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Category 6: Environmental Statement

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Rampion 2 Offshore Wind Farm: Baseline Underwater Noise Monitoring at Kingmere MCZ in the context of black seabream

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1 Executive Summary

Subacoustech Environmental have undertaken an underwater noise baseline assessment in 2023 to support the Rampion 2 Offshore Windfarm Development Consent Order Application (DCO). To support the baseline assessment, an underwater noise monitoring sample was conducted during the black seabream (*Spondyliosoma cantharus*) nesting period of March to July 2023. This updates and builds upon a previous underwater noise monitoring sample conducted between 4th and 20th July 2022 and responds to concerns raised by Natural England (16 June 2022) that the 2022 monitoring was limited as it did not cover the entire black seabream nesting period (March to July).

Discussions with Natural England, the MMO and CEFAS on impacts to black sea bream from under water noise have taken place throughout the pre-application period of the Proposed Development, and include the following key milestones and documents:

- Feb 2022 – initial threshold of 147 decibels p (dB) SELss presented to expert topic groups. **Rampion 2 Technical Note: Additional underwater noise modelling of Appendix D, Evidence Plan [APP-243]**.
- May 2022 – In an advice note to the Applicant, Natural England expressed the view that a piling restriction during the entirety of the breeding season is the only approach that provides certainty that black seabream will not be subject to behavioural disturbance. Natural England and the MMO raised concerns about the proposed behavioural noise threshold.
- July 2022 – first survey of ambient noise levels at the Kingmere MCZ site and within surrounding areas. This survey was undertaken over 15 days. Results are presented in **Appendix 8.3: Underwater noise study for sea bream disturbance [APP-134].**
- September 2022 - a revised behavioural noise threshold of 141dB was presented in the meeting as being at the precautionary end of the scale of potential response levels and was proposed by the Applicant as representing a protective disturbance threshold. The MMO confirmed that it was comfortable with the use of the 141dB SELss noise level to inform the impact assessment but advised that discussions with Natural England would be required regarding mitigation.
- March 2023 - A further technical note, **Piling Noise and Black Bream: Further Information and Response Paper of Appendix D, Evidence Plan [APP-243]** was issued to stakeholders in March 2023, providing responses to the concerns raised on uncertainty within the assessment, baseline data, context from Rampion 1 and efficacy of mitigation measures.

The survey results presented in this document, in addition to the shorter survey conducted in 2022, provide a robust baseline of underwater noise in the area surrounding the Proposed Development. The 2023 results support the findings of the 2022 survey and demonstrate that noise levels varied generally between 105 dB and 125 dB SPL_{RMS}, although regularly exceeded 135 dB SPL_{RMS} and exceedance of 140 dB SPL_{RMS} was not unusual. In respect of SPL_{peak} noise levels, measurements of up to 150 dB SPL_{peak} were a typical daily occurrence and occasional events led to exceedances of over 160 dB SPL_{peak}. As such, the results support the setting of a baseline against which an exceedance-based threshold can be taken forward. In addition to this, Sussex IFCA stated in its Relevant Representation **[RR-380]** *"The threshold for disturbance of breeding black seabream is unknown, therefore we suggest a baseline of background noise occurring during a successful nesting season is used to inform a suitable target for noise abatement mitigation to achieve".*

2 Introduction

2.1 Project overview

The proposed site for Rampion 2 OWF is in proximity of the Kingmere Marine Conservation Zone (MCZ). Black seabream is a protected feature of the MCZ. Disturbance to black seabream during the spawning period could have negative effects on the species at the population level. There is continuing concern from the Marine Management Organisation (MMO), the Centre for Environment Fisheries and Aquaculture Science (Cefas) and Natural England regarding the potential for disturbance to black seabream during their breeding season caused by underwater noise generated during impact piling for Wind Turbine Generator (WTG) foundation installation.

The effect of underwater noise disturbance on an animal receptor depends on the audibility of a sound to the receptor in its existing environment. At a minimum, an introduced noise (such as impact piling) must be above the receptor's hearing threshold and must exceed the existing background noise. Other context-dependent conditions, such as motivation to remain in an area due to life-critical functions such as nesting, will also apply. Therefore, to assist in the assessment of the likelihood of disturbance to black seabream associated with piling, if any, an underwater noise baseline for the region has been established.

This report provides the details and results of an underwater noise baseline survey undertaken in the vicinity of the Kingmere MCZ between March and August 2023. The results from the 2022 survey are referenced and compared in the discussion (section 6.1).

2.2 Assessment overview

This report presents a detailed assessment of the existing underwater noise in the sea surrounding the proposed Rampion 2 OWF site and covers the following:

- Overview of key concepts for measuring and assessing underwater noise.
- Detailed description of the procedure and equipment used for the underwater noise baseline survey.
- Presentation of the measurements from the underwater noise baseline survey, and interpretation of the results.
- Discussion in relation to black seabream, and the baseline survey results in context.
- Summary and conclusions.

3 Key Concepts of Underwater Noise

This report is intended to provide an overview of the potential impact of the noise generated by construction activities associated with Rampion 2 OWF near to the Kingmere MCZ. The following basic acoustic concepts should be understood:

3.1 Decibels

The decibel (dB), by which a level of sound is described, is a ratio measure and as such requires a reference sound pressure to compare with the noise level under consideration. In underwater noise this is conventionally 1 micropascal (1 µPa), as a minimum pressure that could be present. Sound pressure level (SPL) noise levels presented in this report are all referenced to this value and are thus SPL "re 1 µPa". Please note that this is different to the reference used for airborne noise, which is 20 µPa, and airborne and underwater noise levels should not be directly compared.

3.2 Sound pressure level (SPL)

SPL is normally used to characterise noise and vibration of a continuous nature such as drilling, boring, or background noise levels. To calculate the SPL, the variation in sound pressure is measured over a specific period to determine the RMS (root-mean square) level of the time varying acoustic pressure. The SPL_{RMS} can therefore be a measure of the average unweighted level of the sound over the measurement period. The SPL is calculated using the following formula where p is the sound pressure in Pascals (Pa), and p_{ref} is the reference sound pressure, which is typically 1 µPa for underwater sound as noted above.

$$SPL = 20\log_{10}\left(\frac{p}{p_{ref}}\right)$$

As an example, small sea-going vessels typically produce broadband noise at source SPLs of between 170 and 180 dB re 1 µPa @ 1 m (Richardson *et al*., 1995), whereas a supertanker generates SPLs in the region of 198 dB re 1 µPa @ 1 m (Hildebrand, 2004).

Where an SPL is used to characterise transient pressure waves such as that from impact piling, it is critical that the period over which the RMS level is calculated is quoted. For instance, in the case of pile strike lasting, say, a tenth of a second, the mean taken over a tenth of a second will be ten times higher than the mean taken over one second. Often, transient sounds are quantified using "peak" SPL measures.

3.3 Peak sound pressure level (SPL_{peak})

Peak SPLs are often used to characterise sound transients from impulsive sources, such as percussive impact piling and seismic airgun sources. A peak SPL is calculated using the maximum variation of the pressure from positive to zero within the wave. This represents the maximum change in positive pressure (differential pressure from positive to zero) as the transient pressure wave propagates.

A further variation of this is the peak-to-peak SPL where the maximum variation of the pressure from positive to negative within the wave is considered. Where the wave is symmetrically distributed in positive and negative pressure, the peak-to-peak level will be twice the peak level, or 6 dB higher.

The attenuation of sound in the water as it propagates from the noise source must be considered in an impact assessment. As the measurement or receiver point moves away from the source, the sound pressure measured will decrease due to spreading. To standardise all source levels, regardless of where they are measured, they are referred to a conceptual point 1 m away from the point of origin of the noise. Consequently, SPL source levels presented here have units of ‘dB re 1 µPa @ 1 m’.

3.4 Sound Exposure Level (SEL)

The SEL sums the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source and the duration for which the sound is present in the acoustic environment. Where the RMS can be thought of as an average noise level, the SEL is accumulative exposure, and its value will increase in time where the noise level continues.

By selecting a common reference pressure ($Pref$) of 1 µPa for assessments of underwater noise, the SEL and SPL can be compared using the expression:

$$SEL = SPL + 10 \times \log_{10} T$$

where the SPL is a measure of the average level of the broadband noise, and the SEL sums the cumulative broadband noise energy. For continuous noise, an SEL measured over 1 second is roughly equivalent to the SPL_{RMS} measurement. As a rough rule of thumb for impulsive piling noise, Subacoustech has found that the SEL of a pile strike is approximately 7 dB lower than the equivalent SPL_{RMS}. All noise levels defined as SEL in this report are ref. 1 µPa^2s.

The SEL is used in contemporary underwater noise assessments to estimate the potential impact by noise on marine species by both Southall et al. (2019) for marine mammals and Popper et al. (2014) for fish, in terms of adverse effects on hearing and injury.

4 Survey

4.1 Study area

The location for underwater noise monitoring at the Kingmere MCZ is shown in Figure 4-1. The location, 50°42.301' N, 0°25.205' W, was chosen as it is the closest point between the Rampion 2 site boundary and the Kingmere MCZ boundary. It is worth noting that the measurement location is less than 1 mile away from a marine aggregate extraction site. The monitor was positioned in a place that would record any noise from extraction activities and could potentially identify whether extraction noise was detectable.

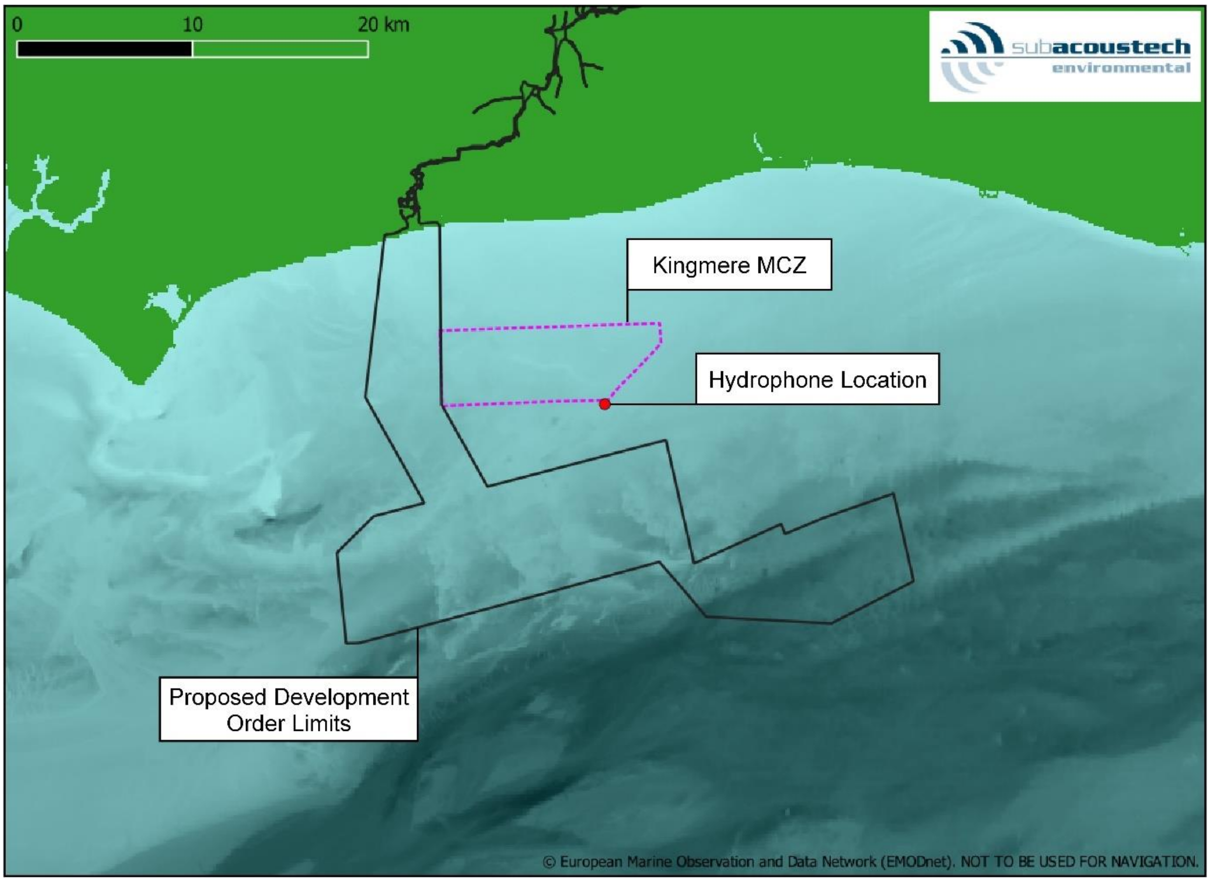

Figure 4-1 Underwater noise monitoring locations showing the Proposed Development Order Limits and Kingmere MCZ boundary.

4.2 Noise Recording Equipment

Static measurements were taken using a remote monitoring setup, capable of undertaking calibrated, autonomous noise measurements over extended periods of time.

The autonomous acoustic recording device was a Wildlife Acoustics SM3M. The hydrophone extended vertically from this device, suspended at approximately 2 m above the sea floor, and was protected by an acoustic monitoring cage. Details of the hydrophone used are described below:

- Hydrophone: HTI 99 UHF
- Sensitivity: -167.4 dB re 1 V/µPa
- Sample rate: 96 kHz
- Bit-depth: 16-bit wav
- Duty cycle: 50% (2 minutes on, 2 minutes off)

The autonomous acoustic recording device also consists of internal hardware (batteries, memory cards, control electronics) enclosed in a secure housing. A single line mooring arrangement was used (see Figure 4-2), which consisted of the autonomous acoustic recording device, suspended directly above two acoustic releases. Secured to the recording device were three sub-surface riser buoys, which allowed for the recording device to float once the acoustic releases were triggered. This assisted with retrieval of the device. The mooring was held to the seabed by five 20 kg weights (100 kg in total) clumped together with a lifting strop, joined by a certified shackle.

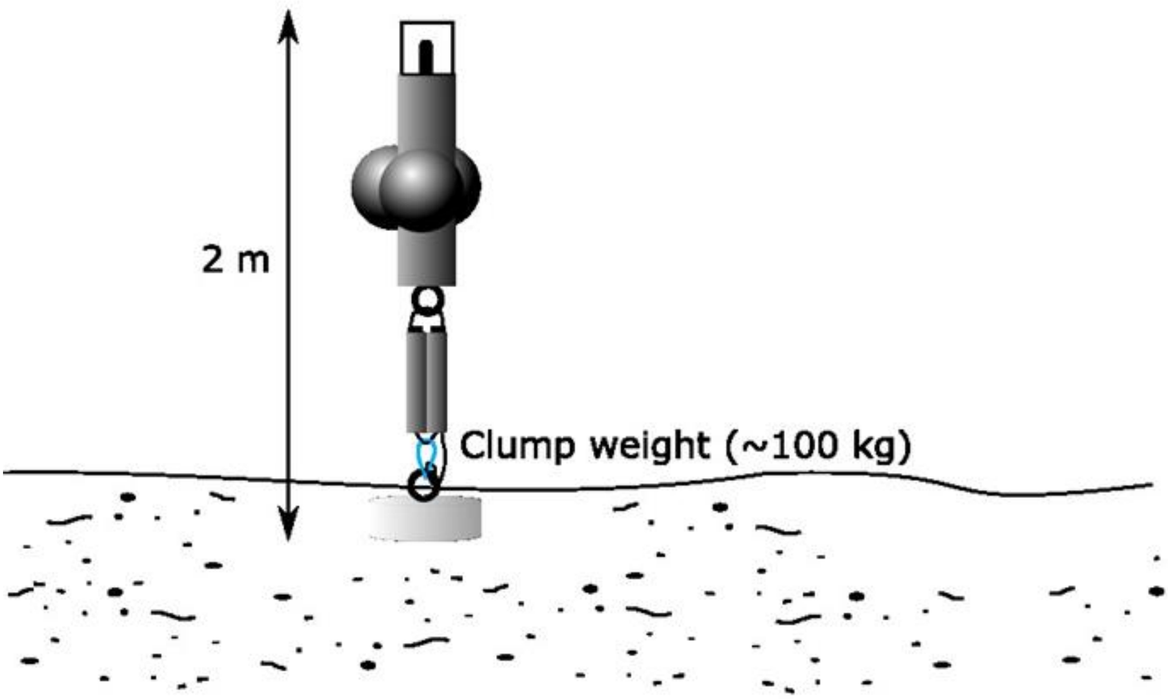

Figure 4-2: Single line moring arrangement of the noise recording equipment used

4.3 Procedure

The noise recording equipment was deployed at a single location on the south-eastern edge of the Kingmere MCZ. This is the nearest edge of the Kingmere MCZ to the Rampion 2 OWF boundary and therefore represents a location that is both representative of the MCZ and precautionary in terms of noise levels received from the piling activities, being in slightly closer proximity to the noise source than the MCZ itself.

The equipment was assembled, calibrated and deployed from the Seren Las survey vessel on 8th March 2023 at the agreed location (50°42.301’ N, 0°25.205' W), as shown in Figure 4-1. A service visit was scheduled for 80 days after the deployment, however on 12th April 2023 the measurement equipment was discovered washed up on the beach at Peacehaven.

The mooring was recovered and redeployed at the first opportunity as could be arranged, on 27th April 2023. A service visit was undertaken 71 days later on 7th July where the monitor was recovered, serviced and redeployed with fresh batteries and memory cards. Final recovery of the equipment was undertaken on 15th August 2023.

Across the survey period, high quality data was captured 8th March – 23rd March, 27th April – 21st June, and 7th July – 15th August 2023. The monitoring equipment was untethered between 23rd March and 27th April so no data was acquired in this period. Battery failure occurred between 21st June and 7th July.

Upon recovery, all data was processed using a 10 Hz high-pass filter before analysis. This filter was used to reduce the effect of non-acoustic noise caused by the flow of water over the hydrophone.

5 Results: Underwater Noise Baseline

Ambient noise levels recorded between 8th March and 15th August 2023 are shown in Table 5-1 and Figure 5-1. The data is presented as 1 minute SPL_{RMS} and SPL_{peak} levels. In Table 5-1 the results have been divided into a summary for data captured in each month of the survey duration. Weekly summaries for the data can be found in Appendix A.

Table 5-1 Summary of noise levels across the survey period, 2023

Month	Dates Monitored	No. Days Monitored	SPL_{RMS} (dB re 1 µPa)			SPL_{peak} (dB re 1 µPa)		
			Max	Min	Mean	Max	Min	Mean
March	08/03 - 23/03	16	147.7	106.3	118.4	165.9	124.6	139.5
April	27/04 - 30/04	4	142.0	106.0	112.4	165.9	123.4	132.7
May	01/05 - 31/05	31	147.3	104.1	112.6	166.0	122.3	132.9
June	01/06 - 21/06	21	146.8	104.8	112.9	163.8	123.3	133.8
July	07/07 - 31/07	25	154.5	104.2	114.4	166.1	125.4	136.4
August	01/08 - 15/08	15	148.3	104.5	115.3	165.8	125.7	137.7

Throughout the survey period there are clear cyclical variations in the recorded noise level. These cycles correspond with the tidal cycle, high tidal flow leads to increased noise levels and low tidal flow or slack water leads to reduced noise levels due to greater change in movement of water and surface material around the hydrophone.

The highest average noise levels were recorded in March. Mean SPL_{RMS} of 118.4 dB re 1 µPa and mean SPL_{peak} of 139.5 dB re 1 µPa were 4 and 3 dB higher than any other month in the survey. Figure A-1 and Figure A-2, a summary of the data captured in March, show that these average noise levels were driven by consistently higher noise levels during the tidal cycle, not unexplained high noise level events. The maximum noise level recorded during this period was 147.7 dB re 1 µPa SPL_{RMS} and 165.9 dB re 1 µPa SPL_{peak}.

In addition to constant cyclical noise features, other non-cyclical noise events are present almost daily. Many of these events are consistent with passing boat traffic, characterised by a quick rise and fall in noise level as a vessel approaches and then moves further away from the hydrophone. As the monitoring location is within close proximity to a marine aggregate extraction site, frequent boat traffic in the area is not uncommon.

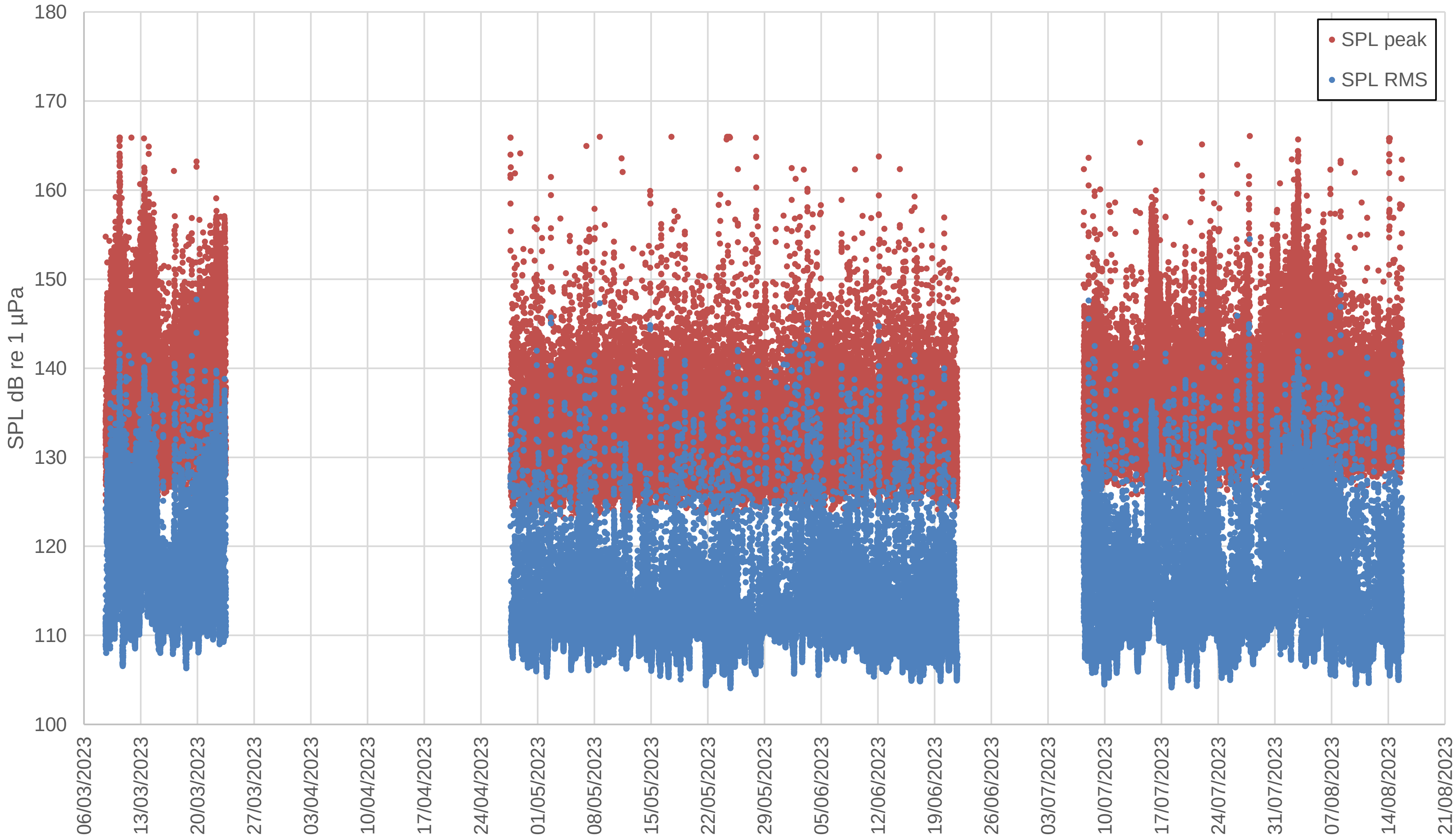

Figure 5-1 Ambient 1-minute SPL_{RMS} and SPL_{peak} noise levels recorded at Kingmere between March and August 2023

6 Discussion

6.1 Comparison with 2022 survey

A comparison has been made with the measurements taken over a two-week period in the middle of July 2022, 7th July to 19th July, across the same time scale (i.e. 7th July 2022 overlaid on 7th July 2023). This comparison is shown in Figure 6-1. Note that the most important determiner of underwater noise levels over the majority of the time is the state of the tide, and the tides (neaps and springs) which lead to maxima and minima in the noise level are different across the two years and so the highest and lowest levels measured will not occur at equivalent times. For example, the highest noise levels are seen in the 2022 data around 17th July, and in 2023 around 8th July.

Typical levels of noise are, however, slightly lower in 2022 compared to 2023. The average SPL_{RMS} for the presented period is 112.1 dB in 2022 vs 114.4 dB in 2023. Some of the increase in the average is caused by an event around 15th July 2023 (the cause of this event could not be identified) although even when this event was eliminated, 2023 still had a slightly higher average noise level, around 1.5 dB. SPL_{peak} noise levels were quite consistent between 2022 and 2023. In the main, the measured noise levels were very similar across the period in both years.

6.2 General discussion

Referring to Figure 5-1, the noise levels varied generally between 105 dB and 125 dB SPL_{RMS}, although regularly (at least once a day) exceeded 135 dB SPL_{RMS} and exceedance of 140 dB SPL_{RMS} was not unusual. In respect of SPL_{peak} noise levels, measurements of up to 150 dB SPL_{peak} were a typical daily occurrence, although occasional events led to exceedances of over 160 dB SPL_{peak}.

The primary purpose of this long-term study is to establish a site-specific baseline of the noise soundscape at the Kingmere MCZ, thereby informing and providing context for the assessment of potential impacts arising from the emission (and immission) of piling noise during the construction of the proposed Rampion 2 offshore wind farm (OWF) on sensitive receptors. This is principally spawning/nesting black seabream. It is accepted that there are no situation-specific data available for the effect of piling noise on black seabream nesting behaviour in the English Channel. That said, all biological noise effects are highly context dependent. Nesting may make the fish more or less likely to react, or limit the duration of the effect or response. The response would almost certainly also be statistical: for example, some of the nesting bream population would react initially to a stimulus over a certain noise level.

As no empirical data on specific responses of nesting black seabream to noise at Kingmere MCZ exist, the determination of potential consequence from exposure to noise at varying levels needs to be described and assessed in the context of available research. The availability of the baseline noise data acquired over the black seabream nesting period makes a substantial contribution to that, providing a real benefit in setting the ambient noise environment within which the seabream currently breed, and allow a more robust assessment of the temporary change in the background noise (as the presence of noise will dissipate rapidly) caused by the introduced noise from impact piling.

6.2.1 *Variation of noise levels*

Although there are variations across the measured period between 8th March and 15th August 2023 (with the March period being slightly louder), the following statistical noise levels are seen:

Table 6-1 Statistical summary of noise levels across the survey period, 2023

	SPL_{RMS} (dB re 1 µPa)				
	Mar (15 days)	**Apr-Jun (55 days)**	**Jul-Aug (39 days)**	**Mar-Augt (109 days)**	**Notes**
$SPL_{RMS,90}$	110.9	108.2	108.3	108.4	Background noise
$SPL_{RMS,50}$	116.9	111.5	112.4	112.1	50th %ile, average noise
$SPL_{RMS,01}$	136.7	132.3	134.3	134.3	Short-term events, ~14 mins/day

The statistical average of the background noise levels over the period was generally around 108.4 dB $SPL_{RMS,90}$ i.e. the level exceeded 90% of the time, with the level 134.3 dB $SPL_{RMS,01}$ exceeded 1% of the time (i.e. on average just over 14 minutes a day) and 112.1 being a reasonable average of the underwater noise in this location.

The implication of this is that 134.3 dB SPL_{RMS} is exceeded regularly under baseline conditions.

6.2.2 Potential noise thresholds

To minimise adverse impacts from piling affecting bream in the Kingmere MCZ, noise reduction should be applied that reduces the risk of avoidance behaviour. As stated above, no criteria are available that can characterise this specific scenario, so previous studies carried out for this Project have referred to research[1,2] based on similar species (sea bass, red seabream) to make a recommendation for a noise limit at the Kingmere MCZ that can be met using commercially available noise abatement systems for piling as Best Practicable Means.

The studies demonstrated that the morphologically similar species at an equivalent life stage to the nesting seabream, adult European seabass, displayed an initial startle response[3] between 141 dB SEL_{ss} and 147.4 dB SEL_{ss}, which was short-lived (i.e. less than two minutes) at 141 dB SEL_{ss}. The selection of the lower value of these – 141 dB SEL_{ss} – is recommended as a reasonable precautionary threshold. The MMO has suggested the use of a lower 135 dB SEL_{ss} threshold, which was reported[4] as leading to a behavioural reaction in sprat in a quiet inland environment. Noting that these values are SEL_{ss}, 135 dB is roughly equivalent to 142 dB SPL_{RMS}, and noise at this level is seen regularly in Figure 5-1. This is not recommended for the reasons below.

Sprat is a fish species in the highest sensitivity hearing category as defined in Popper *et al.* (2014), and is considerably more sensitive than seabass or seabream. Additionally ambient noise in the studied environment, Lough Hyne in Ireland, is very quiet, and thus sounds which would appear loud and

[1] Radford, A.N., Lebre, L., Lecaillon, G., Nedelec, S.L., and Simpson, S.D. (2016). Repeated exposure reduces the response to impulsive noise in European seabass. Global Change Biology, 22, pp. 3349–3360
[2] Kastelein, R.A., Jennings, N., Kommeren, A., Helder-Hoek, L. and Schop, J. (2017). Acoustic dose-behavioral response relationship in sea bass (*Dicentrarchus labrax*) exposed to playbacks of pile driving sounds. Marine environmental research, 130, pp.315-324
[3] Studies into the impact of impulsive underwater noise generally use a different metric to describe the level noise generated, the SEL_{ss} (see section 3.4). This captures well the energy in an impulsive sound but ideally metrics should be compared like-for-like. To provide a more reliable comparison these will be converted to SPL_{RMS}, roughly equivalent to 7 dB greater than an equivalent SEL_{ss} based on data previously measured by Subacoustech.

[4] Hawkins, A.D., Roberts, L. and Cheesman, S. (2014). Responses of free-living coastal pelagic fish to impulsive sounds. Journal of the Acoustic Society of America, 135(5), pp. 3101–3116

startling in this environment would appear much quieter in open seas where the background noise is greater. This would therefore represent an overconservative target, recognising that some noise will be necessarily produced by the piling, and especially in light of the known greater sensitivity of the test fish species and the particularly quiet environment in which the experiment was undertaken.

All reactions to noise stimulus noted in these publications, at all reported noise levels, are relatively minor and short-term. Although sound exposure tests have not been undertaken to identify the reaction of nesting seabream, where this level was only found to lead to an initial and short-lived reaction, it would reasonably be expected to be somewhat less than sufficient for fish to abandon their nests when they would be highly motivated to remain for this activity. Additionally, habituation to noise could be expected: Radford *et al.* (2016) demonstrated a reduction in reaction to piling noise with time at higher levels (146.7 dB SPL_{RMS}) than are proposed for the noise limit at Rampion 2.

6.2.3 Noise levels and mitigation during piling at Rampion 2

To define a suitable underwater noise restriction for the piling noise, it must be both appropriate and achievable. RED maintains that 135 dB SEL_{ss} is not only relevant to a much more sensitive species and derived from a different environment, it is also expected to be difficult to achieve across the Rampion 2 Order Limits, practically, even with two methods of direct noise mitigation (such as a double bubble curtain and attenuated hammer, e.g. MENCK's MNRU). Therefore 141 dB SEL_{ss} (approximately equivalent to 148 dB SPL_{RMS}) has been suggested. It is slightly above the noise levels that are already present (the baseline monitoring showed that pre-existing noise levels are seen to exceed 140 dB and occasionally reach up to 148 dB) and derived in a similar fish species to seabream. It would also, under the worst case scenario for piling at Rampion 2, lead to a total noise exposure of under 186 dB SEL_{cum}, the level of TTS[5] onset in fish (Popper *et al.* 2014) at the edge of the Kingmere site. Also, this level would be considerably below the guideline for damage to eggs or larvae (>210 dB SEL_{ss}) defined in Popper *et al.* (2014), which also considers the risk of any lower effect (e.g. recoverable injury) to be "low".

The proposed threshold of the noise level at Kingmere MCZ, set at 141 dB SEL_{ss}, is based on the worst case scenario of the biggest hammer proposed to be used during the construction of Rampion 2 with a monopile at the maximum assessed energy (4400 kJ) and it is likely that many of the Rampion 2 foundations will not require the maximum assessed hammer energy to be employed. The results of piling noise measurements at the northwest of the Rampion 1 site, close to the nearest point of the Kingmere MCZ, demonstrated that the maximum energy needed to drive the piles was less than half of the maximum available at the site (<1000 kJ) for 76% of the time, increasing the likelihood that a noise limit based on the maximum energy at Rampion 2 will rarely be reached. Rampion 1 had a piling ban implemented during its construction from 15 April and 30 June for monopile foundations, and a partial piling ban[6] from the 15 April to the 30 June for jacket/ multi-leg piles. However, Rampion 1 piling did not use any noise abatement systems and the estimated noise at the Kingmere site was 147.0 to 156 dB SEL_{ss}, based on extrapolations of the measurements from the noise monitoring undertaken at the time. (The noise levels were not measured at this location during WTG foundation construction). There was no apparent impact on breeding success for seabream following the installation of Rampion 1 (with piling taking place within the extended spawning period for black seabream (Mar-Jul)); an increase in population was identified year on year before and after the installation.

[5] Temporary Threshold Shift, the noise exposure at which a temporary, recoverable reduction in hearing acuity can occur in an individual.
[6] Piling for jacket/ multi-leg was not permitted in the north-western corner of the Rampion 1 order limits, as defined by the coordinates in the development consent order: https://webarchive.nationalarchives.gov.uk/ukgwa/20151202180619mp_/http://infrastructure.planninginspectorate.gov.uk/Document/2612560

6.3 Conclusions

It is recognised that a precautionary approach must be taken ("as per commitments under the OSPAR Convention and 1992 Rio Declaration on Environment, which establish that a lack of full scientific evidence must not postpone action to protect the marine environment" as stated in Natural England's communication, 2nd November 2022). It is agreed, as stated in this report, that full scientific evidence is not available, and in all probability may not be possible for this specific case. However, decisions can only be based on the best available evidence and there appears to be no evidence to support the use of 135 dB SEL_{ss} other than that it is lower than 141 dB SEL_{ss}. There is evidence that 141 dB SEL_{ss} is a reasonable precautionary limit for a species similar to seabream, likely to elicit a small and short-duration behavioural reaction, and will lead to a lower impact than that which occurred during the Rampion 1 construction period.

As noted by Natural England, "part of the second conservation objective for Kingmere MCZ in relation to black seabream is: 'the population (whether temporary or otherwise) of that species occurring in the zone be free of the disturbance of a kind likely to significantly affect the survival of its members or their ability to aggregate, nest, or lay, fertilise or guard eggs during breeding'". The 141 dB SEL_{ss} threshold would imply a limited disturbance. The effect was limited to an "initial response", of less than 2 minutes, with Kastelein *et al.* (2017) stating that "that there is no evidence, even at the highest sound level [158 dB SEL_{ss}], for any consistent sustained response to sound exposure by the study animals". Although some disturbance may occur, this is unlikely to be reasonably considered significant. As has already been noted, this restriction would lead to a lower noise impact at the Kingmere MCZ than occurred during the installation of foundations at Rampion 1, which itself appeared to have no impact on seabream populations.

It is recognised that this study was in seabass rather than seabream, although the two species are morphologically similar. In the absence of any more specific data, it is suggested that this would represent the most similar and appropriately precautionary and protective threshold, which can be achieved on site.

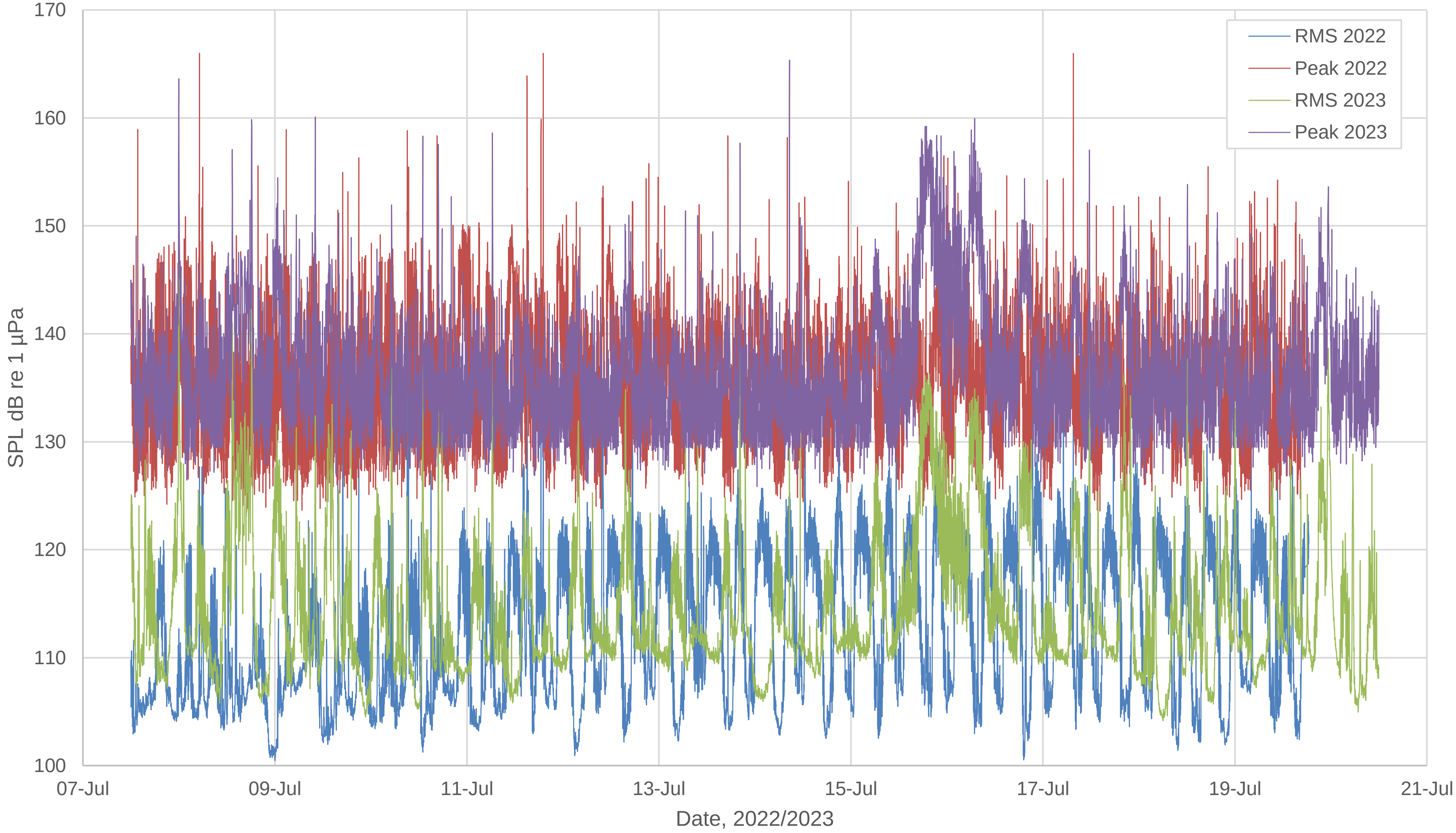

Figure 6-1 Comparison between 2022 and 2023 ambient 1-minute SPL_{RMS} and SPL_{peak} noise levels recorded at Kingmere in July

Appendix A One Week Data Summaries

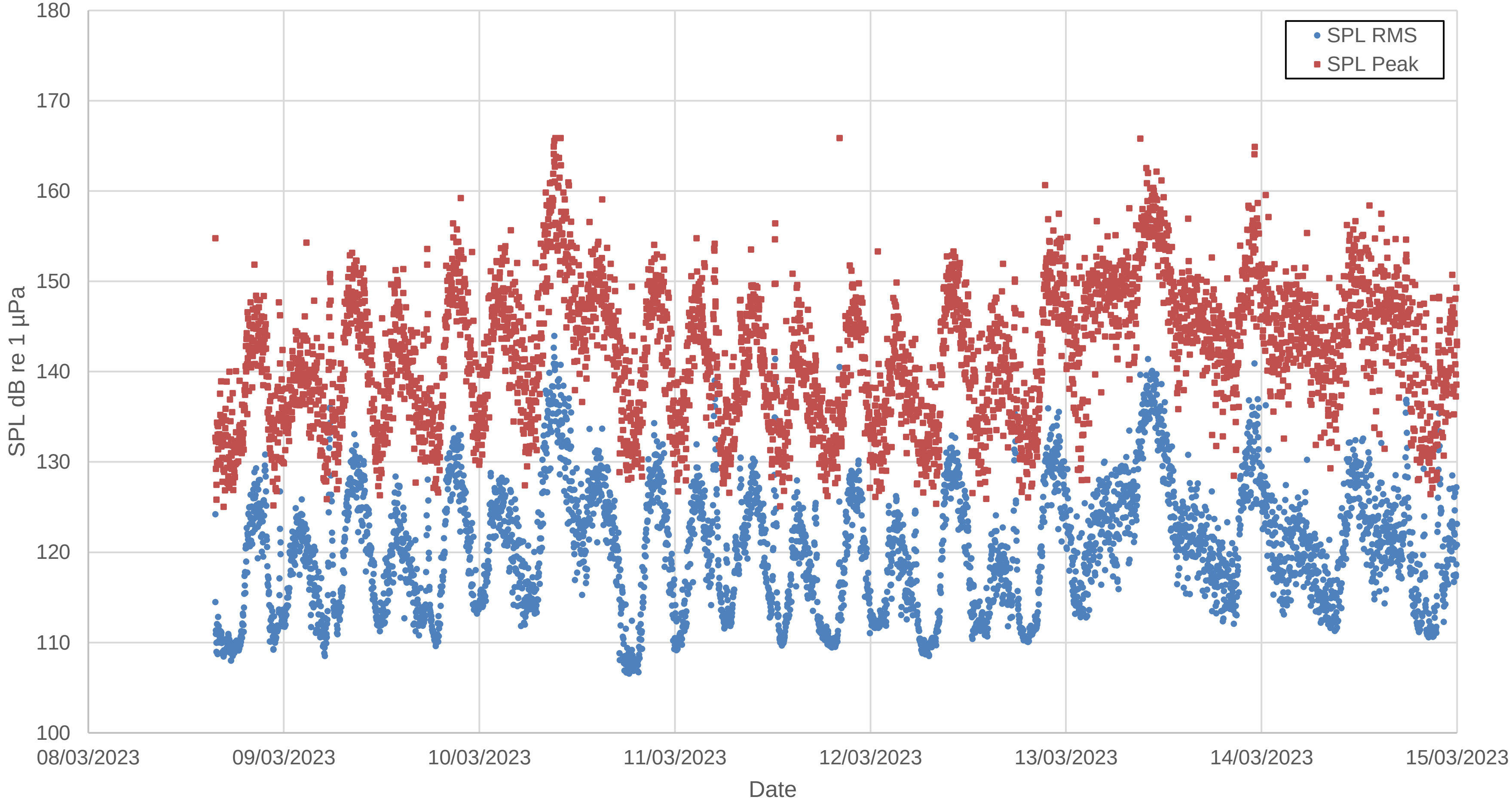

Figure A-1: Underwater noise measurements sampled between 8th March and 15th March, 2023

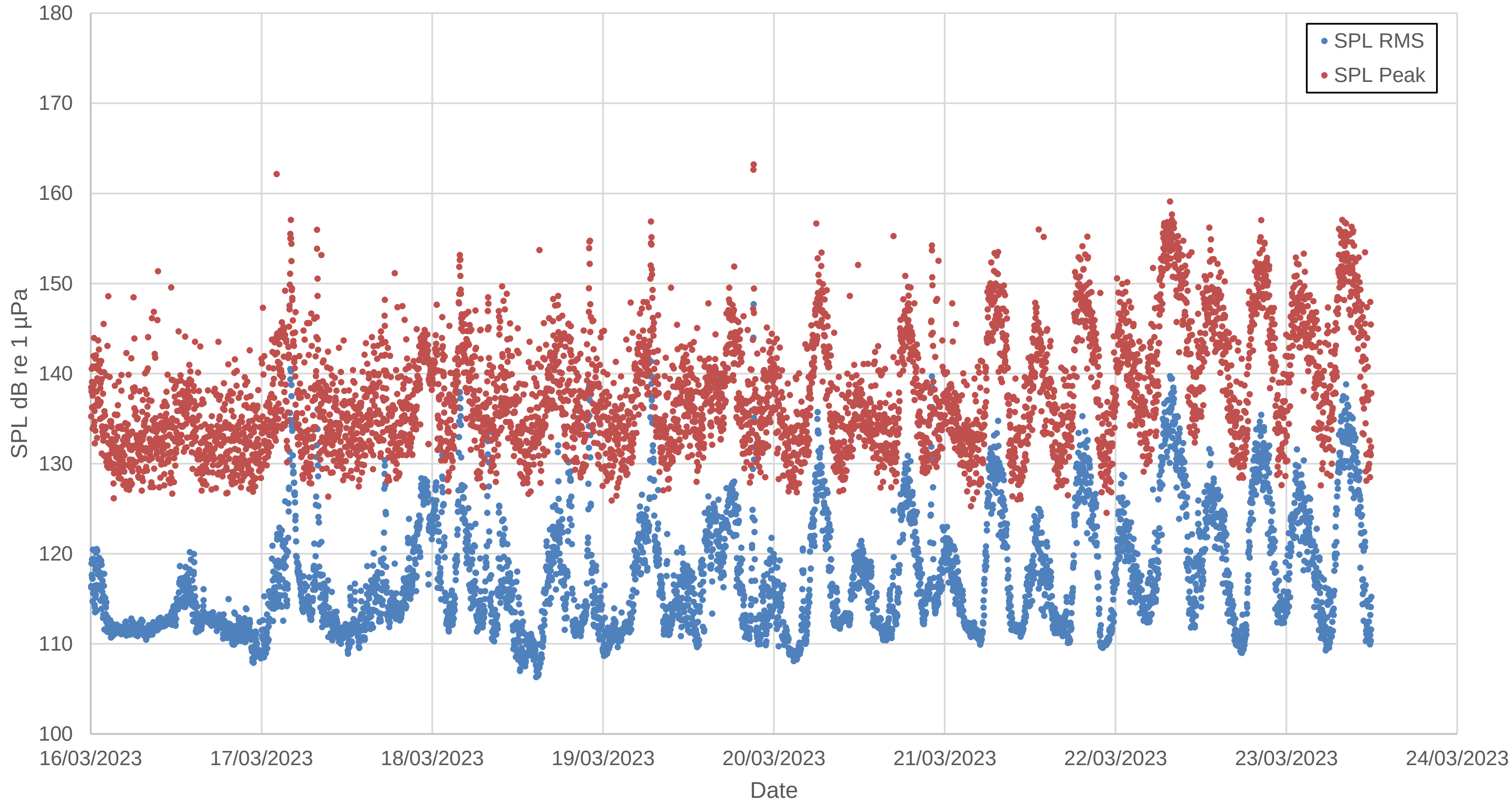

Figure A-2: Underwater noise measurements sampled between 16th March and 24th March, 2023

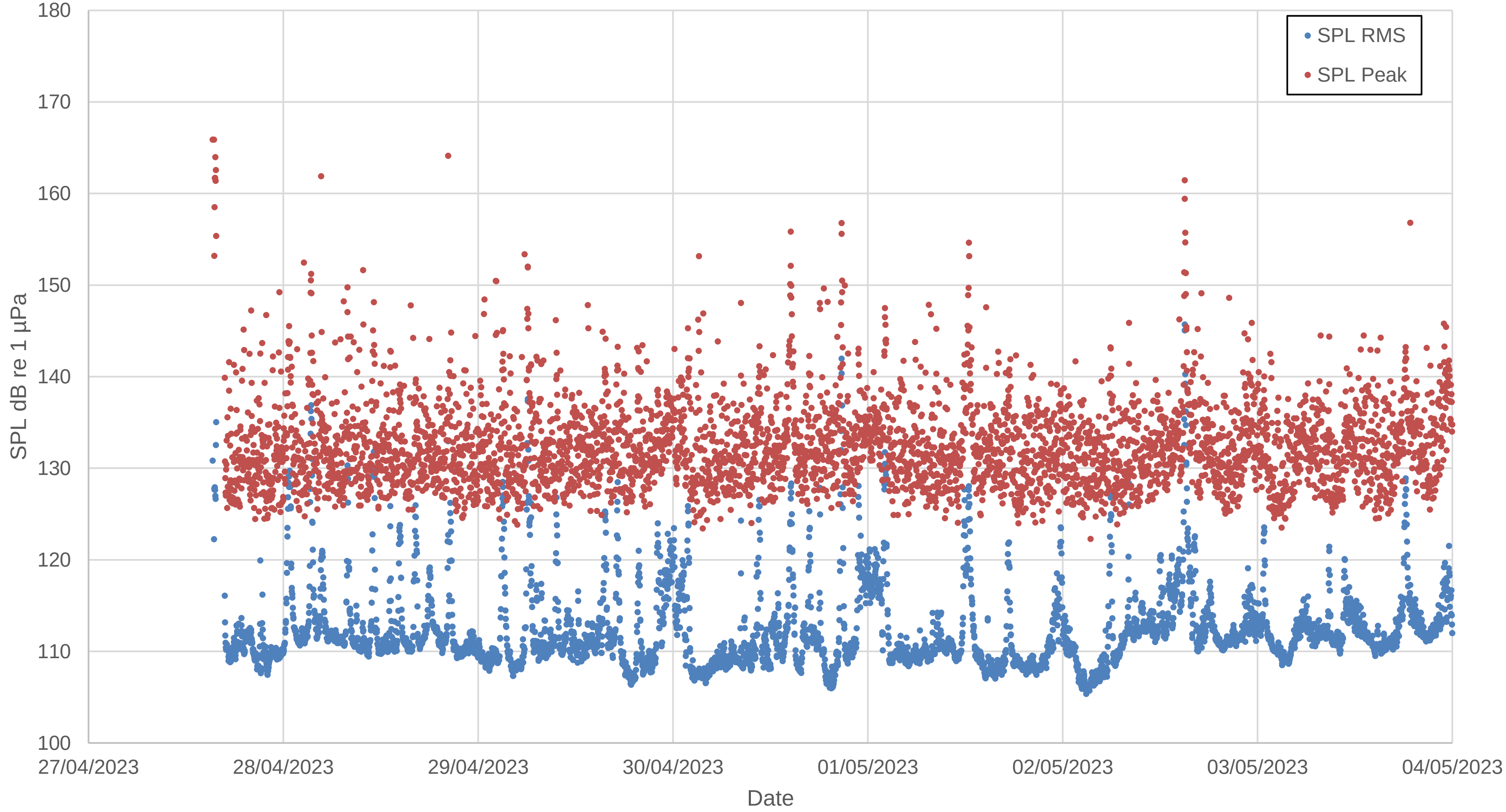

Figure A-3, Underwater noise measurements sampled between 27th March and 4th May, 2023

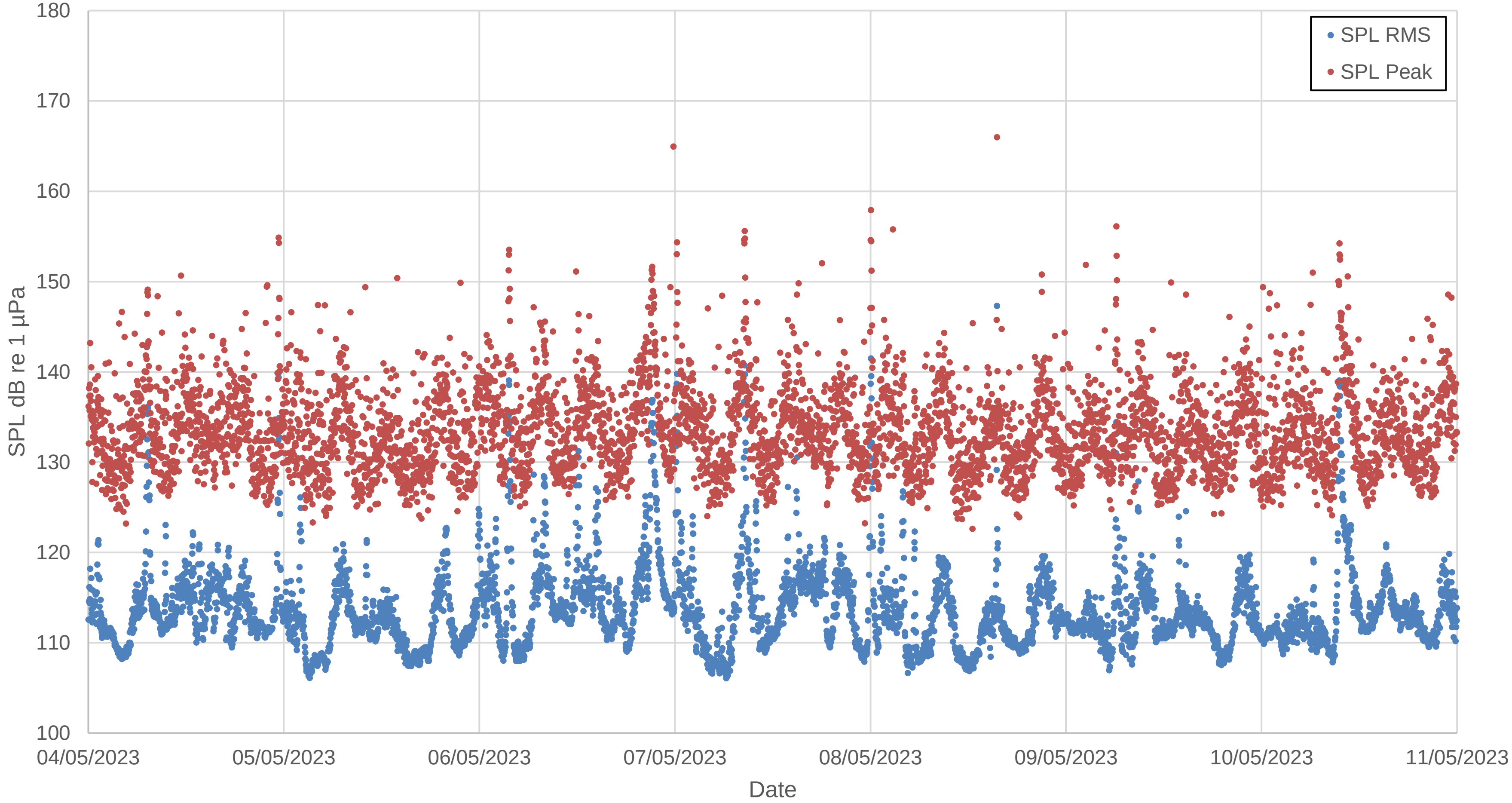

Figure A-4: Underwater noise measurements sampled between 4th May and 11th May, 2023

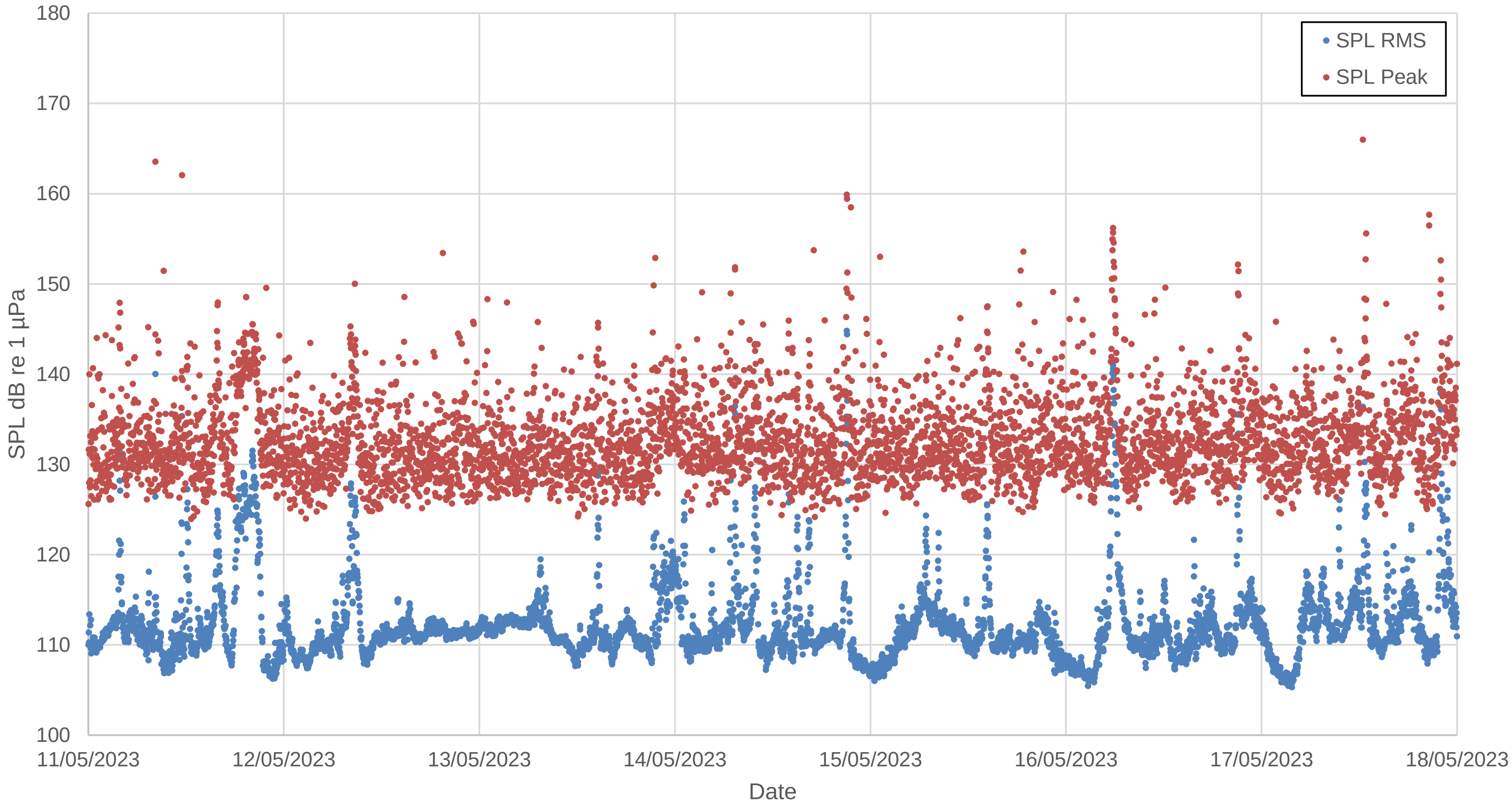

Figure A-5 Underwater noise measurements sampled between 11th May and 18th May, 2023

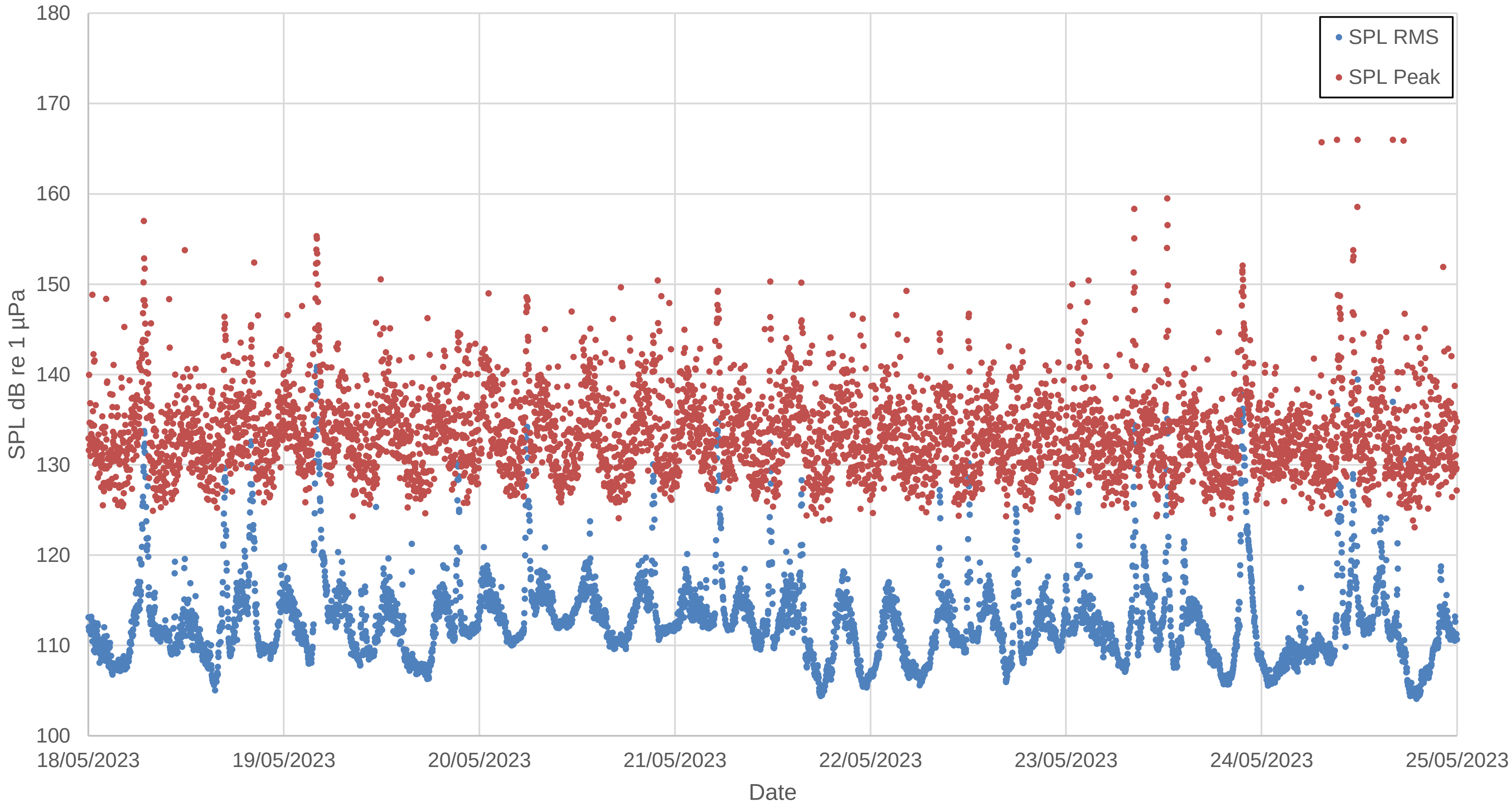

Figure A-6: Underwater noise measurements sampled between 18th May and 25th May, 2023

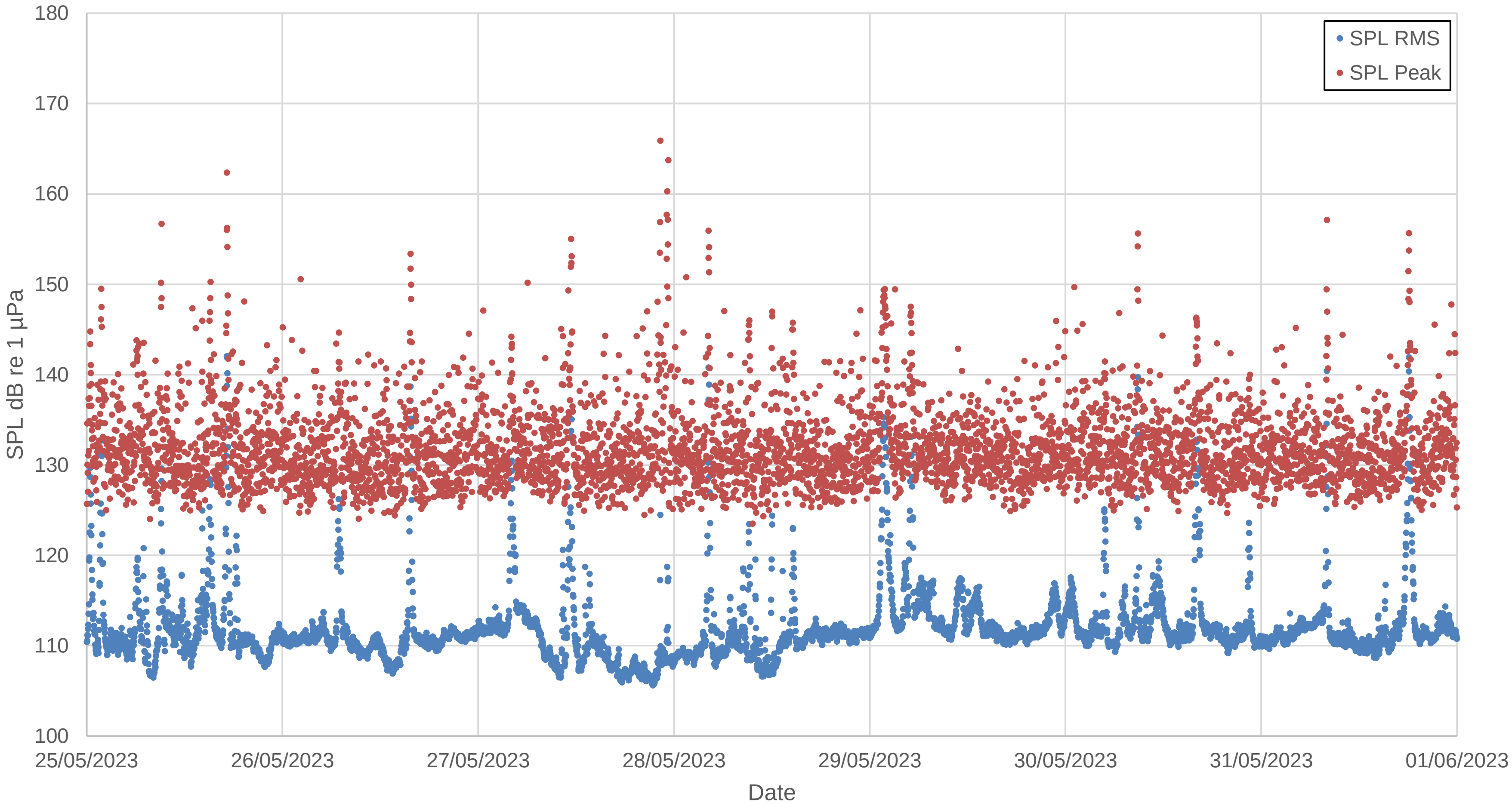

Figure A-7: Underwater noise measurements sampled between 25th May and 1st June, 2023

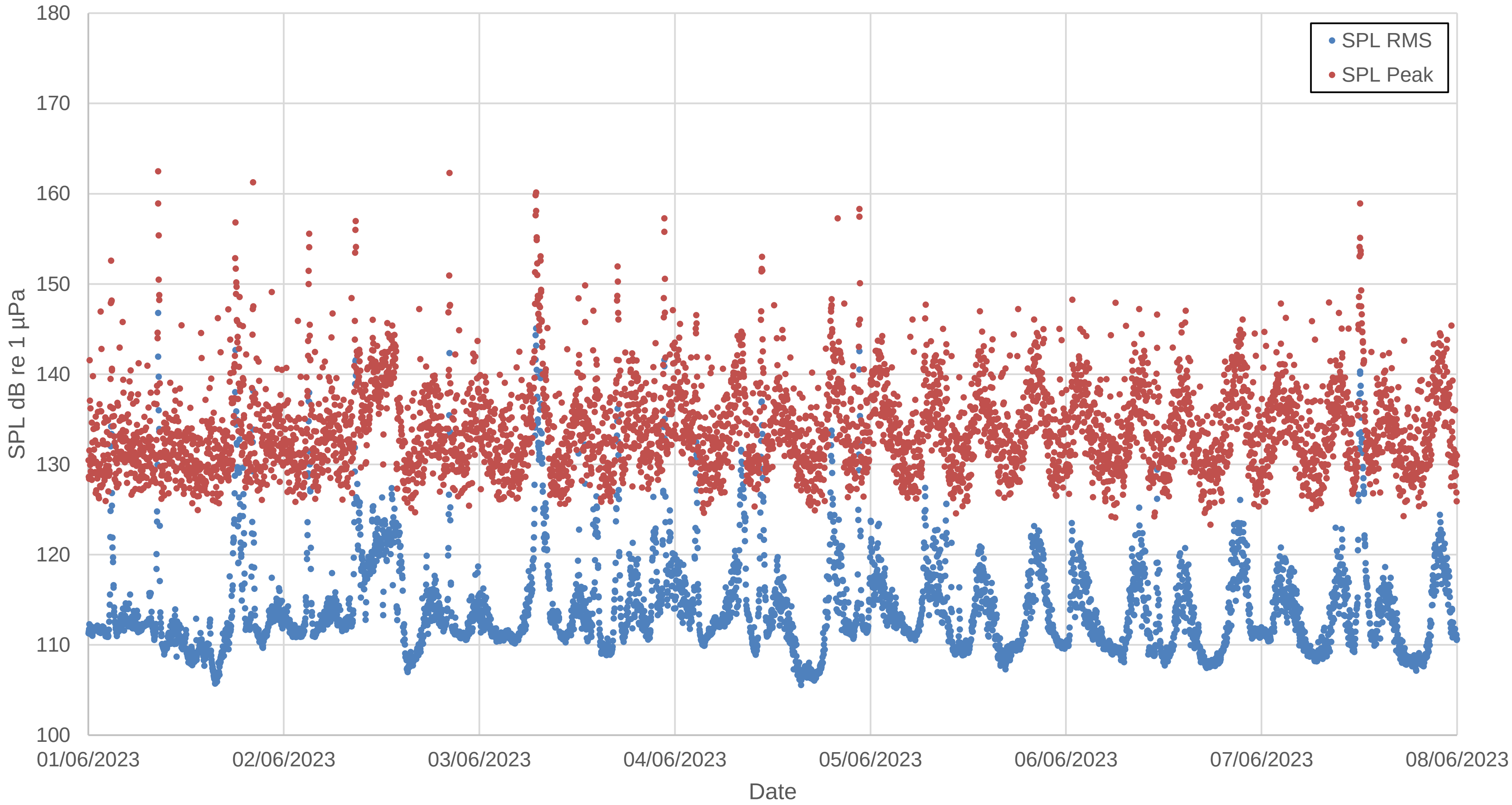

Figure A-8: Underwater noise measurements sampled between 1st June and 8th June, 2023

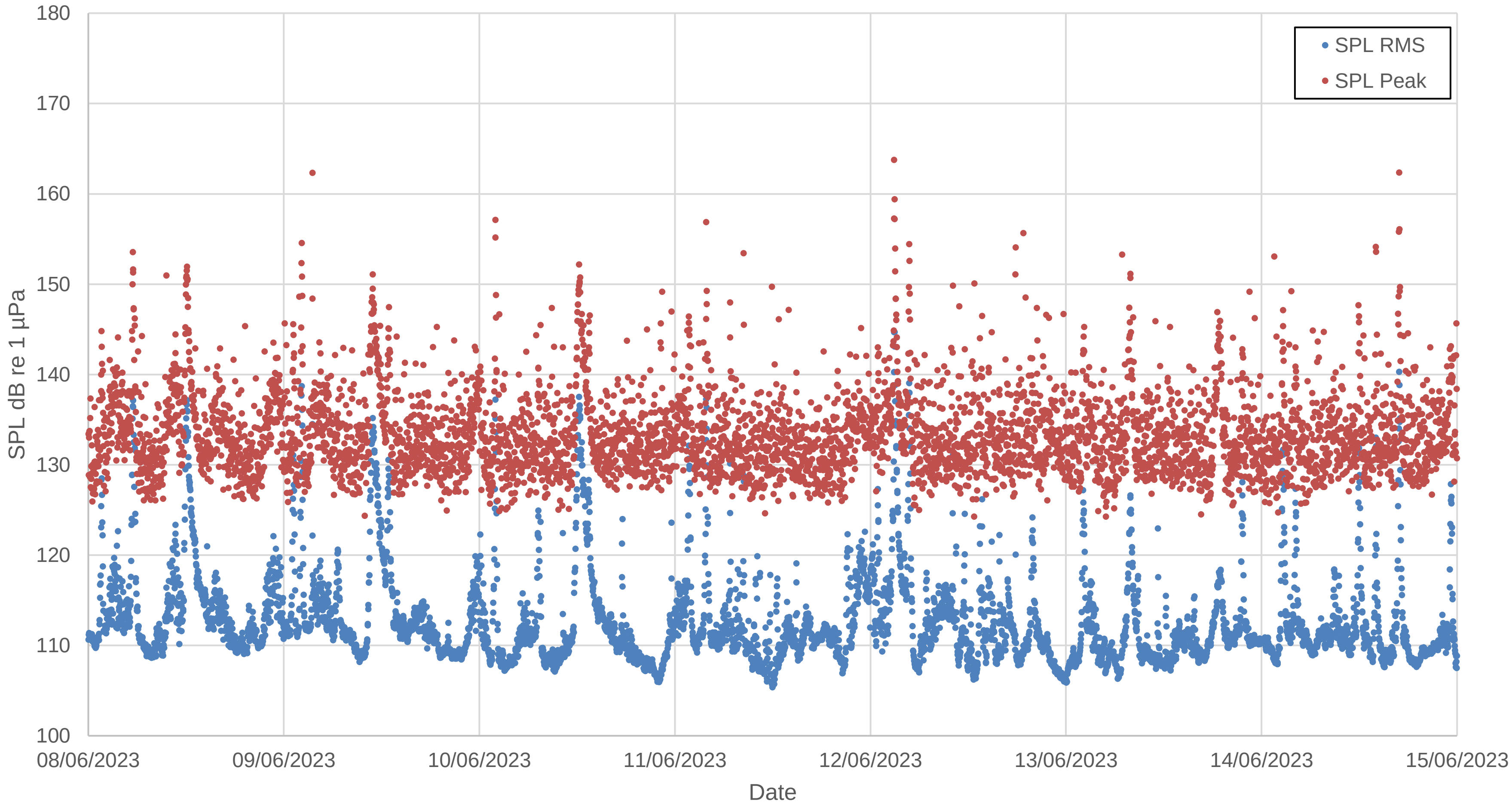

Figure A-9: Underwater noise measurements sampled between 8th June and 15th June, 2023

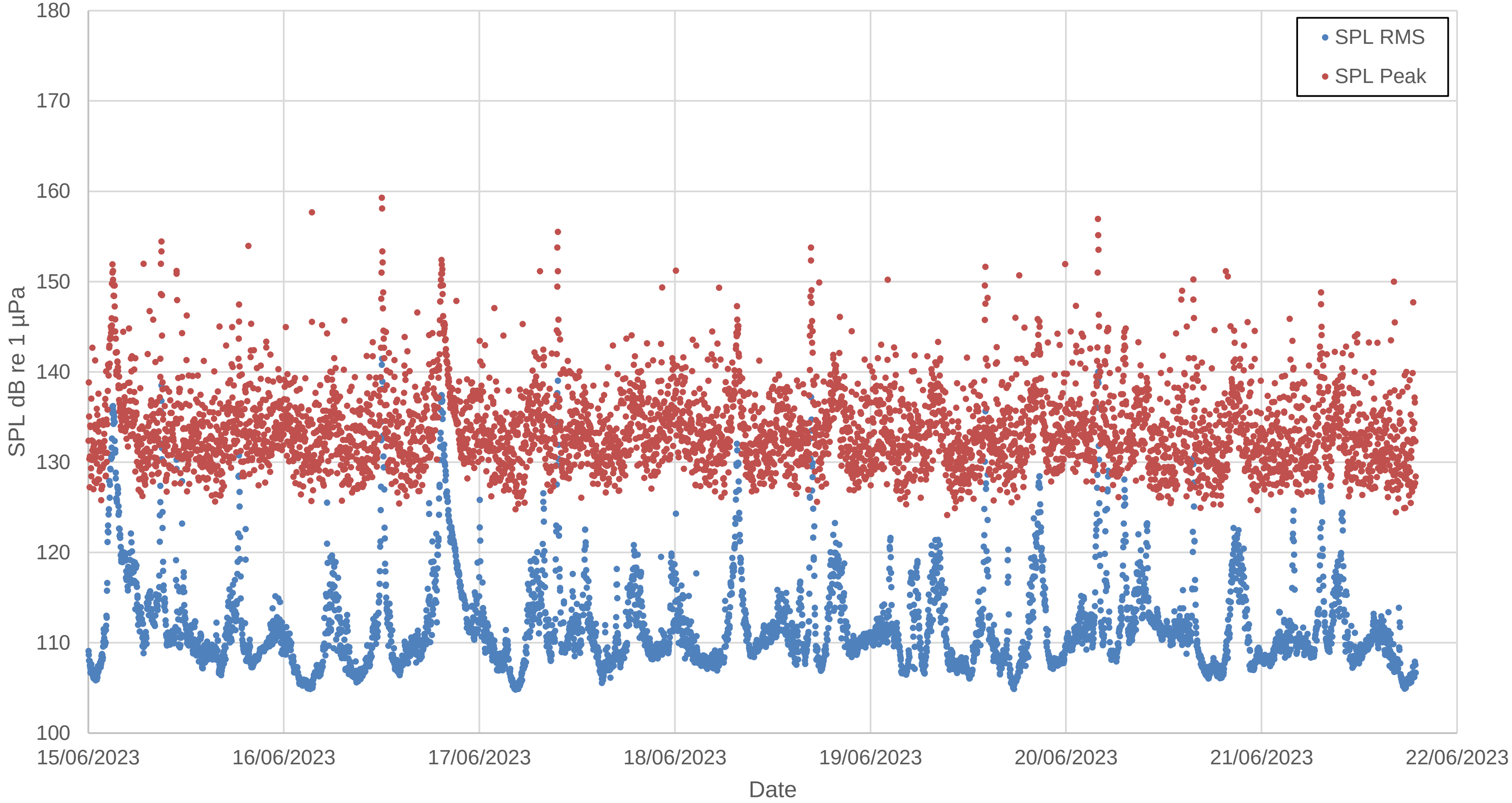

Figure A-10: Underwater noise measurements sampled between 15th June and 22nd June, 2023

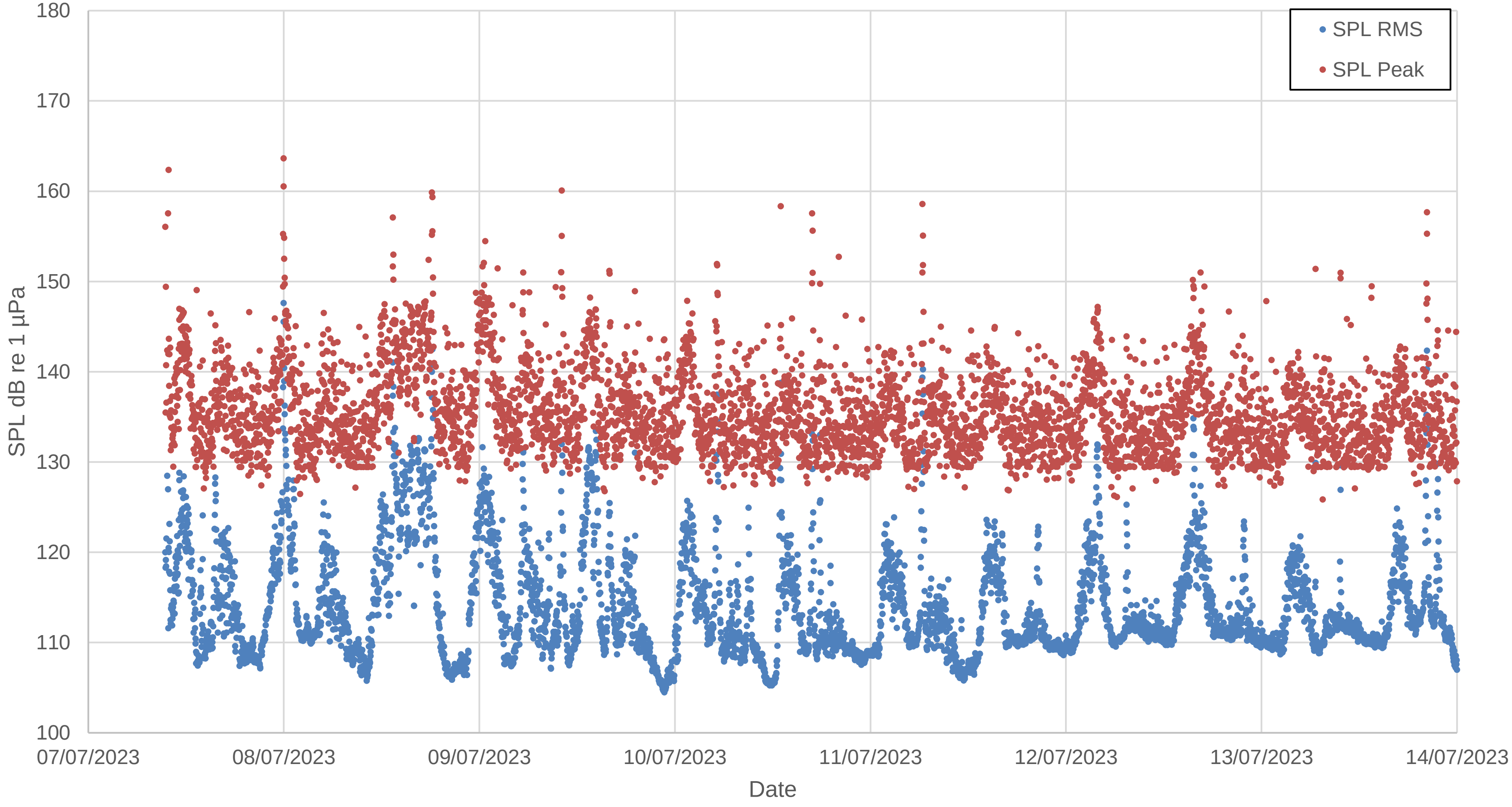

Figure A-11: Underwater noise measurements sampled between 7th July and 14th July, 2023

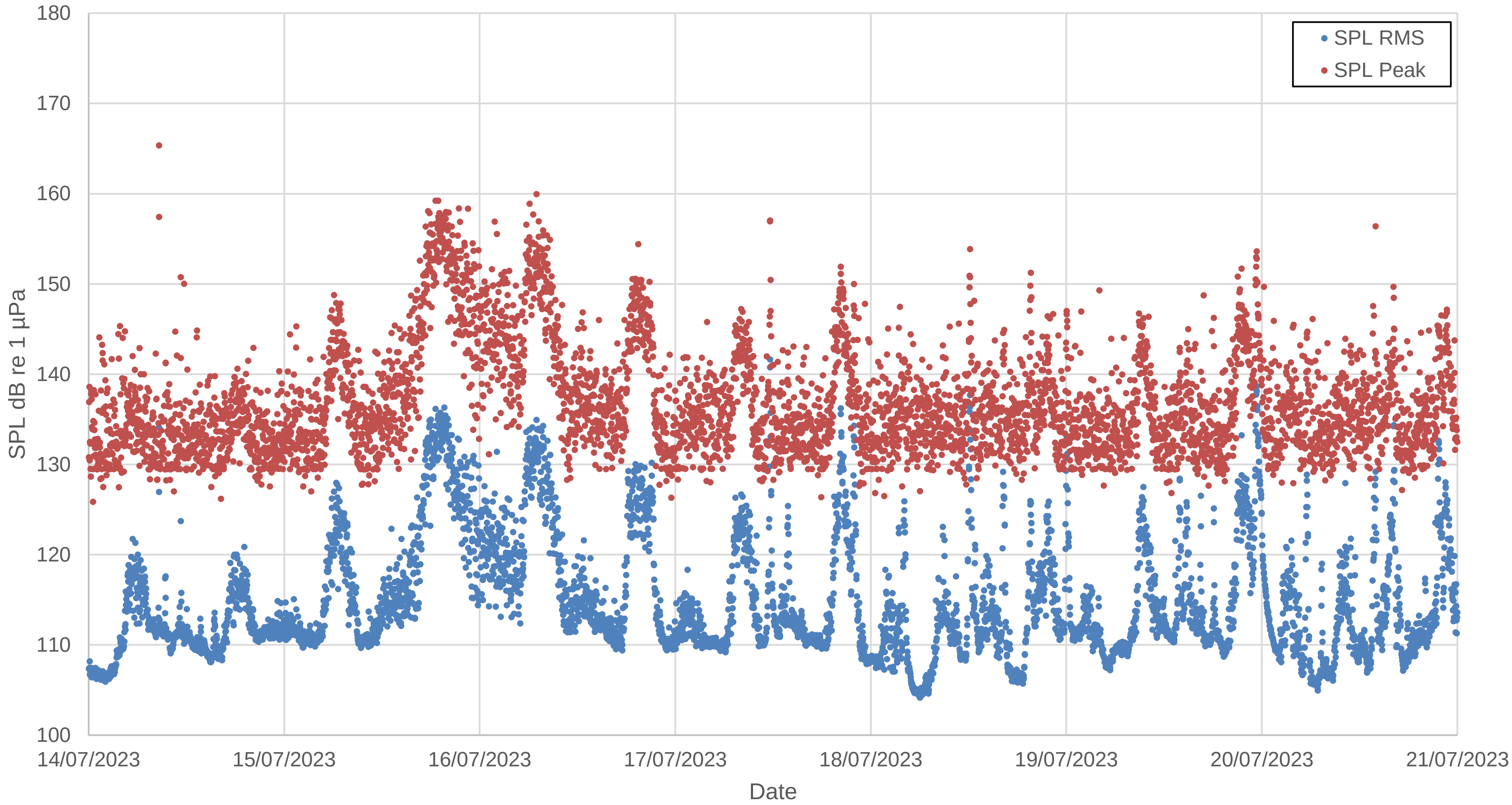

Figure A-12: Underwater noise measurements sampled between 14th July and 21st July, 2023

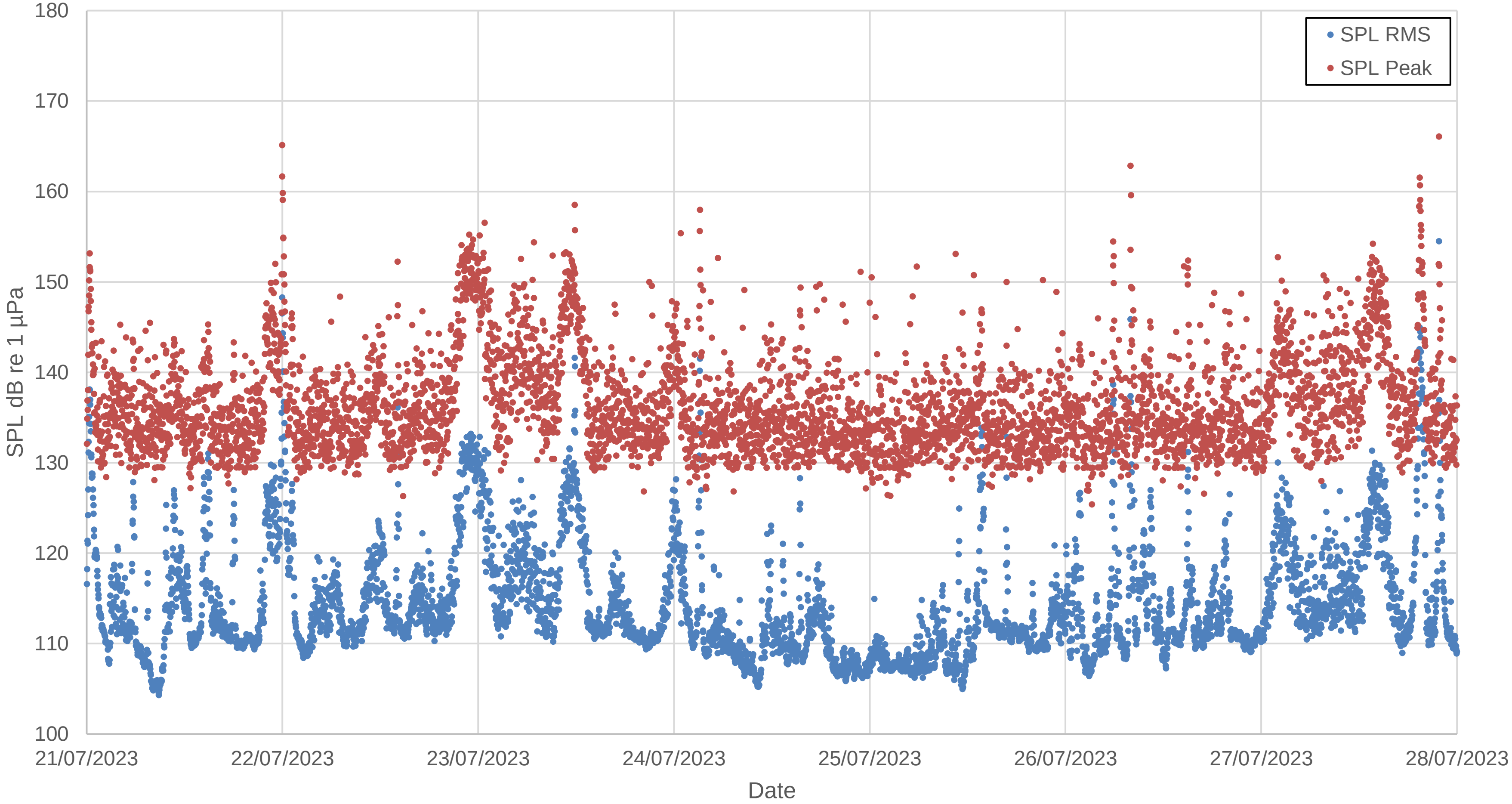

Figure A-13: Underwater noise measurements sampled between 21st July and 28th July, 2023

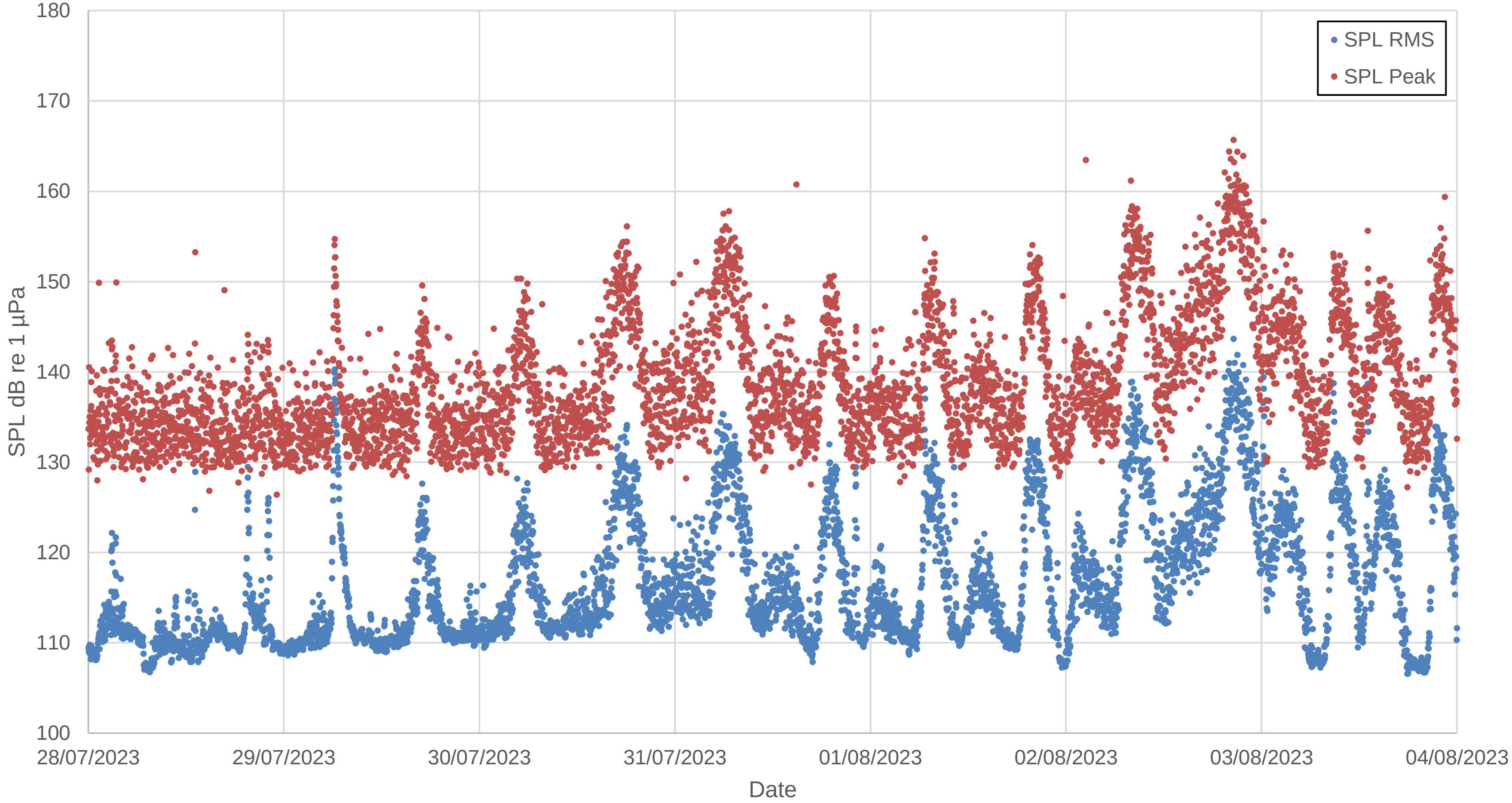

Figure A-14: Underwater noise measurements sampled between 28th July and 4th August, 2023

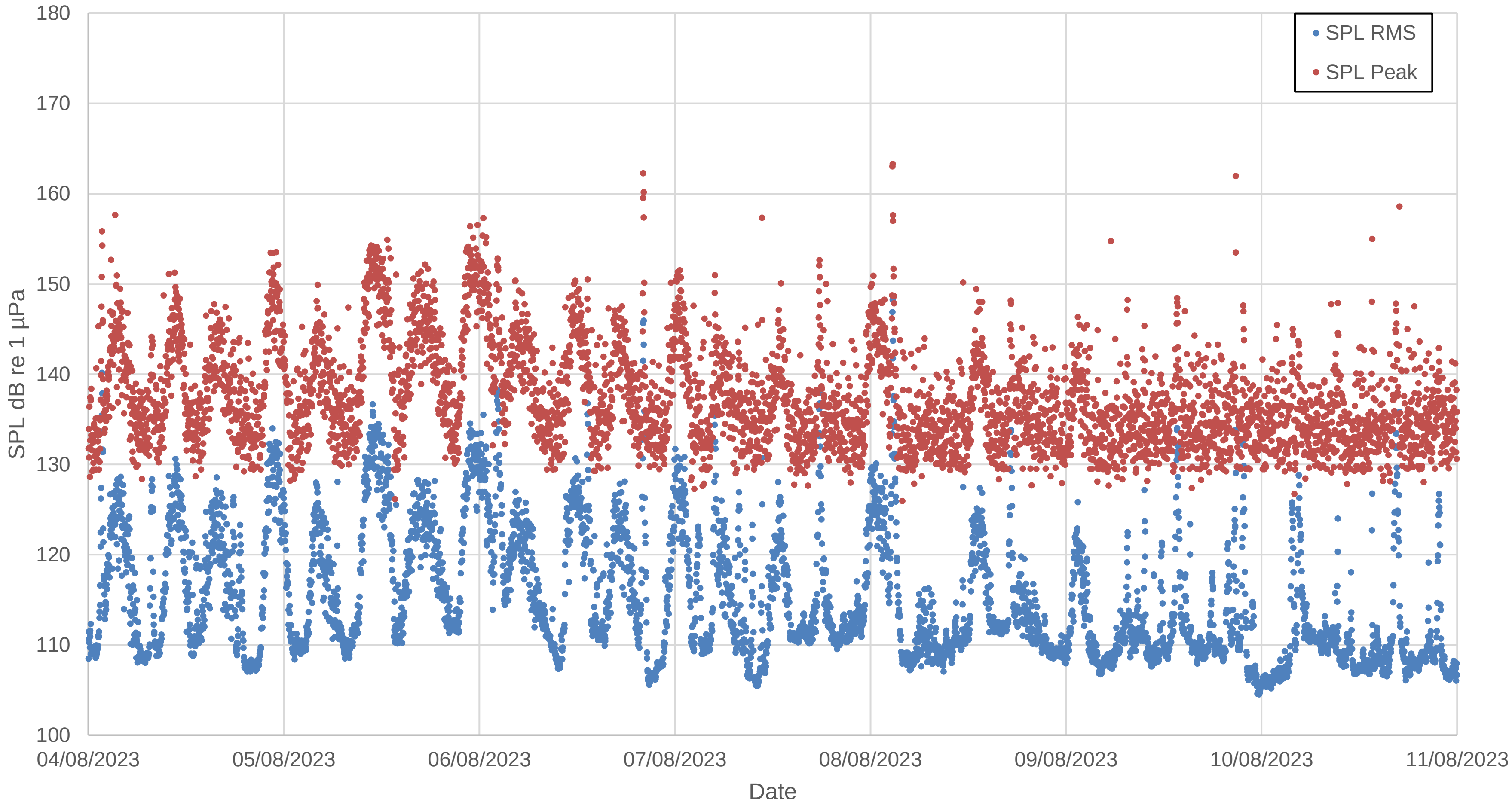

Figure A-15: Underwater noise measurements sampled between 4th August and 11th August, 2023

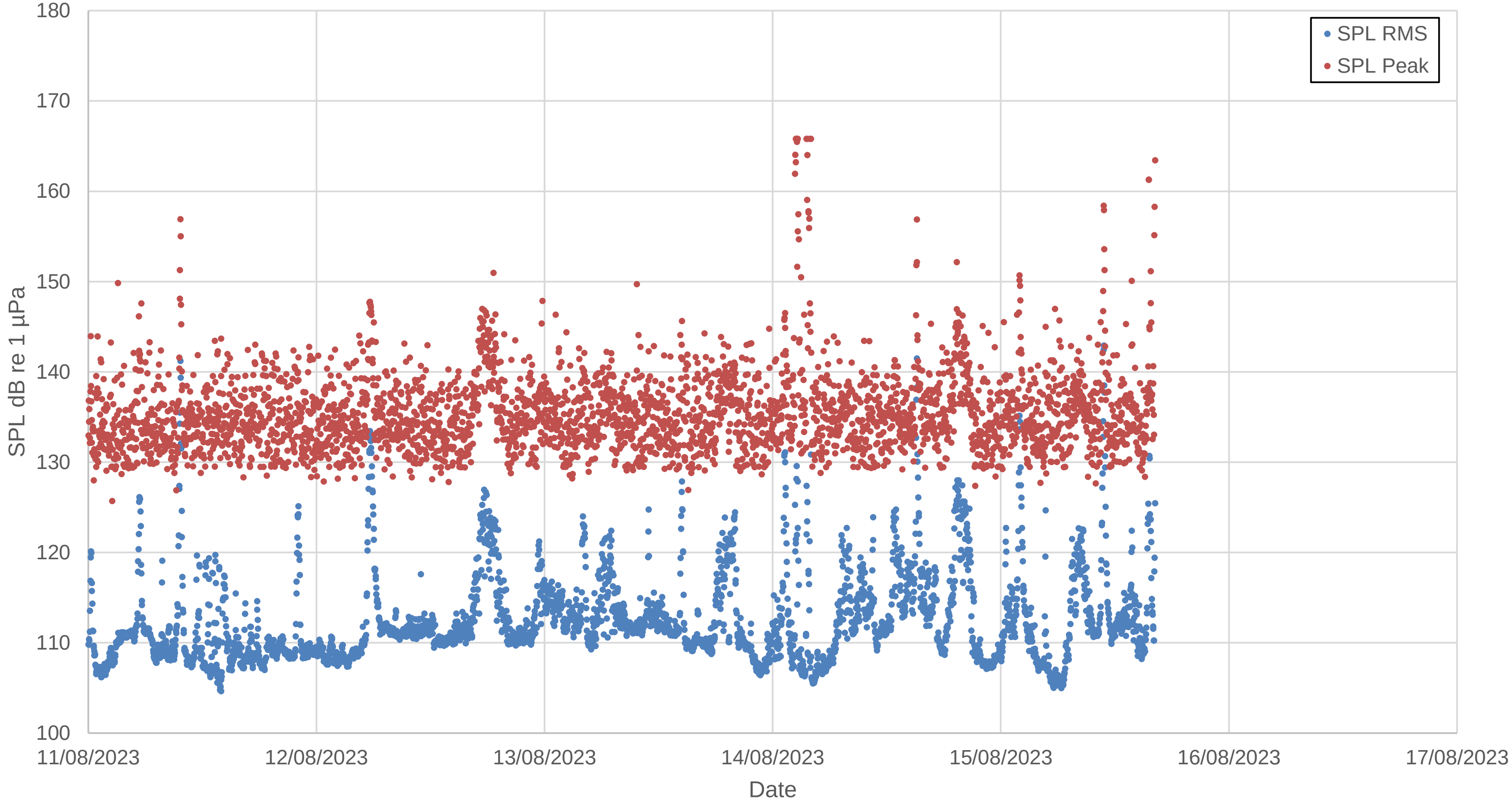

Figure A-16: Underwater noise measurements sampled between 11th August and 15th August, 2023

Report documentation page

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P359R0101	-	19/09/2023	Issue to client
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