



The surveillance programme for *Aphanomyces astaci* in Norway 2025

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Summary

The surveillance programme for *Aphanomyces astaci* in 2025 used environmental DNA (eDNA) for monitoring of *Aphanomyces astaci* as well as noble crayfish (*Astacus astacus*) and signal crayfish (*Pacifastacus leniusculus*) in selected watercourses. Detection of eDNA from *A. astaci* in River Dalselva in Indre Østfold indicates a continued ongoing outbreak linked to the River Hæra system, while no detections were made at other monitored localities. In the Glomma watercourse, no eDNA from *A. astaci* or signal crayfish was detected, whereas noble crayfish eDNA was found in the tributaries Rivers Sageråa and Smalelva. This suggests that River Smalelva has not yet been affected by nearby signal crayfish or crayfish plague. Frequent detections of noble crayfish eDNA within the regulated *A. astaci* restriction zones of the Halden watercourse, Mosse watercourse, and the rivers Vrangselva and Finnsrudelva in Eidskog, suggest the presence of vital noble crayfish populations within these zones.

Sammendrag

Overvåkningsprogrammet for *Aphanomyces astaci* i 2025 benyttet miljø-DNA for overvåking av *Aphanomyces astaci* samt edelkreps (*Astacus astacus*) og signalkreps (*Pacifastacus leniusculus*) i utvalgte vassdrag. Påvisning av miljø-DNA fra *A. astaci* i Dalselva i Indre Østfold indikerer et fortsatt pågående utbrudd knyttet til Hæra-vassdraget, mens det ikke ble gjort påvisninger ved andre overvåkede lokaliteter. I Glommavassdraget ble det ikke påvist miljø-DNA fra *A. astaci* eller signalkreps, mens miljø-DNA fra edelkreps ble funnet i sideelvene Sageråa og Smalelva. Dette indikerer at Smalelva foreløpig ikke er påvirket av nærliggende forekomster av signalkreps eller krepsepest. Hyppige påvisninger av miljø-DNA fra edelkreps innenfor de regulerte restriksjonssonene for bekjempelse av krepsepest i Haldenvassdraget, Mossevassdraget og elvene Vrangselva og Finnsrudelva i Eidskog, tyder på tilstedeværelse av vitale edelkrepsbestander innenfor restriksjonssonene.

Introduction

Aphanomyces astaci in Norway

The oomycete *Aphanomyces astaci*, the crayfish plague pathogen, is lethal to native European freshwater crayfish [1-3]. It is carried and transmitted by North American freshwater crayfish, which act as healthy carriers of the pathogen. *Aphanomyces astaci* reproduces and spreads horizontally via swimming zoospores, the infective stage of the pathogen. It was accidentally introduced to Europe in the 1860s and resulted in mass-mortalities of freshwater crayfish all over Europe. It was later re-introduced to Europe through many independent introductions of alien North American carrier crayfish [3], in particular signal crayfish (*Pacifastacus leniusculus*), red swamp crayfish (*Procambarus clarkii*) and spiny-cheek crayfish (*Faxonius limosus*).

Crayfish plague is a category F disease in Norway, according to the “The animal health regulations” Chapter II, § 6” [FOR-2022-04-06-631](#).

Since 1971, nine water systems in Norway have been affected by crayfish plague outbreaks one or several times [4-6]. These include the River Vrangselva and River Veksa (1971), the Glomma watercourse (1987 and 2003), Lake Store Le (1989), the Halden watercourse (1989, 2005 and 2014), River Lysakerelva (1998), Buåa watercourse (2010), Mosse watercourse (2016), and recently River Hæra (2021). In 2016, crayfish plague was confirmed in noble crayfish inhabiting the bordering River Vrangselva and River Billa between Norway and Sweden (which is also called River Finnsrudelva on the Norwegian side), but the infection has not been detected on the Norwegian side. In addition, five more localities have been (or still are) subject to crayfish plague regulations due to illegally introduced and confirmed *A. astaci* positive signal crayfish [4]. These include Dammane (Telemark), Ostøya (Akershus), The Fjelna watercourse (Trøndelag), Lake Kvesjøen (Trøndelag), Lake Østersjøen (Innlandet) and Lake Øyern (Østfold) where signal crayfish were discovered in 2006, 2009, 2011, 2013, 2023 and 2024 respectively [4, 5, 7, 8, 9]. At two of these locations (Dammane and Ostøya), signal crayfish have been successfully eradicated, and the areas were declared disease free [4]. In addition, illegal *A. astaci* positive signal crayfish have also been discovered at numerous locations in the Halden and Glomma watercourses in recent years (see below).

Halden Watercourse (under regulation [FOR-2015-05-26-592](#))

The Halden watercourse was first struck by crayfish plague in 1989, re-stocked with noble crayfish in the 1990s and the population successfully recovered until the crayfish plague returned in 2005 [10]. Immediate closure of the Ørje water locks prevented upstream spread to Lake Rødenesjøen. Illegally introduced *A. astaci* positive signal crayfish were found in Lake Øymarksjøen in 2008 [11], leading to the permanent closure of the locks. This prevented further spread, until illegally introduced signal crayfish were found upstream of the locks in 2014. The re-established noble crayfish population in Lake Rødenesjøen was lost during the following plague outbreak [12]. By August 2015 the outbreak had also spread throughout the adjacent Lake to the outlet of River Hølandselva. Repeated eDNA monitoring in the period 2016-2024 [6, 7, 9, 13-18] has periodically detected low amounts of *A. astaci* eDNA in the River Hølandselva, but there is no sign of spread upstream the restriction zone (Appendix A, Figure S1). Illegal translocation of signal crayfish within the watercourse has occurred, and signal crayfish is present in the Lakes Rødnnessjøen, Øymarksjøen, Aremarksjøen, Aspern and Femsjøen [19].

The Mosse watercourse (under regulation [FOR-2016-12-13-1523](#))

The Mosse watercourse was struck by crayfish plague in 2016 and eDNA analyses pinpointed an active outbreak to River Tangenelva upstream of Lake Mjærvann and River Hobølelva [7]. No *A. astaci* eDNA was detected in the Mosse watercourse in 2017, but there was a significant drop in eDNA detection of noble crayfish from June to August in Lake Våg [13]. A dead crayfish found in Lake Langen in 2018 was diagnosed with crayfish plague, confirming the upstream spread of crayfish plague in the watercourse [13]. No *A. astaci* has been detected in the watercourse in 2019-2024 [6, 9, 15-18].

The Glomma watercourse (under regulation [FOR-2005-06-20-652](#))

The Glomma watercourse was struck by crayfish plague in July 1987, from Kirkenær in Solør and further downstream including Lake Vingersjøen and Lake Storsjøen/River Oppstadåa [4]. Environment authorities and landowners cooperated to re-establish crayfish in the river system, but the plague returned in 2003. Cage experiments combined with crayfish plague diagnostics confirmed active crayfish plague in the system from 2005 until 2015 [4, 5, 7]. No *A. astaci* eDNA has been detected at the monitored locations in the Glomma watercourse from Hvebergåa to Skarsnes, nor in the outlet of Lake Vingersjøen or Oppstadåa in the period 2016-2023 [6, 7, 13-18]. *Aphanomyces astaci* positive signal crayfish was discovered in Glomma at Fossum bridge, downstream Solbergfoss in 2020 [19, 20] and *A. astaci* positive signal crayfish was discovered in Lake Østersjøen in 2023 [18]. Lake Østersjøen is connected to the Glomma watercourse via the outlet River Gjesa, River Julussa and River Rena into River Glomma. In 2024 *A. astaci* positive signal crayfish was discovered at Mørkfoss in Lake Øyern [9].

Eidskog municipality (under regulation [FOR-2016-08-17-972](#))

The Buåa system was struck by crayfish plague in 2010 caused by the presence of signal crayfish on the Swedish side of the river [21]. A barrier built to prevent the spread of signal crayfish did not stop the infection from spreading but hopefully stopped the signal crayfish [4]. There has been no detection of *A. astaci* with cage experiments (2011-2016 [7]) or eDNA monitoring (2017-2024 [6, 9, 13-16, 18]). Neither has signal crayfish been detected on the Norwegian side of the river using eDNA or trapping [17]. The rivers Vrangselva and Finnsrudelva/Billa in Eidskog municipality that flow across the border into Sweden were struck by crayfish plague on the Swedish side of the border in 2016. The crayfish plague has been active and slowly spreading upstream in River Finnsrudelva/Billa on the Swedish side of the border in 2017 and 2018. However, no sign of crayfish plague has been detected on the Norwegian side of the border in either of these two watercourses in the period 2016-2024 [6, 7, 9, 13-18], nor during the extensive monitoring during 2021 and 2022 to evaluate the watercourse for disease freedom [17].

River Hæra (under regulation [FOR-2005-06-20-652](#))

River Hæra, which drains into Glomma was struck by crayfish plague in 2021 [6]. *Aphanomyces astaci* was detected molecularly from dead crayfish found in the river. The outbreak was limited to the river downstream of Rustadfossen, where a constructed dam could act as a barrier. In August 2022, two eDNA samples amplified for *A. astaci* at the station upstream Rustadfossen in the risk area, but below the detection limit [17]. In June 2023, *A. astaci* eDNA was detected in water samples collected at one station upstream Rustadfossen, indicating a crayfish plague outbreak. Additional trapping and eDNA sampling in 2023 confirmed an active crayfish plague outbreak in the river, with a slow upstream spread during 2023 [18] and further spread into River Dalselva in 2024 [9].

Aims

The surveillance programme for *A. astaci* in 2025 aims to:

- Monitor the presence and spread of the crayfish plague pathogen *A. astaci* in areas regulated as a result of earlier detection of the pathogen (referred to as restriction zones¹).
- Substantiate disease free waterbodies in neighbouring areas of the restriction zones (referred to as risk areas²).
- Evaluate the habitat status of the monitored areas by screening all collected samples for noble crayfish and signal crayfish eDNA.
- Alert the authorities of eventual spread of the disease from restriction zones to risk areas.

The surveillance programme cooperates with the National surveillance programme for noble crayfish and spread of signal crayfish that is commissioned by the Norwegian Environment Agency (NEA) and coordinated by the Norwegian Institute of Nature Research (NINA).

Materials and methods

Surveillance sites

The main areas for surveillance include the Halden watercourse and surrounding areas, the Mosse watercourse, the Glomma watercourse, River Gjesa and River Julussa downstream Lake Østersjøen, River Hæra, and rivers in Eidskog municipality, including the Buåa watercourse, River Vrangselva and River Finnsrudelva. A map of the 45 water sampling stations, as well as the crayfish plague restriction zones, are displayed in Figure 1. Supplementary details are summarised in Appendix 1 (Table S1-S6).

eDNA sampling

Water filter samples were collected in May/June and September. From each site, two samples of up to 5 L water were filtered through sterile glass fibre filters on-site [12]. Ideally, 5 L was to be filtered per filter sample, but due to high turbidity or clay particles, the total filtered volume was sometimes lower. The filters were transferred with single-use, sterile forceps to separately marked 15 ml falcon tubes with ATL-buffer. DNA was extracted using a NucleoSpin Plant II Midi kit (Marcherey-Nagel) protocol [22, 23]. The extracted DNA samples were screened by qPCR for three DNA targets: the species-specific qPCR assay for *A. astaci* [12, 24] and two crayfish species-specific qPCR assays for noble crayfish and signal crayfish [25].

¹ The «restriction zone» refers to the complete restriction zone covered by each of the regulations. For all practical purposes, a crayfish plague restriction zone does not differentiate between a protection zone and a surveillance zone.

² Risk area is not an official term according to the animal health regulations, but a term we have chosen to use for areas adjacent to or geographically close to the crayfish plague restriction zones covered by the regulations. These areas host healthy noble crayfish populations that face a high risk for spread of the infection from the restriction zones.

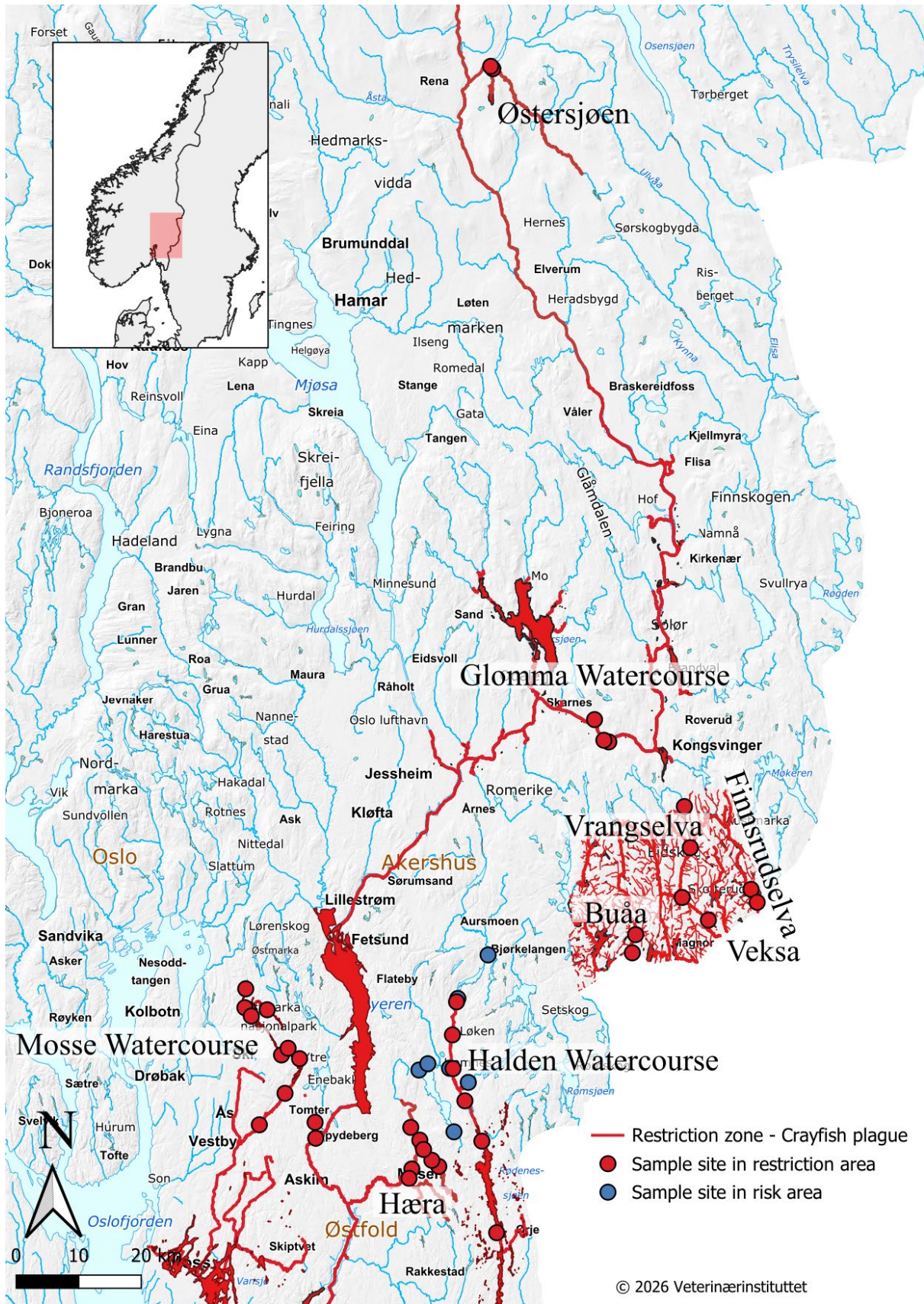


Figure 1. Surveillance sites in South-Eastern Norway 2025. Water samples (circles) were collected in May/June and September. Regulated areas (crayfish plague restriction zones) are marked in red. Note: For Glomma, the restriction zone is an approximation.

Result and Discussion

eDNA monitoring in the Halden watercourse

From the Halden watercourse region, a total of 48 water samples were collected from 13 stations during the sampling in May and September 2025. In the restriction zone, eDNA from signal crayfish was detected at the Southern part of Lake Rødenesjøen (Figure 2, Table S2). No eDNA from *A. astaci* was detected at any of the stations in June or September. Noble crayfish eDNA was detected in 11 water samples from River Hølandselva and upstream (within the restriction zone). The positive detections of noble crayfish eDNA in samples from River Hølandselva and upstream (within the restriction zone) (Figure 2) support the presence of live noble crayfish inhabiting the northern part of the Halden watercourse restriction zone. All water samples from the six stations in the risk area surrounding Halden watercourse were negative for *A. astaci* eDNA and signal crayfish, while most samples (14 samples) were positive for noble crayfish eDNA (Figure 2, Table S2), suggesting the presence of infection free noble crayfish population within most of the monitored risk area. While signal crayfish eDNA was detected in one sample from River Lierelva in 2021, this detection has not been confirmed by the extended sampling in 2022 [17] or in the following surveys in 2023 [19], 2024 [9] or 2025 (Figure 2, Table S2).

eDNA monitoring in the Mosse watercourse

From the Mosse watercourse, a total of 40 water samples were analysed from 10 stations. None of the analysed samples showed any sign of *A. astaci* or signal crayfish eDNA (Figure 3, Table S3). eDNA from noble crayfish was detected at four stations upstream of Lake Langen. This suggests that crayfish plague has not spread upstream from Lake Langen where crayfish plague was confirmed in 2018. Noble crayfish eDNA was also detected in one sample from River Tangenelva.

eDNA monitoring in the Glomma watercourse

From the Glomma watercourse, 20 water samples were analysed from five stations. No sign of *A. astaci* or signal crayfish was detected from any of the monitored stations (Figure 3 & 4, Table S4). eDNA from noble crayfish was detected at the station in the side tributary Sageråa. eDNA from noble crayfish was also detected at the station in the side tributary Smalelva and the station where this tributary meets River Glomma. Lake Østersjøen is connected to the Glomma watercourse, via the outlet River Gjessa, River Julussa and River Rena into River Glomma. Downstream Lake Østersjøen, eight water samples were analysed from two stations. All samples were negative for eDNA from *A. astaci*, signal crayfish and noble crayfish (Figure 4, Table S4).

eDNA monitoring in the rivers Buåa, Vrangselva and Finnsrudselva

In Eidskog municipality, 32 water samples were analysed from eight stations. All samples were negative for eDNA from *A. astaci* and signal crayfish (Figure 5, Table S5). In the Vrangselva watercourse, eDNA from noble crayfish was detected at Åbogen and at Søndre Åklangen, demonstrating that the river stretch is still inhabited by noble crayfish. In River Finnsrudelva, eDNA from noble crayfish was detected at both stations (Figure 5, Table S5). In River Buåa, all samples were negative for eDNA from all three target organisms (Figure 5, Table S5).

eDNA monitoring in River Hæra

From River Hæra and the tributary River Dalselva and River Dugla, a total of 28 water samples were analysed from seven stations. Two stations in River Dalselva were positive for *A. astaci* eDNA, both in June and in September (Figure 6, Table S6). eDNA from noble crayfish was detected at the same stations and at one station in River Hæra (Figure 6, Table S6). The eDNA detection of noble crayfish at these stations most likely represents dead or dying noble crayfish due to the active crayfish plague outbreak in the river. eDNA from signal crayfish-eDNA was not detected in any of the samples (Figure 6, Table S6).

Conclusion

The results from the eDNA monitoring in 2025 indicates overall stable conditions in the surveyed rivers and watercourses with no evidence of further spread of signal crayfish. Apart from the Hæra watercourse, where there is a strong indication of an ongoing crayfish plague outbreak in the connected River Dalselva, there were no indications of other ongoing outbreaks or increased infection pressure in any of the remaining locations. Recurrent detection of noble crayfish eDNA in the risk areas, and within parts of the restriction zones, confirms the persistence of native noble crayfish populations despite the threat from nearby *A. astaci* reservoirs.

In addition to the regular monitoring programme, River Vrangselva, River Veksa, and River Finnsrudselva were evaluated for disease freedom in 2024 and 2025. This evaluation included the collection of additional eDNA samples and crayfish trapping, and the results are reported separately in Strand et al. [26].

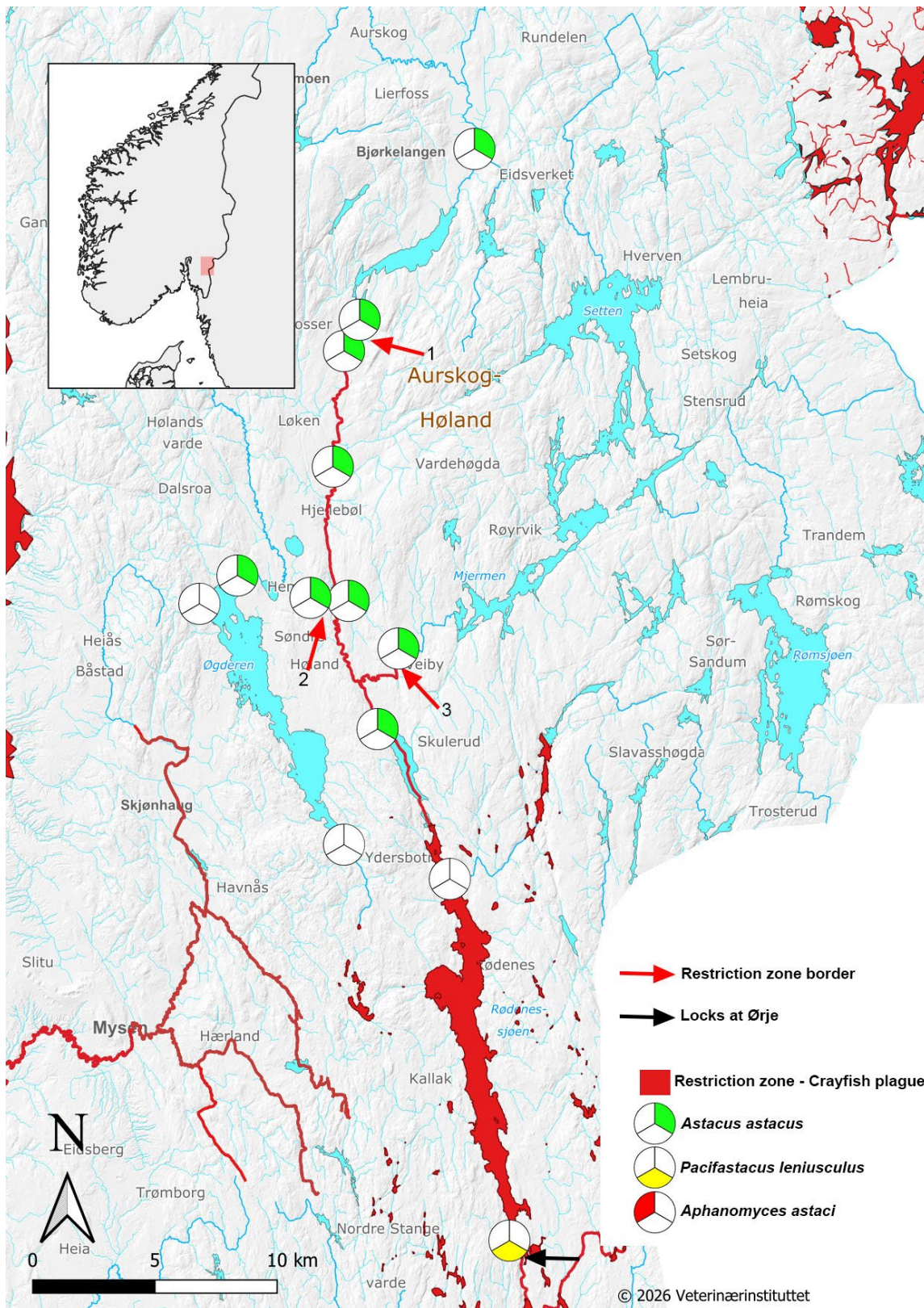


Figure 2. Overview map of the surveyed part of the Halden watercourse region in 2025, starting from the Ørje locks (black arrow) in the south where signal crayfish is present. The restriction zone is indicated by red colour on involved lakes and rivers, and ends at Fosserdam, Daltorpsfoss and Lundfoss (red arrows 1, 2 and 3 respectively), where dams act as artificial barriers for further spread. The pie chart indicates presence (colour) or absence (white) of *A. astaci* (red), signal crayfish (*P. leniusculus*; yellow), and noble crayfish (*A. astacus*; green). Presence is listed if at least one of the tested water samples yielded a positive eDNA result.

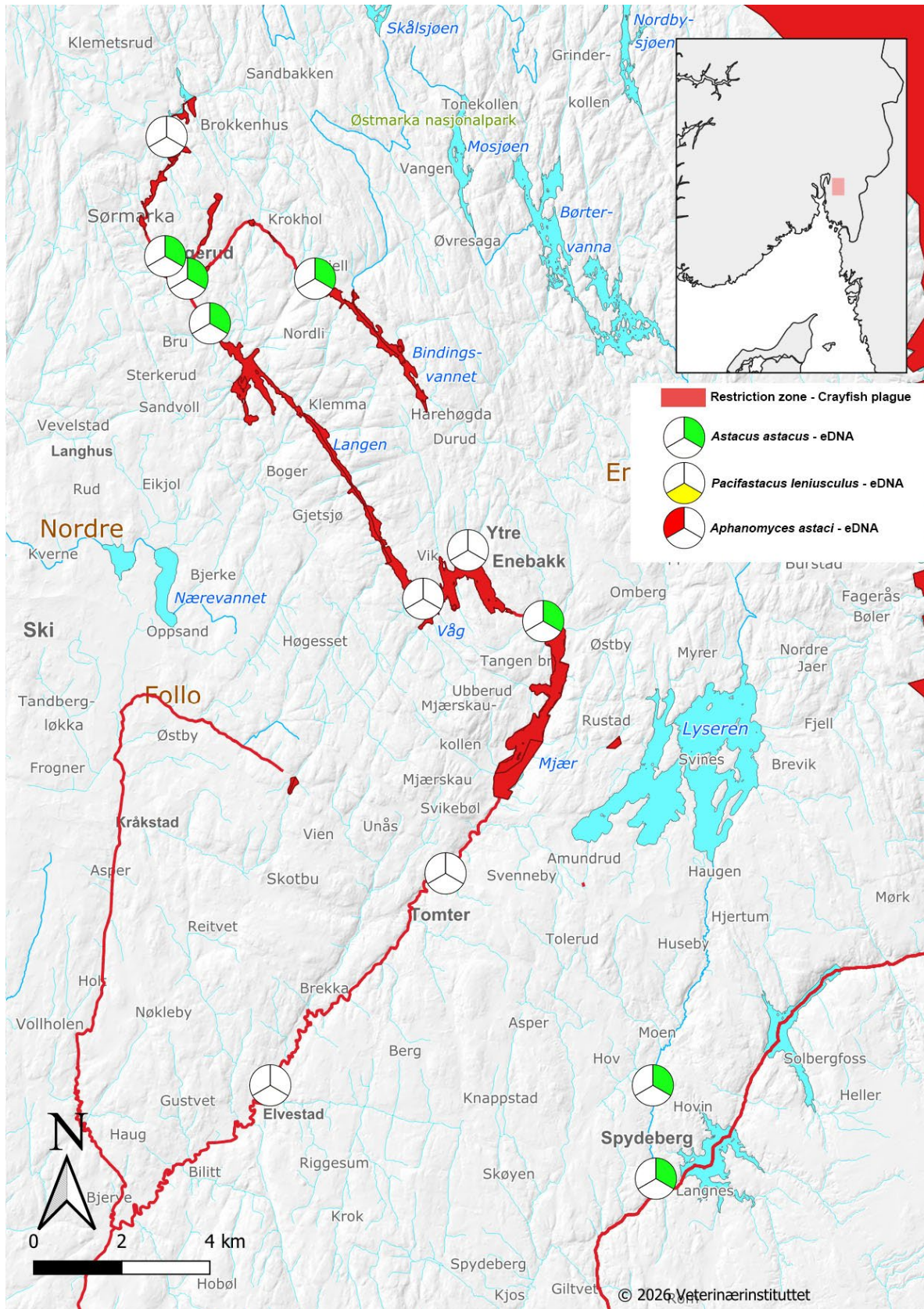


Figure 3. Overview map of the surveyed part of the Mosse watercourse in 2025. The restriction zone is represented by red colour. The pie chart indicates presence (colour) or absence (white) of *A. astaci* (red), signal crayfish (*P. leniusculus*; yellow), and noble crayfish (*A. astacus*; green). Presence is listed if at least one of the tested water samples yielded a positive eDNA result.

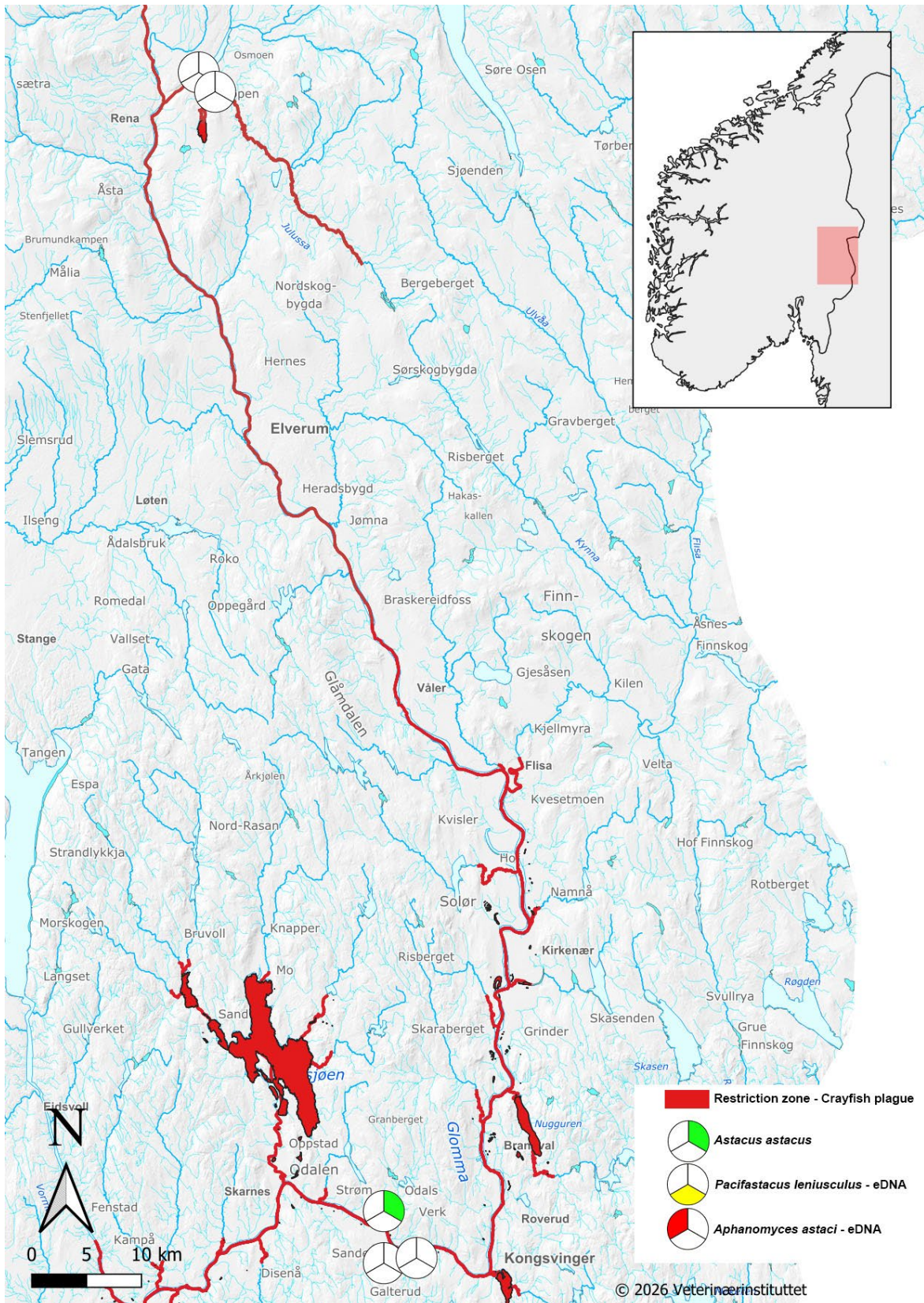


Figure 4. Overview map of the surveyed part of the Glomma watercourse region and downstream Lake Østersjøen in 2025. Regulated areas (crayfish plague restriction zones) are marked in red. For each location site, the pie chart indicates presence (colour) or absence (white) of *A. astaci* (red), signal crayfish (*P. leniusculus*; yellow), and noble crayfish (*A. astacus*; green). Presence is listed if at least one of the tested water samples yielded a positive eDNA result.

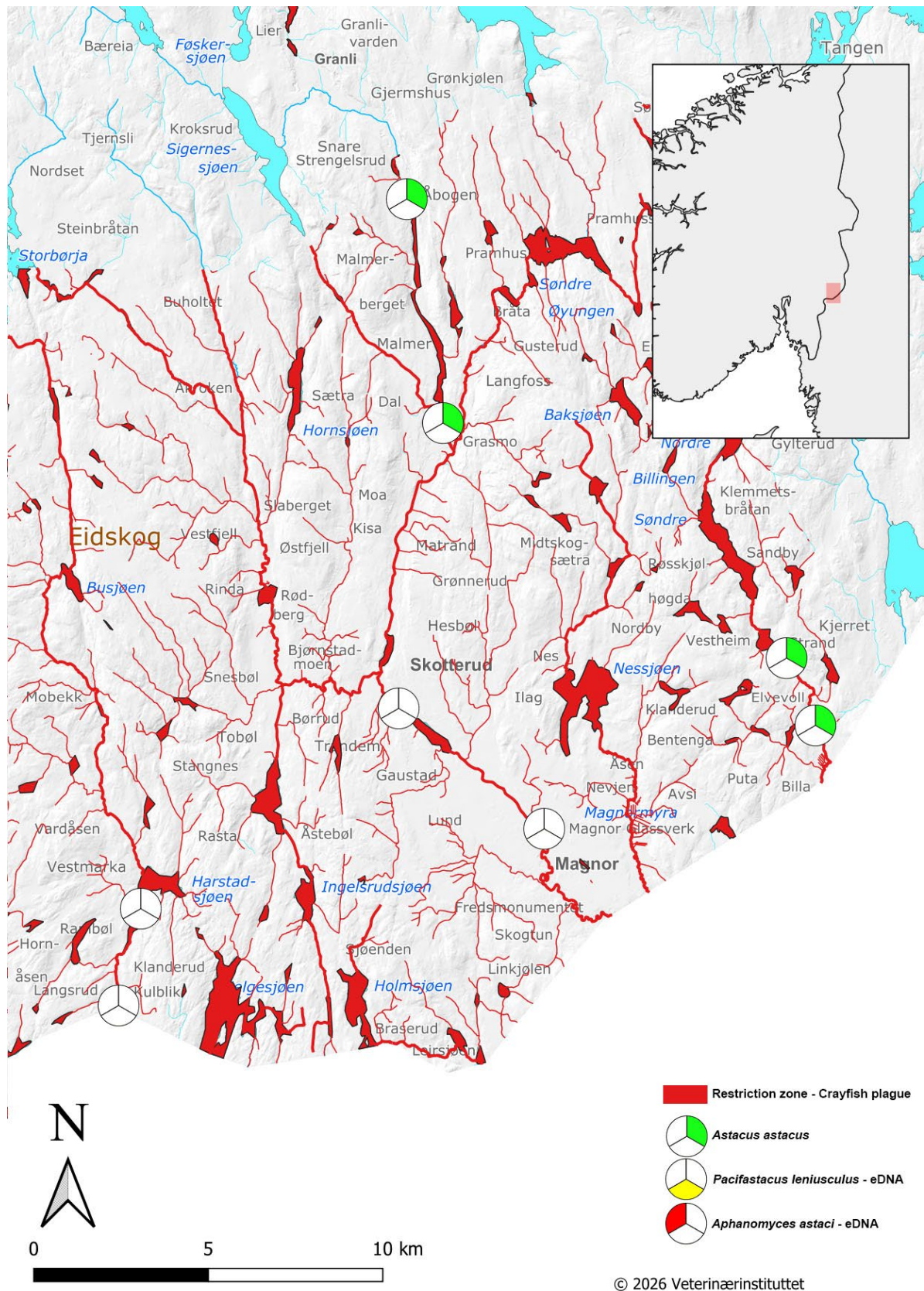


Figure 5. Overview map of the surveyed rivers in Eidskog municipality in 2025. Regulated areas (crayfish plague restriction zones) are marked in red. For each location site, the pie chart indicates presence (colour) or absence (white) of *A. astaci* (red), signal crayfish (*P. leniusculus*; yellow), and noble crayfish (*A. astacus*; green). Presence is listed if at least one of the tested water samples yielded a positive eDNA result.

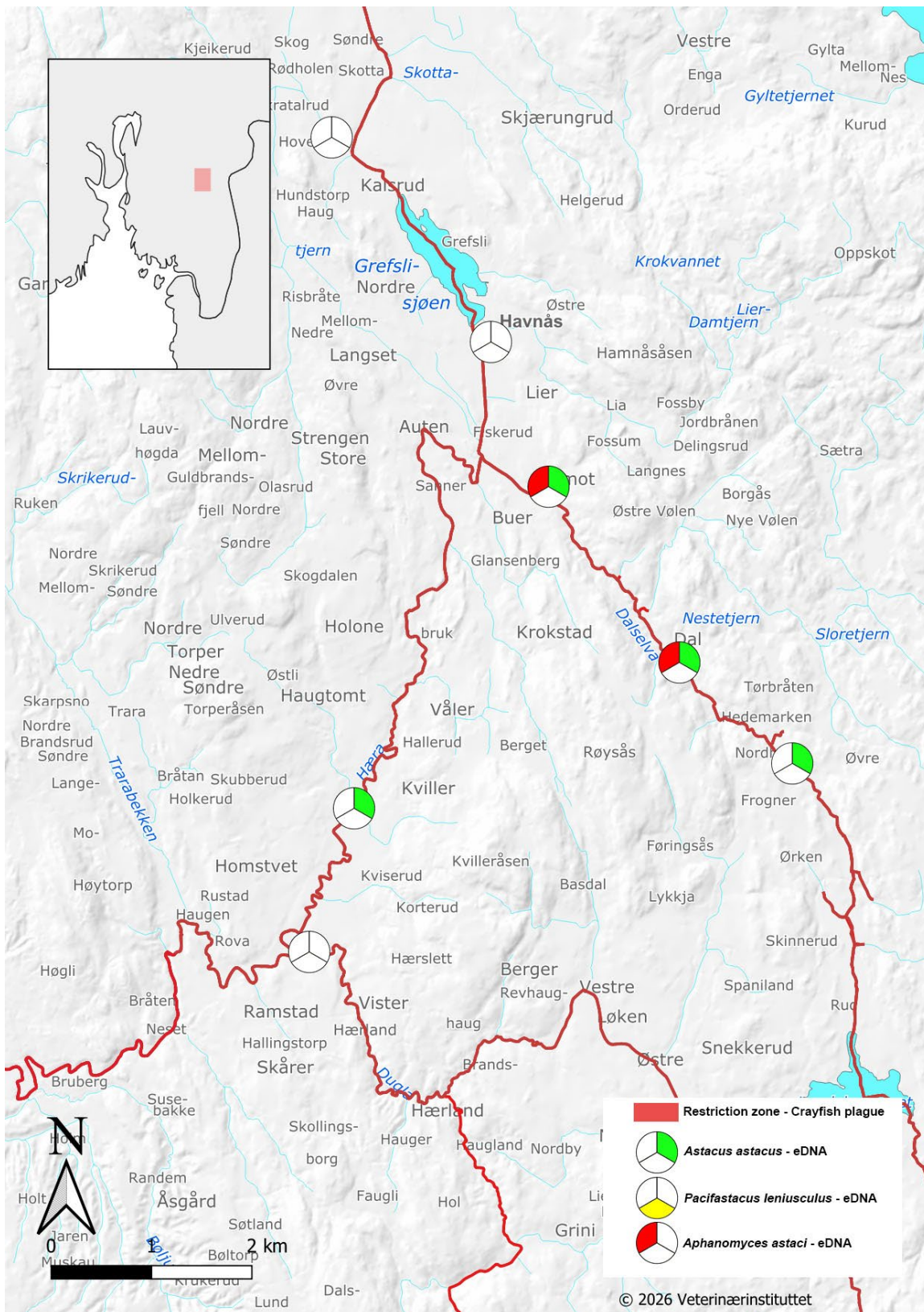


Figure 6. Overview map of the surveyed part of River Hæra in 2025. Regulated areas (crayfish plague restriction zones) are marked in red. For each location site, the pie chart indicates presence (colour) or absence (white) of *A. astaci* (red), signal crayfish (*P. leniusculus*; yellow), and noble crayfish (*A. astacus*; green). Presence is listed if at least one of the tested water samples yielded a positive eDNA result.

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Appendix

Supplementary information to the report “The surveillance programme for *Aphanomyces astaci* in Norway 2025”
- Tables S1 – S6.

Table S1. Agreed areas and sample numbers for the surveillance programme for 2025.

	Water course/River	County ¹	No. stations	No. samples	(Stations x samples x visits)
NOK <i>A. astaci</i> Prog. 2025	Halden watercourse	A, Ø,	13	48	(12 x 2 x 2)
	Glomma watercourse	I, A, Ø	7	28	(7 x 2 x 2)
	River Vrangselva	I,	4	16	(4 x 2 x 2)
	River Finnsrudselva	I,	2	8	(2 x 2 x 2)
	River Buåa	I,	2	8	(7 x 2 x 2)
	Mosse watercourse	A, Ø,	10	40	(7 x 2 x 2)
	Hæra watercourse	Ø	7	28	(7 x 2 x 2)
	Total		45	176	

¹A = Akershus, Ø = Østfold, I = Innlandet.

Table S2. Locations for water sampling in the Halden watercourse area with corresponding location and sample information. eDNA results are listed for crayfish plague, noble crayfish and signal crayfish.

Location ¹	Location details			Water samples ²		# eDNA positive samples ³					
						June			August		
	S ¹	Latitude	Longitude	#	L	CP	SC	NC	CP	SC	NC
Lierelva, Bjørkelagen	R	59.885778	11.575056	4	13	0	0	1	0	0	2
Fosserdam	R	59.821278	11.495306	4	15	0	0	2	0	0	1
Fossersjøen	C	59.816389	11.492333	4	15	0	0	2	0	0	2
Lunds foss	R	59.701806	11.537611	4	16	0	0	2	0	0	2
Hemnessjøen pier N	R	59.715686	11.395690	2	10	0	0	0	0	0	0
Hemnessjøen pier S	R	59.629847	11.504390	2	10	0	0	0	0	0	0
Hemnessjøen outlet	R	59.725444	11.419861	4	10	0	0	2	0	0	0
Daltorpsfoss	R	59.720694	11.482250	4	9	0	0	2	0	0	0
Hølandselva north	C	59.768722	11.485444	4	12	0	0	2	0	0	0
Hølandselva middle	C	59.720333	11.492167	4	11	0	0	2	0	0	0
Hølandselva outlet	C	59.675139	11.530778	4	14	0	0	2	0	0	1
Rødenessjøen Kroksund	C	59.618583	11.584790	4	20	0	0	0	0	0	0
Rødenessjøen Ysterud	C	59.488306	11.639750	4	20	0	2	0	0	2	0
Total				48	174	0	2	17	0	2	8

¹ C = Crayfish plague restriction zone, R = risk area

² # = Total number of water samples (June & August summarized), L = total water volume summarized for all samples

³ Number of samples in June and August with positive detection of eDNA from crayfish plague (CP), noble crayfish (NC), and signal crayfish (SC).

Table S3. Locations for water sampling in Mosse-watercourse area with corresponding location and sample information. eDNA results are listed for crayfish plague, noble crayfish and signal crayfish.

Location	Location details			Water samples ²		# eDNA positive samples ³					
	S ¹	Latitude	Longitude	#	L	June			August		
						CP	SC	NC	CP	SC	NC
Bindingsvann, outlet	C	59.789510	10.954824	4	20	0	0	2	0	0	1
Tangentjern, brusagav.	C	59.788393	10.900794	4	19	0	0	2	0	0	2
Sværsvann	C	59.817607	10.890148	4	19	0	0	0	0	0	0
Tangentjern, Stjerneveien	C	59.790558	10.890969	4	16	0	0	0	0	0	1
Langen, inlet, bridge on Bru-fjellv.	C	59.779107	10.910734	4	15	0	0	0	0	0	2
Langen, bridge on Skiveien	C	59.726024	11.003307	4	13	0	0	0	0	0	0
Våg,	C	59.736235	11.020769	4	9	0	0	0	0	0	0
Tangenelva, bridge on Tomterveien	C	59.722254	11.055222	4	13	0	0	1	0	0	0
Hobøelva, Sagbruk	C	59.671376	11.019753	4	17	0	0	0	0	0	0
Hobøelva, Elvestad	C	59.624056	10.952501	4	16	0	0	0	0	0	0
Total				40	155	0	0	5	0	0	6

¹ C = Crayfish plague restriction zone, R = risk area

² # = Total number of water samples (June & August summarized), L = total water volume summarized for all samples

³ Number of samples in June and August with positive detection of eDNA from crayfish plague (CP), noble crayfish (NC), and signal crayfish (SC).

Table S4. Locations for water sampling in the Glomma region with corresponding location and sample information. eDNA results are listed for crayfish plague, noble crayfish and signal crayfish

Location	Location details			Water samples ²		# eDNA positive samples ³					
	S ¹	Latitude	Longitude	#	L	June			September		
						CP	SC	NC	CP	SC	NC
Gjesa, Sameiebuveien	C	61.156383	11.452283	4	14	0	0	0	0	0	0
Jussula, Sameiebuveien	C	61.159680	11.445496	4	20	0	0	0	0	0	0
Glomma, Kraftverk 1	C	60.199922	11.890957	4	20	0	0	0	0	0	0
Glomma, Kraftverk 2	C	60.201946	11.876586	4	20	0	0	0	0	0	0
Glomma, Sageråa	C	60.230930	11.846906	4	20	0	0	2	0	0	0
Glomma, Fossumskogen	C	59.609615	11.114207	4	20	0	0	0	0	0	2
Glomma, Smalelva	C	59.632378	11.109769	4	15	0	0	2	0	0	2
Total				28	129	0	0	4	0	0	4

¹ C = Crayfish plague restriction zone

² # = Total number of water samples (June & September summarized), L = total water volume summarized for all samples

³ Number of samples in June and September with positive detection of eDNA from crayfish plague (CP), noble crayfish (NC), and signal crayfish (SC).

Table S5. Locations for water sampling in the Eidskog region with corresponding location and sample information. eDNA results are listed for crayfish plague, noble crayfish and signal crayfish.

Location	Location details			Water samples ²		# eDNA positive samples ³					
	S ¹	Latitude	Longitude	#	L	June			September		
						CP	SC	NC	CP	SC	NC
Vrangselsva, Åbogen	C	60.112260	12.116651	4	20	0	0	2	0	0	2
Søndre Åklangen, Badeplass	C	60.053552	12.139129	4	20	0	0	1	0	0	1
Vrangselsva, Skotterud	C	59.982010	12.121258	4	19	0	0	0	0	0	0
Vrangselsva, Magnor bad	C	59.950789	12.199625	4	15	0	0	0	0	0	0
Finnsrudelva, Finnsrudvegen	C	59.997405	12.318277	4	20	0	0	2	0	0	2
Finnsrudelva, Billavegen	C	59.979207	12.337286	4	20	0	0	2	0	0	2

Buåa, Eidskog	C	59.925330	11.993562	4	14	0	0	0	0	0	0
Buåa, Riksgrense	C	59.899040	11.986509	4	13	0	0	0	0	0	0
Total				32	141	0	0	7	0	0	7

¹ C = Crayfish plague restriction zone

² # = Total number of water samples (June & September summarized), L = total water volume summarized for all samples

³ Number of samples in June and September with positive detection of eDNA from crayfish plague (CP), noble crayfish (NC), and signal crayfish (SC).

Table S6. Locations for water sampling in the River Hæra with corresponding location and sample information. eDNA results are listed for crayfish plague, noble crayfish and signal crayfish

Location	Location details			Water samples ²		# eDNA positive samples ³					
	S ¹	Latitude	Longitude	#	L	June			August		
						CP	SC	NC	CP	SC	NC
Hæra, Upstream Grefsligjøen	R	59.632849	11.381442	4	20	0	0	0	0	0	0
Hæra, Downstream Grefsligjøen	R	59.615298	11.408956	4	11	0	0	0	0	0	0
Hæra, Dalselva Hedemarkveien	R	59.579103	11.466705	4	7	0	0	0	0	0	0
Hæra, Dalselva Dalsveien	R	59.587356	11.446157	4	14	2	0	2	1	0	2
Hæra, Dalselva Åmotveien	R	59.602203	11.421013	4	16	2	0	2	1	0	2
Hæra, Kvillerveien	R	59.573380	11.390859	4	14	0	0	2	0	0	0
Hæra, Duga E18	R	59.559744	11.384363	4	19	0	0	0	0	0	0
Total				28	101	4	0	6	2	0	4

¹ C = Crayfish plague restriction zone

² # = Total number of water samples (June & August), L = total water volume summarized for all samples

³ Number of samples in June and August with positive detection of eDNA from crayfish plague (CP), noble crayfish (NC), and signal crayfish (SC).

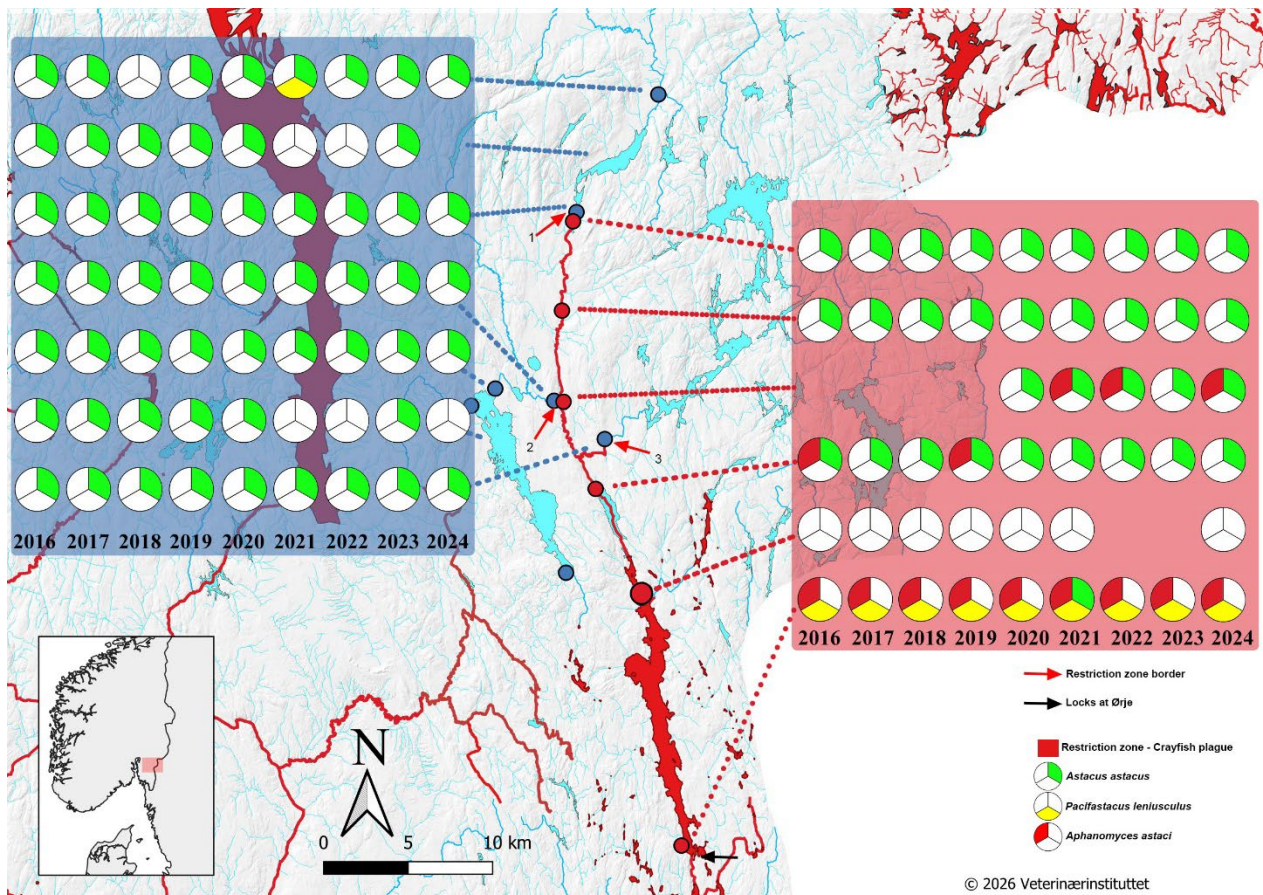


Figure S1. Environmental DNA results from 2016 – 2024 in Halden watercourse, showing the stable detection of noble crayfish eDNA within the crayfish plague restriction zone (red sample sites) from the middle part of River Hølandselva up to the boarder of the restriction zone at Fosserdam. Water samples from the risk zone (blue sample sites) also show overall stable detection of noble crayfish eDNA.

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