012; Kellison et al., 2015). The fact remains that the impact of human activities, including sport, on the natural environment requires immediate and purposeful action and leadership from practitioners and academics that coincide with reducing the causes of and adapting to climate change. This provides a unique position for the sport management academy, specifically its subdiscipline of sport ecology (see McCullough et al., 2020), to instigate and inform sport's measured response to climate change. To this end, the purpose of this paper is to highlight the formative research and provide future research directions concerning the individual organizations and the collect sport sector's environmental impacts and responses to climate change and how those efforts are communicated and engage external stakeholders in those efforts. The paper will also address future directions to better position the sport management academy to engage in essential and formative research on sport and the natural environment for the next 25 years.

Sport and the environment research is taking root

It is fortunate that *Sport Management Review* recognizes the importance of the natural environment and its relationship to sport and sport business. The emergence of research examining the relationship between sport and the natural environment has been characterized as sustainable sport management (Chernushenko, 2001), sport environmental sustainability (Mallen & Chard, 2011), and most recently, sport ecology (McCullough et al.,

2020). This research area got its footing in the 1990s (Gibson, 1998; Lenskyj, 1998) and steadily increased its presence within sport management literature at the start of the new millennium (e.g., Chernushenko, 2001) and continues today.

The growing relevance of the relationship between the natural environment and sport was noted by scholars (Chalip, 2006; Mallen & Chard, 2011; Thibault, 2009). Specifically, Chalip foreshadowed the emergence of a "discourse surrounding sport's relationship to the environment" (p. 10) within the academy. Later, Thibault noted that the globalization of sport contributes to an expanding impact of sport on the environment. Mallen and Chard later advanced this discourse by posing debate questions to frame discussions about the future of environmental sustainability in the sport academy. This work is essential as the sport management academy integrates sport environmental management and sport ecology research to evaluate the role and responsibility of reducing the anthropomorphic environmental impacts of global warming and climate change while adapting to sustain sport to changes in the natural environment. There has been an increase in research in this area across the academy, as highlighted by previous reviews (see Chard et al., 2013; Cury et al., 2023; Mallen et al., 2011; Trendafilova & McCullough, 2018). The previous research in this area is the foundation to advance research in the next quadrans centennial. As an academy, we must focus on the environmental impacts of sport organizations, communicate the importance of climate action to stakeholders purposefully, and how the sport sector can sustain itself through climate action and adaptation. The following sections highlight research in these areas and propose how these areas can advance to expand our understanding and enhance the sport sector's response to climate change.

Clarity on sport's environmental impact

One of the pressing issues within sport ecology circles is the strong emphasis on sport's impact on the natural environment. Thibault noted that "sport makes a significant impact on the environment" and "based on the number of sport events held throughout the world, our ecological footprint related to sport is immense and, for the most part, goes unnoticed" (p. 11). Researchers have examined the environmental impact of local, national, and international events (Collins et al., 2007, 2009; Cooper & McCullough, 2021; Dolf & Teehan, 2015; Goldblatt, 2020) and the impact of recreation and physical activity (Cunningham et al., 2020). This research has been valuable to begin to put these events and sporting activities' environmental impacts into context to frame the debate on the holistic value (i.e., economic, social, environmental) of sporting events from the World Cup and Olympics, national events like the Australian Open, Super Bowl, and London Marathon, and localized events (e.g., American college sport), community sport, and individualized sport participation. However, more work is necessary to contextualize the largest contributing factors to the environmental impacts of sporting events (i.e., Scope 3).

Focus on scope 3 emissions

Scope 3 emissions "are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain" (Environmental Protection Agency, 2023, para. 1). Researchers have demonstrated that

Scope 3 emissions are the most significant contributor to a sporting event's emissions regardless of the scale of the event. Researchers examined spectator transportation, hotel stays, and tailgating as Scope 3 emissions (Bunds et al., 2019; Collins et al., 2009; Cooper & McCullough, 2021; Dolf & Teehan, 2015). Yet Scope 3 emissions go beyond these categories, stressing researchers' importance in identifying the attributable Scope 3 emissions specific to the sport sector. McCullough et al. (2020) argued that externalities of sporting events (i.e., outside auxiliary events associated with the sporting event) should be included in Scope 3 emissions. They also argued that environmental impact assessments should use the same scope as economic impact assessments. There are existing research foundations on the environmental emissions of sporting events (Collins et al., 2007) and organizations (Dolf & Teehan, 2015), but more refinement is needed. There are various methodological approaches (e.g., life cycle analysis, carbon footprint analysis), but more clarity is required for robust and thorough assessments specific to the sport sector. To this end, environmental impact assessments can be enhanced through fields like economics, industrial ecology, and tourism that have been conducting such assessments. Crompton (1995) discussed the best ways to assess new economic activity in a defined area. Environmental impact assessments can follow the same considerations for evaluating the additional environmental emissions more directly attributable to the event.

Likewise, geography theories and methods, like geographic information systems (GIS), can be tremendously (Higham & Hitch, 2002; Ilies et al., 2014; Nite & Underwood, 2013). Sport researchers have used GIS and other approaches to understand human behaviours, movement, and transportation choices of sport participants and fans (Cooper & Alderman, 2020; McCullough et al., 2023; Zeller, 2015). Moreover, tourism and geography research has developed rich literature on the environmental impact of sport (Collins et al., 2007; Jones, 2008) and other public gatherings (Hunter, 2002) that can assist in advancing our conceptualization and understanding of sport's contribution to the emissions that contribute to global warming resulting in climate change. In total, the progression of this work is critical to advance our conversations to contextualize the impact sport has on the natural environment and inform subsequent responses to reduce those impacts, including determining when an event's environmental impacts are too much for a localized environment.

Establish limits for acceptable impacts

Recognizing that environmental impacts are inevitable, despite attempts to claim otherwise through carbon offsetting initiatives is imperative. It is also essential to recognize that environmental impacts are adverse outcomes of human activity from consuming sport as a participant or spectator. Sport organizations and events should improve efficiencies and find less carbon-intensive modes of operation. It is then necessary to determine what environmental impacts are acceptable and what impacts are significant to threaten or detrimentally harm the sustainability (i.e., preserving for future generations) of nature and sports themselves. Goldblatt (2020), for instance, used an aggregated total of the CO2-equivalent emissions from mega sporting events' environmental reports (i.e., Olympics, FIFA World Cup) and research studies between 20 and 30 million metric tonnes per year, which is equivalent to Denmark's annual emissions. He uses the figure as the

premise for radical change to curtail sport. Conversely, Pilke as quoted in Hoy, 2022) noted that:

> About 0.3 per cent of all global carbon dioxide emissions come from sport, from park runs, my kids playing in the park, to the World Cup and the Olympics. . . . In terms of reducing emissions, it doesn't matter what sport does.

These two positions exemplify a gap in understanding the environmental impacts of sport organizations and events within our research and the need for an informed debate rooted in empirical evidence.

Subsequently, researchers have suggested that COVID-19 serves as a case study to examine how spectator sport can be reconfigured to reduce environmental impacts (Cooper & Alderman, 2020). At the same time, others have suggested dramatically limiting and even eliminating elite sport because of the unabated growth of those sport organizations and the consumption levels of fans (Gammelsæter & Loland, 2023). While such arguments stem from our responsibility to protect and preserve the natural environment, the arguments get lost in hyperbole. Without proper context, academics risk running meaningful change off course using such drastic or extreme language to say that sport's impact is immense. Such language is understandable, to an extent, because of common visuals of overflowing trash bins, the exhaust of cars going to or from a sporting event and the idea of fans converging on one city or nation for the World Cup, like in Qatar or the immense amount of water to produce snow at the Beijing Olympics. Such calls and language are not solutions but empty platitudes that will go unfulfilled because of their disconnect from practicality. Such statements support what Kellison and McCullough (2018) cautioned about how "unrelenting idealism must be tempered" (p. 446) within the environmental movement and be rooted in the realities and contexts within society.

Regardless of sport's impact on the environment, the consequences that sport organizations face and will continue to encounter due to climate change are disproportionate to their collective contribution to global emissions. This is not to excuse sport from minimizing its impact where it can. Like any other industry, the sport sector is responsible for eliminating harm through emission reductions and being as sustainable as possible, just as individuals engaging in sport, recreation, and physical activity should reduce their environmental impacts (Sartore-Baldwin & McCullough, 2018). However, a sustained academic discourse is absent on the role and purpose of sport in contributing to positive actions to advance climate action to strike a balance with the adverse impacts of sport (e.g., event operations, travel) on the natural environment. Unresolved issues like this do not establish a set way to measure the progress of environmental efforts of sport organizations and events. The unintended consequences without such established measures are sport organizations engaging in "weak, hollow, and half-hearted" (Wilson & Millington, 2020, p. 2) initiatives and inaction, as mentioned earlier. Thus, efforts to continue to put sport's environmental impact into perspective are needed to inform broader philosophical debates on the purpose of sustaining sport. While sport organizations and events strive to reduce their environmental impacts, they are also adapting to the realized prospects of how climate change will impact the survival of their respective sport.

Actions through climate adaptation

Sport organizations and events must address climate change's environmental impacts and consequences through climate adaptation in tandem. Through climate adaptation, sport must respond to protect and preserve its survival (Orr & Inoue, 2019). However, climate change is happening, and regardless of sport's contribution to global greenhouse gas emissions, the industry must adapt. The sport ecology space has focused on this line of research (see Dingle et al., 2023; Orr & Inoue, 2019; Orr et al., 2022; Scott & McBoyle, 2007). Adaptations are already underway, seemingly driven by economic factors rather than environmental adaptation (Kellison & Orr, 2021). Climate Central (2020) projections indicate that many sport facilities (e.g., arenas, stadiums, golf courses) along the coast are threatened. Team owners recognize this threat and have called for action. Stephen Ross, owner of the Miami Dolphins, noted, "if we don't do something now, we are looking at extinction" (Olick, 2020 para 18). Similarly, winter sports face extinction, but as Ross's comment shows, other sports recognize their viability is threatened, whether long-term by ocean sea rise or threats of event cancellations. For example, Major League Baseball games in New York (Yankees) and Philadelphia (Phillies) and a Women's National Basketball Association game were canceled due to extremely hazardous air quality as the result of Canadian wildfires (Hoch, 2023). Other events are being cancelled due to flooding because of extreme weather events (i.e., hurricanes, Murfree & Moorman, 2021) or delayed because of extreme heat (e.g., Tokyo Olympics, Qatar World Cup Australian Open; for a review, see Orr et al., 2022).

Advancing adaptation research

Sport management researchers can help inform these adaptation issues by identifying various climate scenarios of how sport may be impacted. There are notable examples existing within sport management (DeChano-Cook & Shelley, 2017; Kellison & Orr, 2021; Orr, 2020; Ross & Orr, 2022) and tourism journals (Proebstl-Haider et al., 2021; Scott et al., 2015). These articles have used singular scenarios to project the impacts of climate change on individual sports, events, and venues. It should be noted that these are significant contributions to the broader literature to inform practitioners about the potential and impending risks of climate change on their respective sport. This vein of research is also essential to inform our field of the impacts such scenarios can and will have on our industry and how other aspects of sport management research must respond. However, these articles can be more robust by leveraging the research conducted by including various climate modelling scenarios in their analysis (van Vuuren et al., 2011).

van Vuuren et al. (2011) summarize the development of the Representative Concentration Pathways (RCPs), which are used as a basis for long- and near-term modelling experiments based on greenhouse gas concentration trajectories adopted by the IPCC (2014). The four RCP scenarios include RCP8.5 (high emission scenario), RCP6 (medium baseline or high mitigation case), RCP4.5 (intermedia mitigation case), and RCP2.6 (lowest mitigation scenario). These scenarios allow for different trajectories of climate scenarios of concentrations of atmospheric emissions. While this analysis may seemingly fall outside the scope of sport management research, RCPs

enable researchers "to proceed with experiments in parallel to the development of emission and socio-economic scenarios" (van Vuuren et al., 2011, p. 7) of how climate change may impact human systems. Future research on the projected impact of climate change on sport should utilize RCP scenarios rather than the singular approaches in the past. Expanding the analysis in these types of studies can demonstrate the range of potential impacts on sport depending on the response and mitigation of climate change. Such scenarios can be related to practitioners and the public to personalize and make climate change more relevant to their professional or personal lives. In short, this line of research is an important aspect to increase awareness and educate practitioners about the effects of climate change on the sport industry.

Demonstrative change is needed

Sport organizations

Adaptation is a continual process of evolution that requires active consideration for improvement. Some climate adaptations may be to sustain the financial goals of an organization by building a new facility (Kellison & Orr, 2021) or even moving into artificial environments (Backman & Svensson, 2022). For example, the World Surfing League is threatened by changing ocean tides that threaten the sport in natural settings. Kelly Slater created the Surf Ranch to commercialise the sport as a climate adaptation. This inland facility generates waves in an artificial pool of water. WSL has hosted events there, but not without controversy. Surfers have protested the WSL judging of surfers on "perfect" waves at the Surf Ranch (Koebler, 2023). It is clear from this controversy that governance must protect and preserve sport from climate change and consider how sport adapts to its stakeholders (e.g., athletes, participants). Similar considerations must be given to environmentally intensive sports like golf and skiing that have adapted their operations by harvesting water to maintain playing surfaces or building snowpacks for ski runs, respectively (Pickering et al., 2003; Wheeler & Nauright, 2006). However, researchers need to examine ways sport organizations' climate sustain their organization (i.e., economic, participation) while reducing collective environmental impacts and consumers' receptivity to those climate adaptations (e.g., Formula E vs. Formula 1, shorter executive golf courses; Fouillouze et al., 2023; Næss, 2020).

Sport participation

Beyond the organizational context, sport participants are adapting to sport. An area of growing concern is the impacts of climate change on public health. This line of research can help inform sport participation and training. Some initial work has explored these areas in North America (for a review, see Bernard et al., 2021). It is important to consider human responses to subtle, more overt changes in the natural environment. For example, sport participants who engage in physical activity in the natural environment are more likely to preserve the natural environment (Cunningham et al., 2020). Yet, people are less likely to engage in physical activity when there are higher levels of air pollution (Cunningham et al., 2020). Thus, the decline in

environmental quality (i.e., pollution) will decrease participation in outdoor physical activity, may reduce the desire to protect the natural environment and perpetuate a downward cycle leading to a public health crisis. To this end, researchers could explore individual adaptations participants or spectators make to engage with sport, recreation, or physical activity.

Solutions can lead to more problems

Climate adaptations are necessary but can lead to new or exacerbated sport-related issues (e.g., wellness, accessibility). For example, sport organizations have begun to adopt policy changes to protect participants from heat-related illnesses (Bergeron et al., 2012 2012; Chalmers & Jay, 2018), and research is being conducted to proactively address athlete well-being (e.g., Kakamu et al., 2017). Current heat policies do not align with the scientific understanding of human performance, fatigue, and heat illness (Gamage et al., 2020; Grundstein et al., 2021; Racinais et al., 2023). These issues put athletes into vulnerable positions that threaten their well-being and livelihoods. Translational research is needed to bridge public health findings to effective policies that protect sport participants' well-being as climate change impacts sport and recreational activities.

Climate adaptations will also put stressors on sport organizations to sustain access to sport facilities (i.e., social sustainability) considering increased participation levels (i.e., sustaining sport). For example, youth sport tourism is a significant economic driver for smaller towns and economies in North America. The tournaments must be hosted for cities and sport managers to realize their economic returns (e.g., hotel taxes and registration fees). As a result, many municipalities have installed synthetic turf fields to increase playability and economic returns compared to natural turf fields. However, there are concerns with using artificial turf despite its promise of financial returns, including the health and impacts of participating and competing on the playing surface compared to natural turf (for a review, see Cheng et al., 2014).

Additional concerns focus on the propensity for climate adaptations across the sport sector, which will exacerbate existing issues of accessibility and equality across the sport. The commercialization of sport pressures organizations to ensure that sport can be played outside of traditional playing seasons, so indoor facilities are built and managed to facilitate sport participation (e.g., indoor ice hockey rink, indoor tennis facility, surfing facility). Yet these facilities are expensive to build, operate, and maintain, making these facilities expensive to rent and for teams to gain access. Researchers can contribute to such discussion about the balance of the unpredictability of natural settings juxtaposed with the growth in popularity and increased commercialism of sport in artificial environments (i.e., artificial turf, surfing). In short, initial adaptations may present new issues (e.g., equity, accessibility) but are worthwhile challenges to sustain sport *and* the natural environment. Considerations and implementations of climate adaptations and other environmental initiatives go beyond simply what a sport organization or an event can achieve. Communicating and engaging sport consumers is necessary to ensure stakeholder buy and the success of such adaptations and initiatives.

Communication and engagement for environmental action

Sport is a great communicator and platform for social change, which extends to environmental sustainability and pro-environmental behaviours. Inoue and Kent (2012) demonstrated that sport is a solid platform to promote pro-environmental messages to fans. This line of research has been expanded and understood in different sport contexts (Casper et al., 2020, Gionfriddo et al., in press; McCullough et al., 2023; Trail & McCullough, 2020). Engaging fans in environmental sustainability efforts can be cumbersome. Still, these researchers have demonstrated that sport fans may be more receptive to environmental messages in the context of sport than in other aspects of their lives. Thus, sport can be leveraged to promote pro-environmental behaviours at sporting events and everyday life (Casper et al., 2020).

Environmental communications literature can aid campaign messages and the influence of sport events on pro-environmental behavioural change (Cox, 2013; Hurst & Stern, 2020). As sport organizations develop robust environmental efforts, they engage their fans in environmental initiatives and campaigns (McCullough et al., 2016). These new initiatives within the sport sector also open new opportunities for sponsorship inventory (McCullough & Trail, 2023) and open the propensity of greenwashing (Miller, 2017) and sport washing (Fruh et al., 2023). For example, sponsors can use sport sponsorships to convey a cleaner image, shifting public opinion away from the sponsor's carbon-intensive production or business models to appear more environmentally friendly (Sherry et al., 2022). A deeper understanding is necessary to navigate the delicate balance of legitimacy to promote sport as environmentally sustainable and a sport's platform to influence fans and participants to be more environmentally sustainable in everyday life. Without this understanding, sport organizations and events can risk overextending themselves and overstating the environmental contributions of their organization, undermining their influence to engage the public on environmental sustainability issues.

Undoubtedly, critics (i.e., academics, the public) will emerge challenging the purpose and motivations of sport organizations for engaging in what some have dubbed as an empty ploy to generate goodwill and more revenues (i.e., corporate social responsibility). Critical research is needed to examine the conditions when greenwashing or sport washing is effective and its influence on consumer behaviour. This is not to encourage such practices but to demonstrate how associations deceive fans. A possible explanation may be that fans do care about their team being morally and environmentally responsible (see Bayern Munich example), but not to the extent where fans engage in consumer activism (Hawkins, 2010) and stop supporting their team because of the team's environmental inaction or greenwashing communications. Sport philosophers and sociologists could contribute to this discourse to understand whether an organization's motivations need to be altruistic to benefit the environment or can other legitimate reasons to reduce the impacts of sport organizations and events. For example, researchers could explore why sport fans are not as active and vocal to encourage their teams to be more environmentally responsible.

Perspectives from sport sociology would benefit this line of research, like the work of Leslie Howe, Brian Wilson, Brad Millington, jay johnson, and others. For example, work by Howe (2019) highlights that sport participants frequently use nature as the end to their engagement and enjoyment of sport rather than seeing nature as an end in and of itself complementary to their participation and engagement in sport. Howe's perspective raises the question of how we might be sustaining sport rather than how we can sustain sport

and nature in tandem. Similarly, Millington and Wilson (2013) have explored the evolution of the golf industry and the contradictions between the sector or individual golf clubs' environmental claims and their actual credentials. Their work is an essential foundation to explore how sport can become more environmentally responsible under scrutiny, but the continued pressures to prove environmental credentials while maintaining the sport and business (i.e., golf course). As sport organizations continue their environmental efforts, they will encourage contractions in their stated values and operations, leading to a new wave of environmentalism in sport (McCullough et al., 2016).

Waves of environmentalism in sport

McCullough et al. (2016) use waves as an analogy to describe how individual sport organizations progress through their environmental movements from awareness and engagement (wave 1), knowledge creation and advancement (wave 2), and strategic development and engagement (wave 3), while being mindful that these movements may regress (i.e., ebbs) despite efforts to advance (i.e., flow). This is to say, a sport entity's progression through the waves is not a static "levelling up" but rather a dynamic process where setbacks can occur. For example, the COVID-19 pandemic demonstrated a clear ebb in the progression of the environmental sustainability movement (e.g., reintroduction of single-use plastics; Borg et al., 2022) while offering new opportunities to streamline business operations (e.g., digital ticketing; Smith & Skinner, 2022).

Researchers have used the waves typology to characterize their empirical work (e.g., Daddi et al., 2022; Hugaerts et al., 2023; Trendafilova et al., 2021). As McCullough et al. (2016) framed in the original paper, the waves typology captures various levels of sport, from individual sport organizations to leagues, international federations, and even the global sport sector. These returns can be focused on those to increase financial returns, reduce environmental impacts, and deepen fan goodwill by meeting or exceeding expectations. Researchers can help advance these efforts to ensure that practitioners consider all relevant, or perhaps identify overlooked, stakeholder perspectives that may enhance and holistically present more robust strategic plans that are frankly equitable, and sustainable strategic plans.

Strategic planning is critical for the successful deployment of sustainability initiatives. Still, environmental strategic plans are severely lacking among sport organizations, including nearly half of the signatories of the United Nations Sports for Climate Action Framework. Nevertheless, theoretical and methodological advancements are being made to materiality assessments to equitably determine stakeholder perspectives and prioritize sustainability initiatives among sport organizations (Dietrich et al., 2022).

The strategy from wave three then becomes a way to evaluate how environmental values permeate the organization through learning processes to the extent that the organization questions its other aspects and *modus operandi*. Institutional pressures can advance this introspection of the organization (see Babiak & Trendafilova, 2011; McCullough & Cunningham, 2010; Todaro et al., 2023) that can call into question contradictions in stated environmental values to the organization's values in action. The process of moralization serves as the frame to characterize the fourth wave.

Process of moralization

The process of moralization outlines how certain behaviours or business practices become associated with moral values (Rozin, 1999). This process can change a moral behaviour or value from acceptable to unacceptable or an immoral behaviour from unfit to acceptable. This process can be instigated through media, education, and activism. The moralization wave and permeation of sustainability values throughout a sport organization allow standardized practices to be revisited because of inconsistencies with emerging sustainability values. For example, several sport organizations have questioned the need to build a new facility and have instead opted to renovate an existing facility, significantly reducing the environmental impact of construction (Climate Pledge Arena in Seattle; Baltimore Arena).

Similarly, external stakeholders (e.g., fans) may pressure sports organizations to live up to their stated environmental values. For example, sport fans and media outlets have applied social and political pressures on various sport teams for the incongruence of their stated environmental values and actions. For example, a player and coach for Paris Saint-Germain laughed at the prospects of taking less carbon-intensive travel options than short-haul flights when questioned about it in a press conference (Monde, 2022). Similarly, Liverpool FC fans and media have pointed out the hypocrisy of the team taking a 33-minute flight rather than taking a motorcoach despite actively promoting its environmental credentials through the Red Way, noting that the club "with millions of followers around the world we are proud to take the issue [environmental impact] seriously" (Liverpool, 2023 para 1). Further, Bayern Munich fans protested the choice to extend a jersey sponsor to Qatar Airlines due to social and environmental factors of the state-backed and fossil fuel-intensive company (Fahey, 2021). In Australia, Tennis Australia ended its partnership with Santos, an oil and gas production company, considering the impacts of climate change (i.e., increased temperatures, wildfires, poor air quality) at the Australian Open (Mair, 2022). Netballers in Australia protested an AUD 15 million sponsorship from Hancock Prospecting, a mining company, resulting in the cancellation of the sponsorship.

These examples highlight an organizational value action gap (Todaro et al., 2023) between managerial actions and, sometimes, self-proclaimed values. Still, these examples indicate growing trends in how pressures are mounting that require the broader sport sector and individual organisations to consider environmental dissonance when striving for environmental legitimacy. Combined with comprehensive strategic plans to advance organizational environmental values, these pressures would lead to a fourth wave where the organization operates within a new mindset based on authentic environmental sustainability values.

A fourth wave of environmentalism in sport

Sport organizations enter the fourth wave as they encounter dissonance between their environmental values and decision-making processes for sponsorship selection, procurement, and transportation. Mallen and Chard (2011) described this as the sustainability paradox. Within this paradox, engaging in environmental sustainability is a never-ending process where continual improvements are possible.

Within this wave, organizations will be confronted to resolve this dissonance and rationalize their business operations considering their environmentalism ethic. If organizations advance within this wave, they may embrace degrowth and circular economy operational approaches as they abandon resistance to deeply integrating environmental sustainability by taking on a moralization logic that more proactively engages in climate action.

The moralization of the environmental movement within the sport sector frames how organizations and, more broadly, the sport sector accepts and institutionalise environmentalism. The wave highlights the increased pressures that the sport sector (i.e., local sport to international organizations) will encounter to ensure the authenticity and consistency of environmental efforts throughout the organization while avoiding the propensity of greenwashing (Miller, 2017) and sport washing (Fruh et al., 2023). An internal reckoning takes place to ensure their actions align with their stated environmental values. Such improvements can range from improving procurement procedures and policies, choosing to renovate over new construction of facilities, choosing less carbon-intensive transportation options, and discontinuing misaligned partnerships with sponsors (e.g., fossil fuel-intensive industries), among other value alignments. Societal and organizational shifts in environmental values and applied pressures from within and outside the organization will drive change. Much like before, this wave presents ripe opportunities for researchers to explore phenomena within the sport sector as it confronts climate change and the immediacy for action.

Future fruits of sport and the environment research

Research surrounding environmental sport management or sport ecology seems quite favourable. More researchers are entering this space, taking on new, important interdisciplinary, theoretical, and methodological approaches. As outlined in McCullough, Orr and Kellison (2020) paper introducing the subdiscipline of sport ecology, many disciplines can converge with sport management to understand how to preserve the natural environment and sport best. Future research areas, including those areas that need to be explored further, have been outlined in the increasing number of review articles surveying the literature (e.g., Chard et al., 2013; Cury et al., 2023; Mallen et al., 2011; Trendafilova & McCullough, 2018) and in featured issues of journals (e.g., Breitbarth et al., 2023; Bunds & Casper, 2018). It is also encouraging to see the support for SMAANZ, NASSM, and EASM, which feature environmental sustainability as a research category for conference abstracts.

While sport ecology is not an exclusive research line, there are opportunities for those who conduct research with practitioners using their backgrounds and knowledge of research methods to engage in this new topic in sport management research. However, what is missing here is knowledge of the broader literature, sound theoretical grounding, rigorous methods, and meaningful, practical implications to provide more depth to the breadth of existing research. In short, to advance sport ecology within the sport management academy, we must move away from interesting to important research topics (see Tihanyi, 2020 for further discussion).

Future research

As noted in the sections above, sport ecology research will advance with broader theoretical and methodological approaches from other disciplines. The research progression will be based on the rigour researchers apply to such vital issues. The breadth of sport ecology research has been established and recognized (Mallen & Chard, 2011; Cury et al., 2023), but its depth is still to come. Future research into sport ecology topics, like those outlined above from environmental impacts, social influence of sport, and adaptation, require that the external environment (i.e., social, political, economic) be considered to provide more profound importance and make measured practical recommendations to advance industry practice.

Environmental impacts

As noted above, there is still more clarity to assess the environmental impacts of sport organizations and events – especially within Scope 3. Since Scope 3 makes up most of a sporting event's emissions (Dolf & Teehan, 2015), exploring what contributing factors apply to the sport sector is noteworthy. There is a need to explore whose responsibility it is to reduce Scope 3 emissions since they extend beyond the control of the sport organization or event (e.g., Are sport events or airlines responsible for emissions resulting from air travel? Are sport events or hotels responsible for emissions resulting from hotels stays?). Considering more comprehensive environmental impact assessments (i.e., Scope 3) and determining the responsibility of sport events to reduce Scope 3 emissions will determine whether the individual sport events or the sport sector's collective emissions are significant. This line of inquiry can influence the responses the sport sector will take to reduce those emissions while improving the efficiencies of general operations for economic and environmental purposes. To this point, sport organizations must recognize where their efforts will significantly reduce emissions. A common saying among sport practitioners focused on the environment is that the most environmentally sustainable event is the one that never happens. However, suggesting eliminating sport activities at the elite to recreational level is not practical or feasible. Thus, adaptations are necessary to preserve sport, as we know it, *and* the natural environment.

Climate adaptions

Sport must recognize it is fighting on two fronts – to sustain the environments individual sport organizations or events operate in and to sustain sport from changing environments due to climate change. Climate change threatens sports (Orr et al., 2022). However, what is less clear is how individual sports confront that front (i.e., climate adaptation) while also seeking to reduce its environmental impact, and as a result, our field may not be fully exposed to these risks. As such, researchers should incorporate RCP scenarios rather than the singular approaches in the past. These various climate scenarios are necessary to depict the possible effects on sport, which can instigate more immediate action among practitioners. Researchers can also test Orr and Inoue's (2019) climate vulnerability of sport organizations framework and ways to increase adaptive capacities across various contexts.. Researchers can study sport managers' perceptions of these risks and the

capacity of their organizations to respond (i.e., adapt). Yet, a lone adaptation does not future-proof sport; the law of unintended consequences states that resolving one issue will result in additional problems. So, climate adaptations will create additional problems researchers can seek to predict or investigate as they emerge. For example, field managers may install artificial turf to preserve field conditions in environments with increased rainfall. Still, synthetic turf has adverse health outcomes for athletes due to increased injsuries, emissions, and heat stroke. As sports (e.g., ice hockey) move from natural environments to artificial (i.e., indoor), the economic costs and environmental impacts of construction and operation of these facilities create new problems of accessibility and new environmental demands on a region already impacted by climate change. Researchers should explore the paradoxes of unintended consequences of climate adaptations, especially concerning athletes and participants, sustaining the viability of sports, and balancing environmental concerns with economic costs. However, the actions of sport organizations and events are not enough. It is necessary to engage and encourage behavioural change among participants and spectators.

Engagement and communication

Previous work within this space has established that sport can be a platform to encourage pro-environmental behaviours at sport events and in everyday life (Casper et al., 2020; Gionfriddo et al., 2023; Inoue & Kent, 2012; Trail & McCullough, 2020). These communications have been used to bring awareness and educate participants and fans of a sport organization or event's environmental efforts. Sport organizations have hesitated to push messages further due to fears of politicization (Casper et al., 2021). Researchers should explore the perceptions of external stakeholders regarding environmental communications, or lack thereof. This line of inquiry could examine how fans perceive greenwashing and the effects of sportwashing within this space – where carbon-intensive sponsors will seek to improve their brand value through association with a sport event or organization. The sport management field has discussed this issue but has yet to explore the conditions and extent to which such strategies are effective for those sponsorships. Considering this inquiry, researchers can also explore the tolerance of external stakeholders to such initiatives and calls to action and how authentic environmental efforts increase brand values and perceptions. The disproportionate impact climate change has on sport than sport has on climate change stresses the importance that messaging can be used to make climate change relatable to sport fans and participants. Personalizing and relating the impacts of climate inspires behavioural change. Thus, more research is needed to see how sport organizations and events can decrease the environmental impact of spectators' and participants' behaviours in their everyday life. The claims of the social influence of sport on environmental and behavioural change have poor standing without being able to demonstrate this influence.

Missing perspectives

Undoubtedly, other perspectives missing or emerging in the sport ecology research space will provide a deeper understanding of the relationships between sport and the natural environment. To encourage that advancement, new perspectives from

outside academic disciplines should be welcomed to advance our field and address the impact climate change will have on the sport industry. I would be remiss to fail to mention that the collective body of sport ecology research would benefit from considerations of environmental justice and their application to public health outcomes within sport recreation and physical activity (Chen & Kellison, 2023; Cunningham et al., 2020). These perspectives can enrich how we approach and relate our research for the public good and ensure that disparaged and marginalized populations impacted by climate change will be further impacted (see Kellison, 2022). Specifically, Cury et al. (2023) noted the absence of the Global South in this line of research. The National Olympic committees of Global South nations are grossly underfunded and understaffed (Chappelet, 2008). As a result, they are ill-prepared to address climate change's impacts, considering these nations contribute the least to climate change but are encountering the greatest threats from climate change. Researchers must address ways to serve these nations to preserve their national sport programs in a meaningful and authentic way that is true to their cultural values and autonomy.

Conclusion

The fact remains that the sport has an intimate relationship with the natural environment. Regardless of its environmental impacts, whether small or significantly large, sport has a role and responsibility to reduce its environmental impact and preserve the natural environment it requires; the sport industry and professionals will need help to advance and enhance their environmental efforts in collaboration with academic researchers. As research on the natural environment and sport progress in the next 25 years, the collective sport industry (e.g., practitioners, academics, students, fans, participants) needs to ensure that it has done its best to reduce the environmental impacts of the sport sector where it can. Undoubtedly, there will and should be academic debates and discourse on achieving the delicate balance between sustaining sport and the natural environment. We should welcome and even encourage these disagreements, debates, and perhaps flat-out arguments about achieving this, but collectively, we should strive to sustain sport and the natural environment. As the sport management academy, we should strive to preserve the sports we love while respecting the opportunities for future generations to build upon the sustainable foundations we created for them.

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