2020 Olympic and Paralympic Games Environmental Update

November 2019

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It has been two years since a comprehensive environmental investigation was undertaken across several Olympic and Paralympic venues in and around Tokyo. To gain further insight into the Tokyo environment, HPSNZ staff monitored conditions over the 2017, 2018 and 2019 Olympic (24th July – 9th August) and Paralympic (25th August – 6th September) periods. Data was collected from the Japanese Met Agency, an online weather source previously verified to have the most accurate and reliable environmental information for each Olympic zone.

This report updates the previous '2020 Olympic and Paralympic Game Environmental Assessment Report' that was provided to the NZOC and PNZ on the 17th of December 2017. This environmental update includes:

- A comparison of the environmental conditions in 2017, 2018 and 2019 compared to historic data (2013-2017) (Table 1).
- The recorded environmental conditions of each Olympic and Paralympic Zone in 2019 (Table 2).
- A summary of HPSNZ recommendations for dealing with the Tokyo environment (Table 3-6).

Key Observations from 2019

Olympic Period (24th July – 9th August):

Tokyo was hotter and more humid this year compared with recent years

- This year 17/17 days reached above 30°C in Tokyo central, compared with 11/17 and 12/17 days in 2017 and 2018, respectively.
- Median daytime relative humidity was 80% in 2019, compared with 73% and 67% in 2017 and 2018, respectively.

Paralympic Period (25th August – 6th September):

Temperatures were similar in Tokyo to previous years, although, this year humidity was higher, and it rained less often

- This year 12/13 days reached above 27°C, compared with 6/13 and 11/13 in 2017 and 2018, respectively.
- Median daytime relative humidity was 83% in 2019, compared with 69% in both 2017 and 2018.
- This year it rained 5/13 days in Tokyo Central, compared with 7/13 and 9/13 days in 2017 and 2018, respectively.

Venue Microclimates:

Factors such as shade (or lack of), wind (or lack of), sunlight, and proximity to heat absorbing surfaces (roads, concrete buildings, etc.) can create microclimates which can increase the overall heat stress on an individual at a given training or competition venue. HPSNZ staff that visited Tokyo in 2018 and 2019 commented on microclimates and staff should be aware that forecasted daily weather conditions during the Olympic and Paralympic Games will not always reflect the microclimate where an event is taking place

Table 1. Summary of the Tokyo environmental conditions in 2019 compared to historic data.

Measure	Olympic Period				Paralympic Period				Implications
	Historic Norms (2013-2017)	2017	2018	2019	Historic Norms (2013-2017)	2017	2018	2019	
Day Time Temperature range (°C)	24 - 37	25 - 36	25-37	31 - 36	21 - 35	21 - 35	23 - 36	26 - 34	The temperature during the 2019 Olympic and Paralympic periods was higher than historic norms. 100% and 92% of days were ≥ 27°C, during Olympic and Paralympic periods, respectively. Temperatures ≥ 27°C cause increased physiological strain and can impair performance.
% Days ≥ 27°C	88 - 100 %	88%	88%	100%	31 - 92%	46%	85%	92%	
% Days ≥ 30°C	65 - 100%	65%	71%	100%	8 - 62%	38%	62%	46%	

Median Humidity (%)	74	73	67	80	77	69	69	83	The humidity during the Olympic and Paralympic periods was higher this year than historic norms. High humidity makes any given temperature 'feel' hotter and reduces the evaporation of sweat, limiting heat loss.
Humidity Range (%)	36 - 100	49 - 98	41 - 100	51 - 100	43 - 100	47 - 99	48 - 100	53 - 100	
Rainfall (mm)	2 - 24	69	119	26	52 - 125	52	59	42	Rainfall observed in 2019 was similar during the Olympic period but lower for the Paralympic period.
Days Raining (#)	0 - 6	8	6	4	4 - 10	7	9	5	
Wind Speed (km/h)	8 - 13	11	12	13	9 - 12	12	13	11	Wind speed was stable and within historic norms for the Olympic and Paralympic periods.

Air Pollution	- A global air pollution standard measurement is the particulate matter in the air that are < 2.5 µm ($PM_{2.5}$). The annual mean $PM_{2.5}$ level for Tokyo is 14 µg/m^3. This is double the amount experienced in Auckland (7 µg/m^3), but is below the World Health Organisation exposure limit of 25 µg/m^3 over a 24 h period. Overall, the $PM_{2.5}$ expected for Tokyo Olympics is much better than recent games: Beijing (2008): 56 µg/m^3 and Rio de Janeiro (2016): 36 µg/m^3. - SO_2, NO_2 and CO measures are generally low and below NZ thresholds.	Athletes who already suffer from respiratory tract conditions or disease (e.g., exercise induced asthma) could be at a greater risk of experiencing these symptoms (e.g., chest tightness, wheezing, coughing) when training or competing in Tokyo conditions.
Water Pollution	*Drinking water & ice:* - Suitable for human consumption and unlikely to present any major risk. However, we would still recommend bottled water for athletes. *Water quality at outdoor venues:* - Generally poor and considered unsuitable for swimming due to the elevated concentrations of faecal indicator bacteria present. However, the metropolitan government has proposed several strategies (e.g., underwater screens to filter water and prevent flow of bacteria) to be implemented in time for the 2020 Games. - Day-to-day water quality varies significantly depending on weather conditions (particularly rainfall). The swim of the 2019 Para-triathlon test event was cancelled as Escherichia coli (E. coli) levels were more than two times over the international triathlon unit limits. According to Tokyo Government officials, increased rainfall from a typhoon caused E. Coli levels to increase as when the rainfall excessed the capacity of sewage facilities, sewage diluted with rain water may be released into the bay.	Water quality at outdoor venues is poor due to the high level of faecal bacteria, which worsens following rainfall. Athletes competing in outdoor water events may be at an increased risk of illness.

Table 2. Zone specific environmental conditions during 2019.

Zone/ Sport Venue	Station	Measure	Unit	Olympic Period 2019	Paralympic Period 2019
Tokyo Bay Zone*	Edogawa	Days ≥ 27°C	(%)	100	92
		Days ≥ 30°C	(%)	94	38
		Day Time High	(°C)	28 - 34	26 - 34
		Night Time Low	(°C)	24 - 28	22 - 27
		Average Wind Speed	(km/h)	22	17
		Rainfall Total	(mm)	23	37
		Days Raining	(#)	2/17	4/13
Heritage Zone*	Fuchu	Days ≥ 27°C	(%)	100	85
		Days ≥ 30°C	(%)	94	46
		Day Time High	(°C)	30 - 36	26 - 33
		Night Time Low	(°C)	24 - 28	21 - 26
		Average Wind Speed	(km/h)	11	7
		Rainfall Total	(mm)	18	116
		Days Raining	(#)	3/17	6/13
Surfing	Mobara	Days ≥ 27°C	(%)	100	92
		Days ≥ 30°C	(%)	94	46
		Day Time High	(°C)	30 - 37	25 - 35
		Night Time Low	(°C)	24 - 27	23 - 26
		Average Wind Speed	(km/h)	10	9
		Rainfall Total	(mm)	10	49
		Days Raining	(#)	2/17	5/13

Zone/ Sport Venue	Station	Measure	Unit	Olympic Period 2019	Paralympic Period 2019
Shooting	Nerima	Days ≥ 27°C	(%)	100	92
		Days ≥ 30°C	(%)	100	46
		Day Time High	(°C)	31 - 37	26 - 34
		Night Time Low	(°C)	25 - 29	22 - 27
		Average Wind Speed	(km/h)	5	5
		Rainfall Total	(mm)	19	37
		Days Raining	(#)	3/17	4/13
Golf	Tokorozawa	Days ≥ 27°C	(%)	100	62
		Days ≥ 30°C	(%)	100	46
		Day Time High	(°C)	27 - 36	24 - 33
		Night Time Low	(°C)	23 - 27	21 - 26
		Average Wind Speed	(km/h)	9	7
		Rainfall Total	(mm)	61	41
		Days Raining	(#)	4/17	8/13
Yachting	Tsujido	Days ≥ 27°C	(%)	100	100
		Days ≥ 30°C	(%)	82	46
		Day Time High	(°C)	30 - 32	26 - 31
		Night Time Low	(°C)	25 - 28	23 - 27
		Average Wind Speed	(km/h)	15	14
		Rainfall Total	(mm)	10	49
		Days Raining	(#)	3/17	3/13

Zone/ Sport Venue	Station	Measure	Unit	Olympic Period 2019	Paralympic Period 2019
Cycling (Road, Velodrome & Mountain Bike)	**Izu**	Days ≥ 27°C	(%)	100	100
		Days ≥ 30°C	(%)	100	85
		Day Time High	(°C)	31 - 35	29 - 34
		Night Time Low	(°C)	24 - 29	22 - 27
		Humidity range	(%)	48 - 99	41 - 98
		Rainfall Total	(mm)	26	99
		Days Raining	(#)	2/17	4/13
Marathon & Race Walk	**Sapporo**	Days ≥ 27°C	(%)	76	23
		Days ≥ 30°C	(%)	53	0
		Day Time High	(°C)	20 - 33	22 - 29
		Night Time Low	(°C)	20 - 28	15 - 23
		Humidity range	(%)	43 - 97	33 - 99
		Rainfall Total	(mm)	49	36
		Days Raining	(#)	6/17	5/13

*** Olympic Sports in Tokyo Bay Zone:** Volleyball, Gymnastics, BMX, Skateboarding, Tennis, Marathon Swim, Triathlon, Volleyball, Basketball, Sport Climbing, Hockey, Equestrian, Canoe (Sprint), Rowing, Canoe (Slalom), Archery, Aquatics (Swimming, Diving, Artistic Swimming, Water Polo), Taekwondo, Wrestling and Fencing.

*** Olympic Sports in Heritage Zone:** Athletics, Table Tennis, Handball, Judo, Karate, Weightlifting, Boxing, Equestrian, Badminton, Fencing, Football, Rugby, Pentathlon, Cycling (Road).

*** Paralympic Sports in Tokyo Bay Zone:** Wheelchair Basketball, Boccia, Wheelchair Tennis, Triathlon, Football 5-a-side, Canoe, Rowing, Archery, Swimming, Sitting Volleyball, Goalball, Taekwondo and Wheelchair Fencing.

*** Paralympic Sports in Heritage Zone:** Athletics, Table Tennis, Badminton, Wheelchair Rugby, Judo, Powerlifting, Equestrian, Wheelchair Basketball.

Table 3. Summary of HPSNZ Recommendations for the Tokyo Environment.

Temperature	▪ Plan for it to be hot (≥ 30°C) and humid (> 70%). ▪ Heat and humidity can impair an athletes' performance. ▪ Four key strategies can help athletes manage the effects of heat during competition: 1) Adapting to the hot conditions – Heat Acclimation/acclimatisation 2) Pre, during and post-exercise cooling, while optimising/adapting warm up 3) Ensuring adequate hydration with cold fluids 4) Ensuring sufficient carbohydrate sources are available to support the exercise *See below for additional heat management information and considerations for athletes AND coaches/support staff.*
Air Quality	▪ Pollution cannot be adapted to, so minimising exposure is the only viable strategy. ○ Limit exposure in and around traffic (avoidance and air conditioned car) ○ Screen for and manage respiratory conditions (by team physician/physiologist)
Water Quality *(Tap)*	▪ *The quality of tap water and restaurant ice has been shown to be suitable for human consumption* ○ While tap water in Tokyo is unlikely to present a risk, bottled water is always the safest option
Water Quality *(Open Water)*	▪ *Water at the Odaiba, Sea Forest and Enoshima sites exceeds guidelines for contact recreation* ○ There is a high risk of infection in open water and strategies to reduce this risk will be advised by your HPSNZ Medical Team

Table 4. Heat Management Overview for the Tokyo Games.

What	The Tokyo Olympic Summer Games are predicted to be hottest Games in history. It is the high humidity that will set these Games apart, as high humidity combined with high temperature reduces the body's ability to cool and increases heat load on an individual.
So What	Heat stress may impact different sports and even individuals within a sport to vastly different extents. For some, the heat and humidity will be entirely manageable, while for many it will remain a performance (and potentially health) limiting factor. The impact of the heat and humidity on athletes in some outdoor sports will be entirely different to that which coaches and support staff will perceive.
Now What	- Understand general and individual responses to the heat - Have well-reasoned and practiced mitigation (especially cooling) strategies in place for athletes, coaches, and support staff - Athletes, coaches, and support staff should complete heat acclimation - Consider living/training routines in Japan - Know the signs and symptoms of heat illness
Support Team Considerations	- Know the rules and regulations of individual sports - Medical management of heat stressed athletes and staff - In Games monitoring of at risk individuals

Table 5. Athlete Checklist.

Individual Responses	- Each athlete will respond individually to heat stress and HA. Those who struggle in the heat/are slow to adapt may need more heat exposure - Females have a delayed onset of sweating and sweat less compared to males making them more at risk of heat illness - Athletes with previous exertional heat illness (EHI) have reduced tolerance to heat (training or competition in temperate conditions (20-25°C) can induce symptoms). These athletes can adapt with HA, although some may need more exposure.
Heat Acclimation/ Acclimatisation	- Each athlete should include some amount of active or passive HA (event dependant) into their schedule leading into the Olympics. Consult your Performance Physiologist for an individualised HA plan. - For female athletes undergoing HA, have them track menstrual cycle (e.g. FitrWoman or Clue), as an ↑ core temperature during the luteal phase can mask adaptations to HA.
Living in Japan	- Limit time outside when possible. At outdoor competition venues, we would recommend staying in air-conditioned areas before, between and after events. - Athletes are encouraged to stay cool while sleeping (set room to ~19-22^{o}C). Sleeping in hot environments will not provide further benefits and can impair sleep quality. - During competition avoid antiperspirant, which can reduce sweating by blocking sweat ducts - The UV Index in Japan (10-11) is similar to NZ (12) in the summer months. Use Sun Smart practices to avoid sunburn. - Choose alcohol-based sunscreens as they facilitate sweating more than oil-based sunscreens. In terms of water-resistant sunscreens, select oxybenzone based as they allow better thermoregulation than titanium dioxide based products.
Training in Japan	- Adding heat to training is fatiguing, therefore, consider how it's integrated (gradual ↑ heat load and intensity) - For key sessions or sessions that are high in intensity or of long duration, use cooling strategies. - If you are relying on further HA adaptations after arriving in Japan, ensure you consider the key HA considerations in the HA Protocol Guidelines table.
Cooling Strategies	- Mixed method most efficient (internal and external cooling) - Important to keep active musculature warm when using cooling techniques (i.e., external cooling should avoid active musculature) - Consult your Performance Physiologist to optimise pre, during and post cooling strategies based on your sport's needs.
Hydration	- Focus on hydration status and encourage athletes to be well hydrated - Consult your Performance Nutritionist for individualised hydration strategies when training and competing in Tokyo.

Nutrition	- Appetite is reduced, carbohydrate requirements are increased, and glycogen resynthesis is delayed in hot conditions, therefore consult your Performance Nutritionist for individualised nutrition plans for training and competing in Tokyo.
Immunity	- Those who are showing any symptoms of illness should NOT perform heat training, which can put further strain on their immune system. - Fever or upper-respiratory tract infections increases exertional heat illness (EHI) risk.
What to Monitor	- Daily Wellness - Hydration status - Heat illness signs and symptoms - Resting HR and HRV - Sweat rate

Table 6. Coaches and Support Staff Checklist.

Individual Responses	- Each person will respond individually to heat stress and adapting to the heat - Know if you or your staff have any risk factors for heat illness and take steps to mitigate these. For many staff the most beneficial action will be to increase their personal fitness.
Heat Acclimation/ Acclimatisation	- Each coach or support staff member is advised to complete 4-5 d of passive heat acclimation, which can be done in a sauna or spa. - Coaches and support staff are encouraged to improve their aerobic fitness as this is a key strategy to reduce the risk of heat illness and enhance working in hot environments. - A Performance physiologist is available to assist staff and coaches with implementing HA and fitness programs for their own preparation.
Living in Japan	- As above, limit time outside and stay in air conditioning when possible. - Stay cool while sleeping (set room to ~19-22^{o}C). - The UV Index in Japan (10-11) is similar to NZ (12) in the summer months. Use Sun Smart practices to avoid sunburn. - Choose alcohol-based sunscreens as they facilitate sweating more than oil-based sunscreens. In terms of water-resistant sunscreens, select oxybenzone based as they allow better thermoregulation than titanium dioxide based products.
Cooling Strategies	- Cool for comfort (ice slushy, ice vests, cooling hats, cooling neck ties, etc.). - If outdoors for long durations try and take breaks in air conditioning if possible.
Hydration Nutrition	- Be aware of hydration status and aim to be well hydrated. - Be aware of appetite and have strategies in place to consume enough food during the day. Eat meals in air conditioning if possible.
Immunity	- Those who are showing any symptoms of illness should avoid being outdoors in the heat. If this is not possible, thorough cooling strategies are recommended (wear cooling vests, hats, and neck ties, and drink slushy). - Fever or upper-respiratory tract infections increases exertional heat illness (EHI) risk.
What to Monitor	- Daily wellness - Hydration status - Appetite - Heat illness signs and symptoms

Summary

This environmental update highlights that conditions in Tokyo are getting hotter and more humid, with the highest heat indexes observed in 2019 compared to previous years and historic data. Sports should plan for the 2020 Tokyo Olympic and Paralympic Games to be hot (≥ 30°C) and humid (>70%). Heat management strategies (outlined above) should be applied to optimise athletes, coaches and support staff members performance in the heat.

As each sport has different needs and individual athletes, coaches and support staff members will respond differently to the heat, it is highly recommended to consult HPSNZ athlete performance support staff (listed below) to optimally implement a sport-specific heat management plan.

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