Marine spatial ecology

Comparing the effects of daytime vs. nighttime release of juvenile brown trout (*Salmo trutta*) on migration and survival in a case study in Kattinge bay in Roskilde Fjord.

Special course

Technical University of Denmark

Institute for aquatic resources

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Abstract

This project aims to investigate the effects of the time of release on the migration and survival of smolt raised in aquaculture and evaluate the potential benefits of releasing in the day or night, which has been observed in closely related Salmon (*Salmo salar*) smolts[1]. In April 2019, 60 juvenile sea trout (smolt) were fitted with hydroacoustic transmitters and split into 10 equal groups, half of which were released in the night and the other half in the day over 5 consecutive days, into the mouth of the river Langvad in Roskilde Fjord. Data from stationary hydrophones in Kattinge Bay and Roskilde Fjord gathered during the following 5 months indicated a significant difference in what time during the diel cycle the smolts were migrating and that the fish release during the day showed a greater tendency to move during the day. The fish released during the night showed a strong tendency to travel during the night and also exhibited indications of higher survival rate compared to the day group. The effects of timing the release of hatchery raised smolt seem to have an impact on survival and fitness and should be examined further to improve management and optimize the strategy implemented by local stakeholders who invest time and resources in the stocking of trout.

Indhold

Introduction

Sea run brown trout (*Salmo trutta*), or simply trout, is an anadromous salmonid and it is the most important species for recreational anglers in Denmark where coastal angling targeting this species constitutes 27% of the total angling activities, making it the most common type of angling in Denmark[2]. In the sea, anyone can target sea run brown trout if they purchase the mandatory national angling license and the open access and popularity of the fishery makes it the "National recreational fishery of Denmark"[2]. Anglers are allowed to catch and keep an unlimited number of trout over 40 cm, but may not fish closer than 500m to designated spawning rivers and may only catch non-spawning individuals from November 15th till January 15th [3], though more restrictive regulations may apply locally. An additional 8% of Danish angling effort targets brown trout in the rivers[2] where access is limited by the landowners who own the properties adjacent to the rivers. Here the fishing primarily takes place in the lower parts of the river where local unions and associations obtain private and governmental access by collective payment to the property owners to fish the rivers, or the fishery is managed privately with the local landowners[2]. The local fishing associations are supported mainly by volunteers who commit their time and resources to manage and maintain not only access to fishing ground for their members, but also directly contribute to the improvement of local fish stocks through habitat restoration and stocking of juvenile trout to support the local population. The stocking of juvenile trout mitigates the deficiency in production by the spawning stock that is observed in many Danish trout rivers and which can be caused by habitat degradation, pollution and eutrophication, blocking or restricting the spawning migration or increased mortality by recreational angling and commercial fishing or multiple of these factors in combination[4 5 6]. The deficiency in production is estimated by sampling the river and counting the trouts that are present[5] and the subsequent stocking of juvenile trout is engineered to offset this lower abundance and compensate to maintain biological and ecological functioning as well as provide fishing opportunities for local anglers. Local stakeholders from the fishing associations trap the adult trout as they enter the river in the autumn to spawn and harvest the eggs and sperm. These are combined and the resulting trout larvae are raised in aquaculture until they reach app. 15 cm length and begin smoltification, a process where the metabolism and physiology of the trout is fundamentally changed to adapt to the different environmental conditions the trout will experience in the sea[7] where they will forage and grow[8], before they return to spawn in the river as adults. When smoltification is observed in a significant number of the juvenile trout they are transported to the mouth of the river where they are released and able to migrate to the sea. In the river Langvad Å, this work is done by the local associations of Roskilde og Omegns Lystfiske Klub (ROLK) and Foreningen til Ophjælpning af Fiskeriet I Roskilde Fjord, in collaboration with local authorities and stakeholders. In late March and early April each year app. 12.000 juvenile trout are released into the mouth of Langvad Å by members of these associations in the hope that they will contribute to the health and viability of the trout population spawning in Langvad Å. The newly released smolt are vulnerable as they have to adapt from the relative safety and comfort of an aquaculture facility where food is abundant and predators absent, to the sea where they must cope with different physical and chemical conditions including salinity and temperature, find and catch their prey and avoid being predated themselves[9]. This process in analogous but not identical to the natural smolt migration which has been demonstrated to be a vulnerable and critical time in the life cycle of anadromous brown trout[6]. These challenges and predation in particular is assumed to cause high mortality among juvenile trout[10] [6]. Releasing the smolt during the night may allow them to hide from visual predators as the darkness can act as camouflage[11] and night release has been observed to increase survival of Atlantic Salmon smolts[1] which have a similar anadromous behavior and is closely related to brown trout. Members of the angling associations report observing significant numbers of cormorant (*Phalacrocorax carbo*) present at the river mouth in the hours and days after a release event and as this is known to be a main predator of smolt[10]. In addition the river mouth and estuary is known to be areas of high smolt mortality[6], and stakeholders are motivated to optimize the survival of the released smolt which is expected to the increase spawning population[12] and an increase in survival of smolt and post-smolt stages may be crucial to re-establishing and conserving wild populations[6].

Methods

To compare the effects of release in the day and in the night, a survey design was developed in corporation with stakeholders and volunteers from the local angling associations. In preparation for the project, the hydrophones which were placed by collaborators in the research group beginning in 2017 in the survey area in Kattinge bay were serviced on March 29th and a range test was performed in accordance with best practices for testing hydro acoustic equipment in telemetry studies[13] and manufacturer guidelines[14]. The test would give a baseline of the detection distance under local conditions and serve as a basis for assessing the hydrophone arrays in the survey area and confirm that the placement and number of hydrophones were adequate to capture the signals from the migrating smolts. The range test was performed by using one of the smolt transmitters as a test transmitter and suspending it at 1m depth for 5 minutes at 250, 200, 150, 125, 100 and 75m distance from one of the hydrophones in Kattinge bay. The signal data from the hydrophone used in the range test showed no detections as 150m distance but 3 detections at 125m giving a minimum detection distance of more than 125m but less than 150m. Based on this information it was decided to reinforce the hydrophone arrays in Kattinge Bay by placing an additional 3 hydrophones. This would ensure that no smolt could pass through array Kattinge2 or Kattinge5 (see survey area map) without being detected on at least one hydrophone.

A total of app. 12.000 smolts arrived from the aquaculture facility on Sunday April 7th after being transported from Jutland in the western part of Denmark. App. 3.000 smolts were isolated from the group and placed in holding tanks at the angling associations facility “Klækkehuset” near Roskilde Fjord where they were kept in holding tanks. The remaining 9.000 smolts were released immediately into the mouth of Langvad river. The 3.000 smolts which were isolated in the morning would constitute the sample group for the project and would eventually be separated into 10 separate release groups which would be released at 10 separate release events in groups of app. 300 individuals. In each group 6 individuals would carry acoustic transmitters which would transmit unique identification signals at 60s intervals which are detectable by the hydrophones in the survey area.

Figure 1 (left) ID-LP7 Acoustic transmitters from ThelmaBiotel. (right) Vemco VR2W Hydrophone.

The transmitters used in the project were the ID-LP7 from ThelmaBiotel. The transmitters are 7.3mm in diameter and 17mm in length with a weight of 1.8g in air and 1.1g in water. The transmitters output 139dB at a frequency of 69kHz which is a compatible signal frequency with the Vemco VR2W 69kHz hydrophones which were deployed in the survey area. The estimated battery life of the transmitters are 140 days. The transmitters outputs the acoustic a signal every 60 seconds which carries a unique identification number. The signal propagates through the water and is received by the hydrophone which stores the identification number along with a timestamp of when the signal was received in its internal memory. This data accumulates in the hydrophone memory and must be offloaded periodically to retrieve the data. In addition to the harvesting of data, the hydrophones must also be cleaned of biofouling which inhibits the signal and the batteries must be changed. The hydrophones were suspended at app. 1m depth below floating marker bouys, and these also require regular maintenance to ensure they do not become entangled or loosened from their anchors. This periodic service and data collection was performed at approximately 1 month intervals and by the end of the project the positions of the hydrophones in Kattinge bay were measured using GPS to confirm that their placement had not shifted significantly during their deployment. This effort showed that the maximum drift was <40m and for most hydrophones <10m after 5½ months deployment.

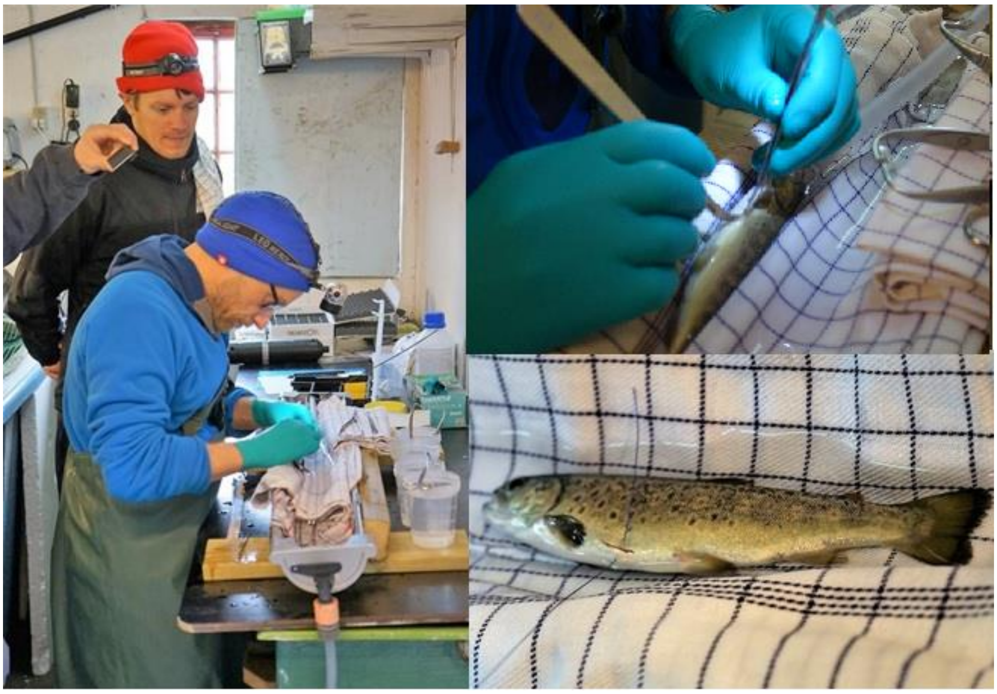

Figure 2 - *Careful implanting of the acoustic transmitters into the gut cavity of the smolts. The fish were anesthetized during the procedure and the incision wound was closed with a single stitch. Only one fish out of 60 was lost due to bleeding during the procedure, at the transmitter was subsequently removed and placed in another specimen.*

The survey was engineered to isolate the effects of the release time and homogenize the treatment and handling of the groups to make the observations as independent and comparable as possible. The survey design aims to investigate the effects of releasing the smolt in the night compared to releasing them during the day. To achieve this, the 5 groups of night fish were released at 21:00 on 5 consecutive nights starting on April 7th and ending on April 11th, 2019. The release time for the night groups was app. 1 hour after sunset and it was confirmed that the conditions were in fact completely dark at this time at the first release event. The day fish were released at 08.00 which was app 1½ hours after sunrise, and in completely light conditions. Prior the release event, a manual survey was conducted with a portable hydrophone, which was placed for app. 5 min at the release site in the channel, and an additional app. 5 minutes at the mouth of the channel. This would reveal if any smolts from the previous releases were still present in the channel where the releases were taking place.

Figure 3 - *Release of smolts showing the capturing of the fish from the holding tanks (top left) - the retrieval of fish from the transport tank at the release site (top right), the smolt in the bucket just prior to release (bottom left) and the deployment of a manual hydrophone at the release site just prior to a release event (bottom right)*

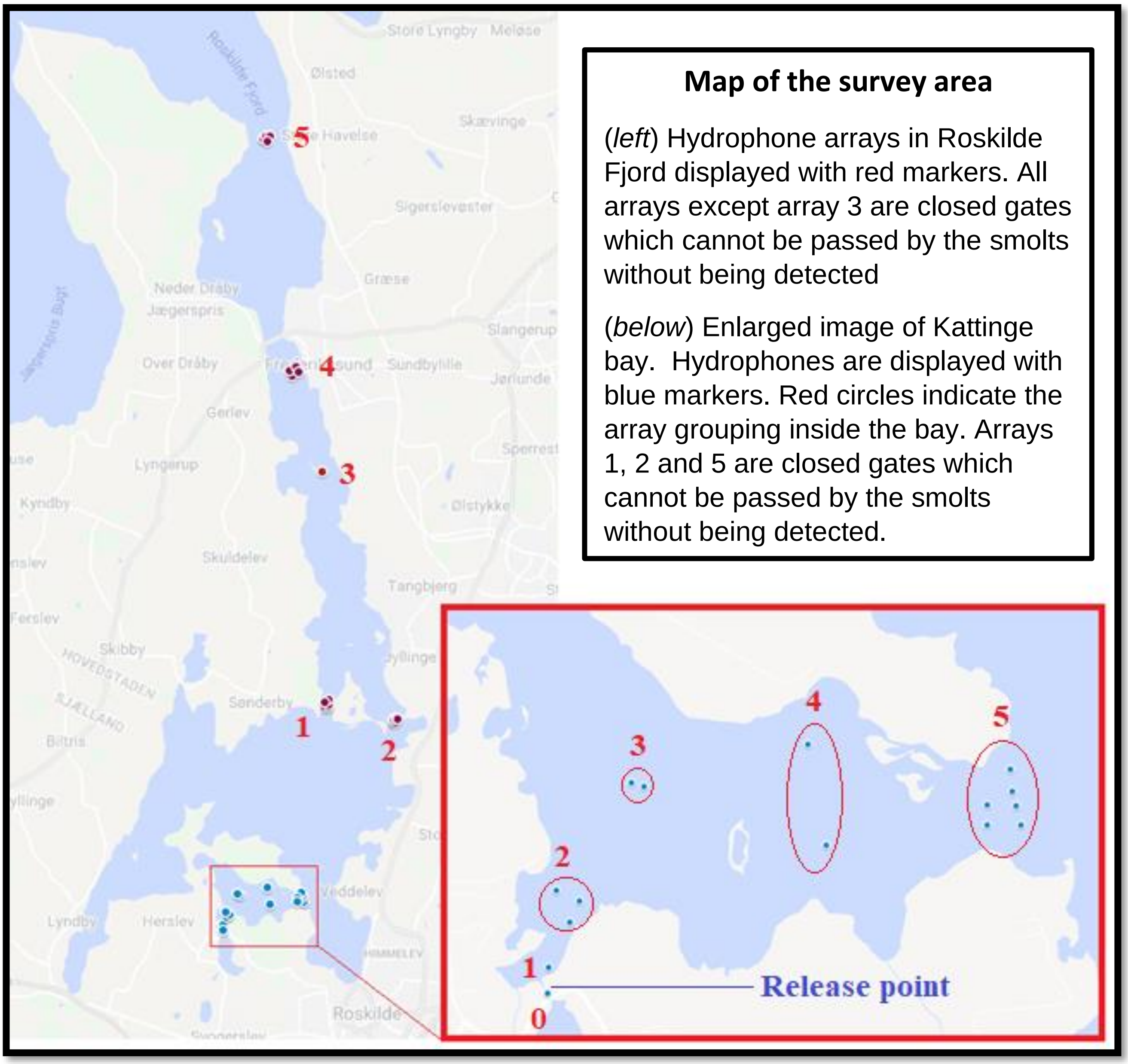

Figure 4 - *Map of the survey area showing the placement of hydrophones. The hydrophones are grouped into arrays with arrays “Kattinge0” to “Kattinge5” displayed in blue markers in the southern end of the survey area, and arrays “Roskilde1” to “Roskilde5” displayed in the central and northern part. For full list of hydrophone coordinates and placement, see appendix.*

Results

Of the 60 smolts released in Langvad Å, 7 individuals (5290, 5299, 5313, 5319, 5322, 5337 and 5342) were not detected on any of the hydrophones in the survey area, but the efforts with the manual receiver showed that 5290 which was released at 08:00 on April 9th was detected at 21:00 the same day at the release site and 5322 which was released at 21:00 on April 10th was similarly detected with the manual receiver the following day at

08:00 on April 11th. One individual (5296) was only detected on a hydrophone placed in a fish ladder in the mouth of Langvad Å and detected only once at 06:00 in the morning, 9 hours after being released on the 8th of April.

Migration through the survey area

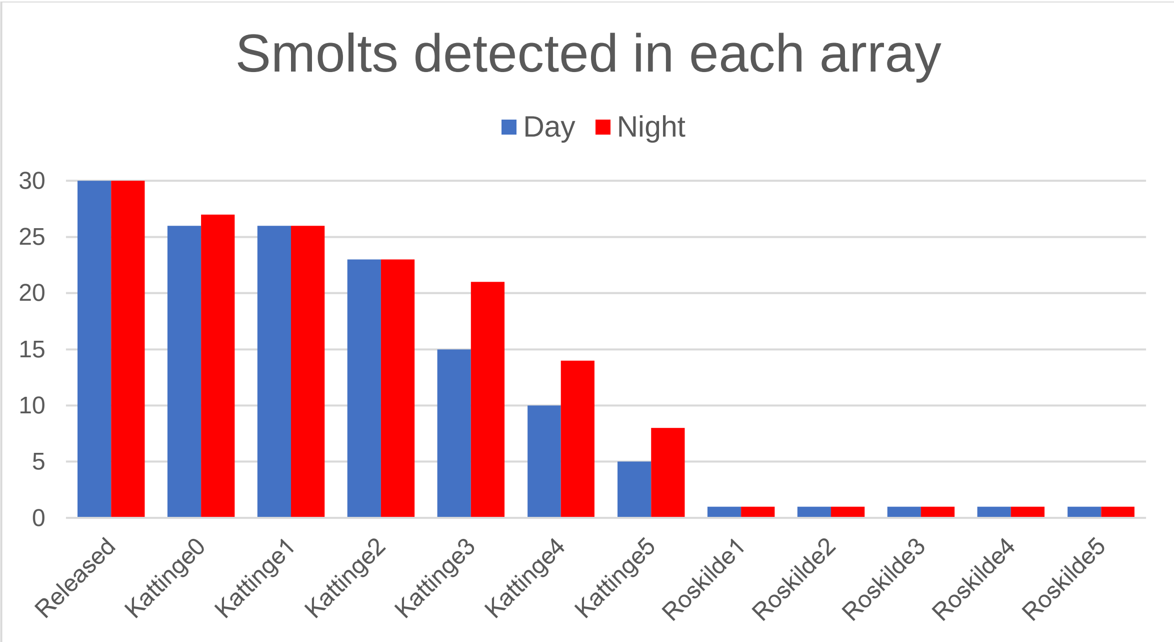

Figure 5 *Number of smolts detected in each hydrophone group, comparing day and night releases.*

The 53 individuals detected in the survey area was distributed symmetrically between night and day releases in the first two arrays, excluding the one detected in the fish ladder. Arrays Kattinge3, Kattinge4 and Kattinge5 showed a difference in the number of fish detected from the day and night groups, with 6, 4 and 3 individuals from the night groups detected in these arrays respectively (see Figure 5). It should be noted that the arrays Kattinge3 and Kattinge4 are open gates and that the smolt can circumvent these arrays and reach Kattinge5 without being detected in arrays Kattinge3 and Kattinge4. Kattinge5 is the gate between Kattinge Bay and the rest of Roskilde Fjord and here a total of 5 individuals from the day group and 8 from the night group were detected for the last time. This indicates that no more than 13 individuals from total sample of 60 smolts left Kattinge Bay and into Roskilde Fjord during the survey period. The arrays in Roskilde Fjord only detected 2 of the 13 smolt that left Kattinge Bay and one was released in the day and the other in the night and both made it all the way out of Roskilde Fjord (see Figure 6).

Qualitative examples

Two individuals left the survey area and thus succeeded in completing a migration run out of Roskilde Fjord toward the Kattegat sea or Isefjorden taking 6 and 8 weeks to leave the survey area post release.

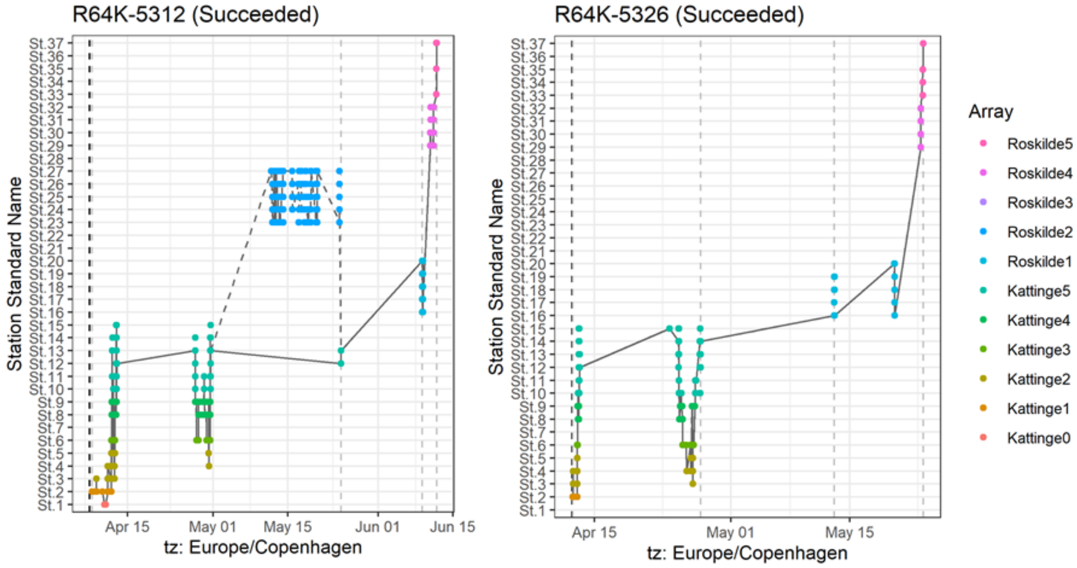

Figure 6 *The two individuals that left the survey area and migrated all the way out of Roskilde Fjord. 5312 (left) was detected east of Eskilsø around May 15th and was detected in the mouth of Kattinge bay before leaving west of Eskilsø and exiting Roskilde Fjord around June 15th . 5326 (right) left Kattinge Bay and was detected twice west of Eskilsø before leaving Roskilde Fjord in the end of May.*

The 13 individuals that were detected in the mouth of Kattinge Bay for the last time had all left Kattinge Bay within 4 days post release and the fastest leaving Kattinge Bay in around 24h. (see figure 7)

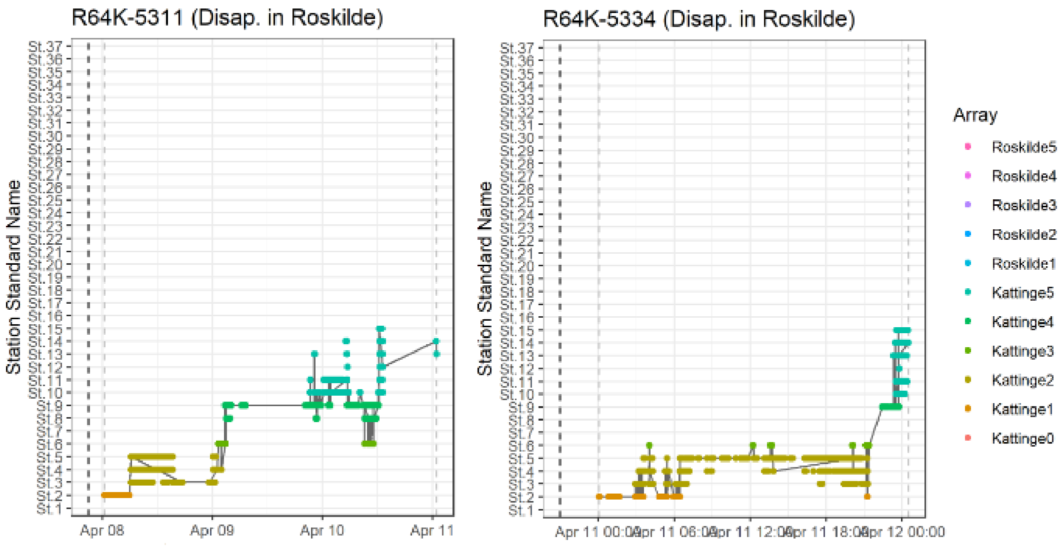

Figure 7 *- Two of the 13 fish that left Kattinge Bay and disappeared in Roskilde Fjord south of Eskilsø.*

The remaining 31 smolts were lost between the first hydrophone array after the release point and the exit of Kattinge Bay and in this group 29 were lost within one week post release (see figure 8).

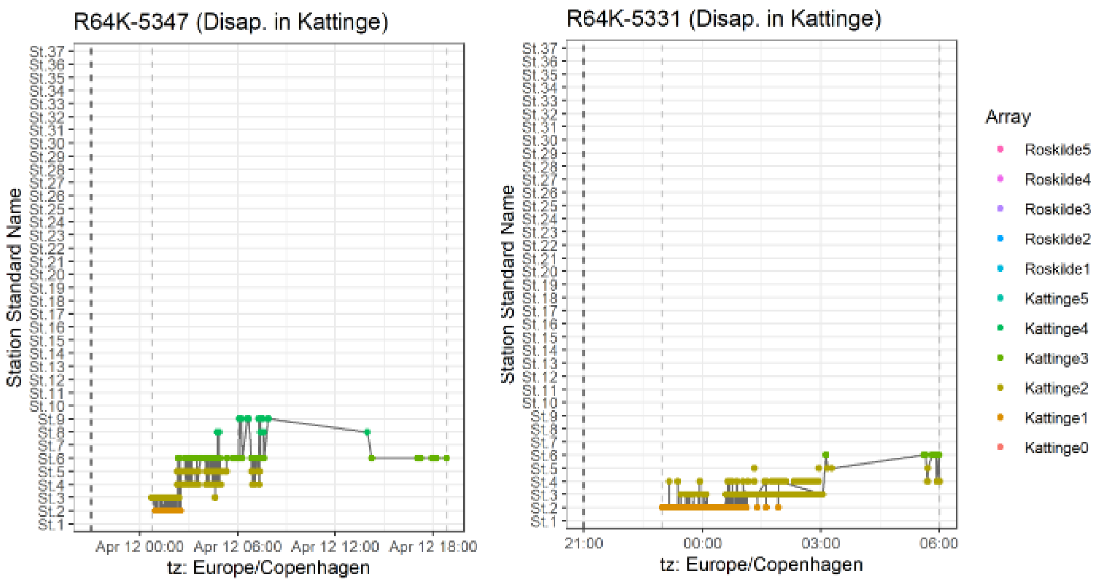

Figure 8 *Examples of the smolts that were lost in Kattinge Bay.*

For full list of figures showing the individual observations for each smolt - see appendix.

Timing of movement

Different timing of movement was observed for both groups released in the night and in the day (see figure 9). In the first array (Kattinge1), proximal to the release site, a clear difference between the time of first detection for the night and day fish was observed. The fish released in the day are detected from 10:00 till just after sunset at 21:00 with a mean around noon at 12:00. The night fish display the opposite with most movement between 22:00 and 04:00 and a mean around 01:00. This difference is likely induced by the different release time and show that the time of first movement is determined by the time of release. In the second array (Kattinge2) the time of movement is relatively unchanged for the night group, which I still being detected for the first time during the night, with a mean around 01:30, but the day group has shifted toward moving during the night with a mean around 01:00. However, close to 30% of the day fish are moving between 10:00 and 12:00 which is in contrast to the night fish where only a few are moving in the early morning between 06:00 and 07:00 which is the first hour after sunrise, and the rest being detected for the first time during the night. In array Kattinge3, both groups are moving during the night and in Kattinge4, a similar pattern to Kattinge2 is observed where both groups primarily move during the night, but with some fish in the day group moving after sunrise but before noon. In Kattinge5, there is movement from both groups during the day, but the night group is mostly detected for the first time in the night, and the day group is mostly detected for the first time during the day.

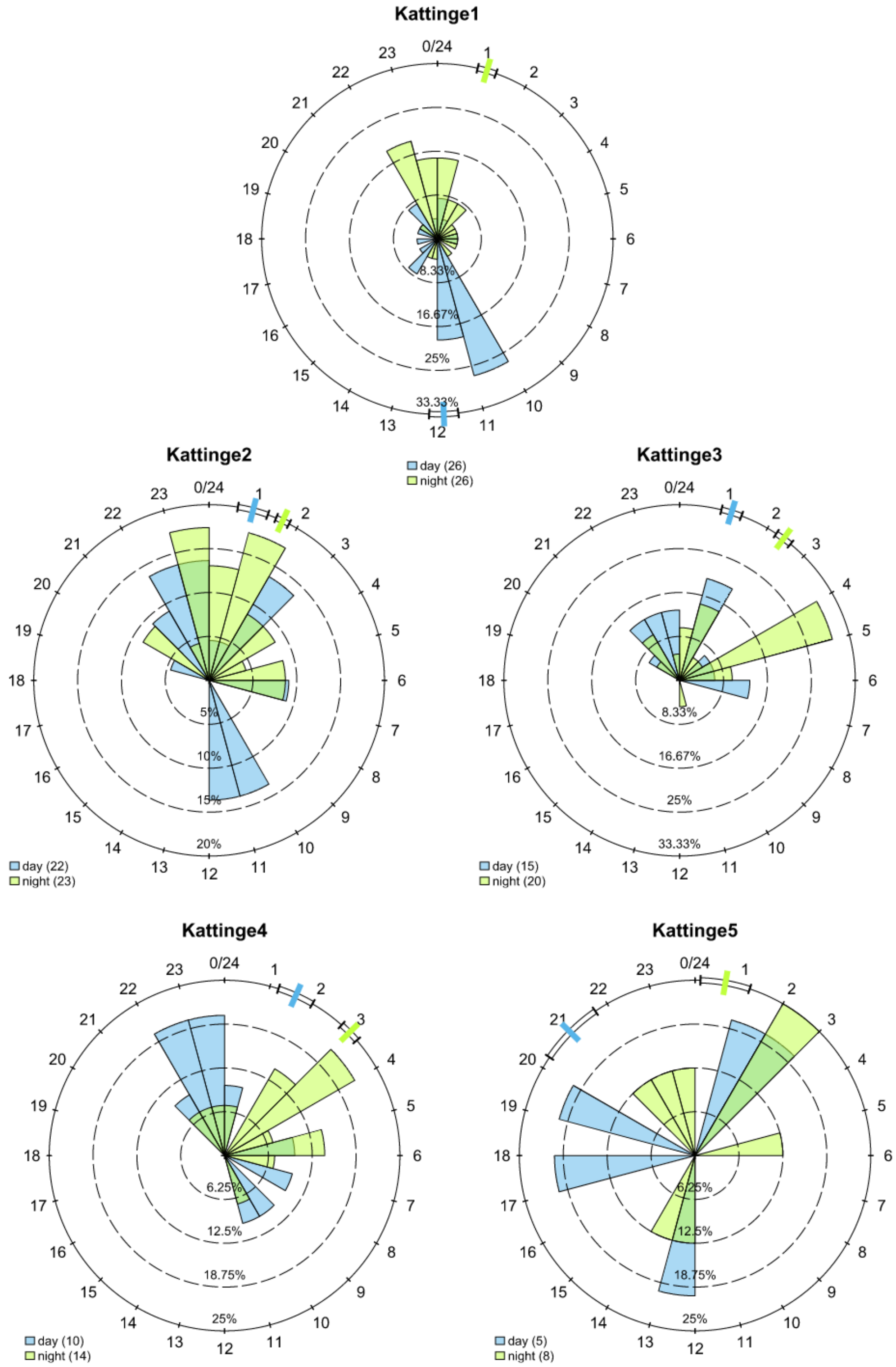

Figure 9 *- Time of first detection for each hydrophone array in Kattinge Bay.*

Discussion

The immediate loss of 8 fish before the first hydrophone, of which 2 were detected with the manual receiver app. 12 hours post release at the release site, but never again, suggest that these individuals are removed from the water very soon after the release. If they had succumbed to physiological stress or had been predated by aquatic predators, it is assumed that signals would be received by the manual surveys taking place prior to the release events, or by hydrophones in the survey area. If the smolts had died and were laying in the water at the release site, the manual receiver would pick up their signals during the manual surveys. The first hydrophone (group Kattinge01) is only 75m from the release site but is blocked by a blind angle and the smolt need to exit the river mouth channel before being in line of sight to the hydrophone. These observations suggest that the 8 fish which is not detected in Kattinge Bay are lost to predation in the channel within 24 hours post release. The findings are in agreement with studies on smolt survival which indicate that there is high mortality associated with the migration from river to sea[6].The overall number of smolts detected by each hydrophone array and presented in Figure 5, indicates that a greater number of night fish are detected and that they make it further. The array in the mouth of Kattinge Bay has detections from 8 night and 5 day fish indicating a somewhat higher success rate of making it out of Kattinge Bay. The tendency is not very strong however, and further studies should be conducted to investigate this effect in more detail.

The time of first detection presented in figure 9 demonstrates that the time of release affects the time when the smolts are active and are migrating. The smolts generally seem to prefer travelling during the night which has been observed in other studies of smolt migration[6], but whereas the night group demonstrates a strong tendency toward migrating at night, there is a significant portion of the day group that is travelling during the day. This can potentially expose them to a greater risk of predation from visual predators and thus be a sub optimal strategy.

Conclusions

In summary this analysis does not indicate a substantial improvement in survival or fitness for the night group compared to the day group. Though the results indicate that there is significant mortality shortly after release, and that the time of release affects the timing of movement of the smolts in the days following the release, the overall survival and success rate does not differ greatly. The most significant result is the difference between 5 smolt from the day group and 8 smolt from the night group leaving Kattinge Bay. This indicate that there might be an effect, and the overall tendency in all arrays is shifted in favor of the night group. The sample size is unfortunately too small to capture a weak effect, so further studies should be attempted to strengthen the data set. In addition, qualitative studies of predation of juvenile trout in Roskilde Fjord and Kattinge Bay may point to areas of interest which can explain the observed effects in greater detail and could optimize the survey design to capture unobserved effects. It must be noted that the general picture is one of high mortality among the newly released smolt. The fact that 47 of the smolt are lost in Kattinge Bay and that 45 of those are lost within the first week post release, indicates that the survival of the smolts is low and that any improvements herein may yield substantial gains in stocking efficiency as each individual smolt contributes to a substantial increase in spawning population[10 12]. The findings of this project suggest that if resources permit, there can be some advantage gained by releasing smolt during the night, though the increase may not be dramatic.

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Appendix

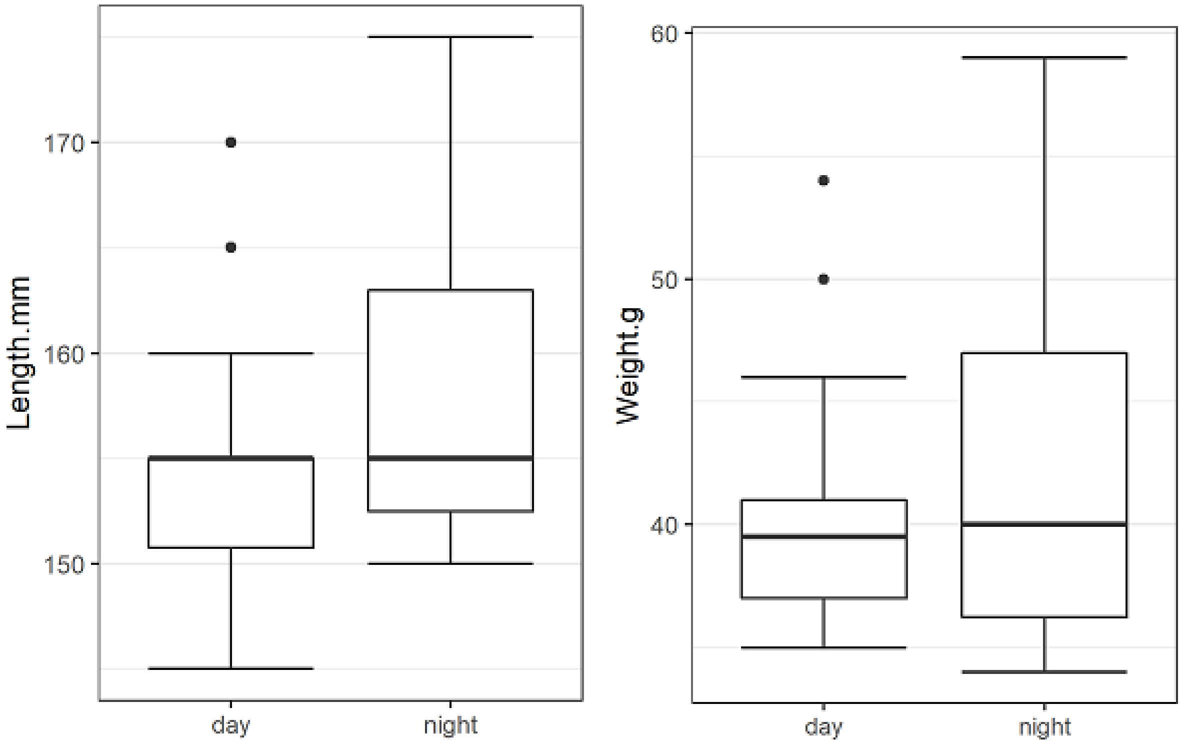
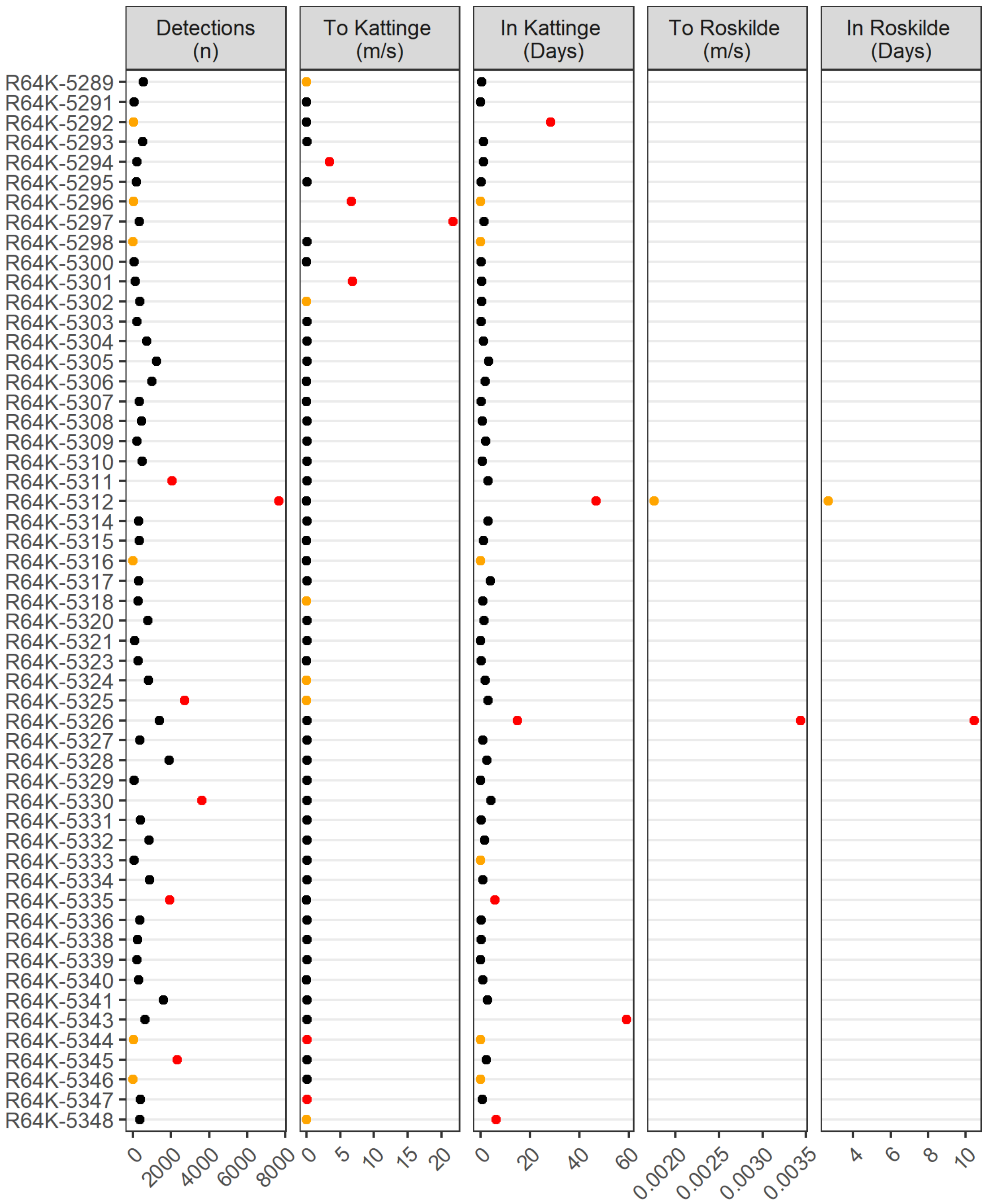
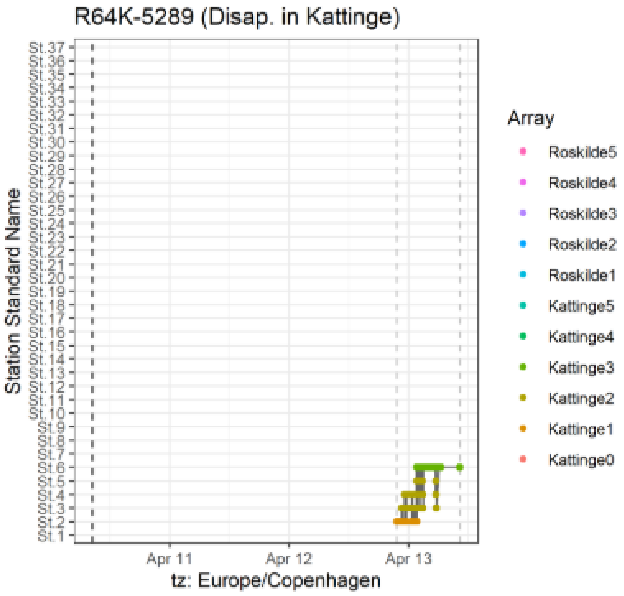


***Figure 10** - Length and weight distribution of the smolts in the night and day groups.*

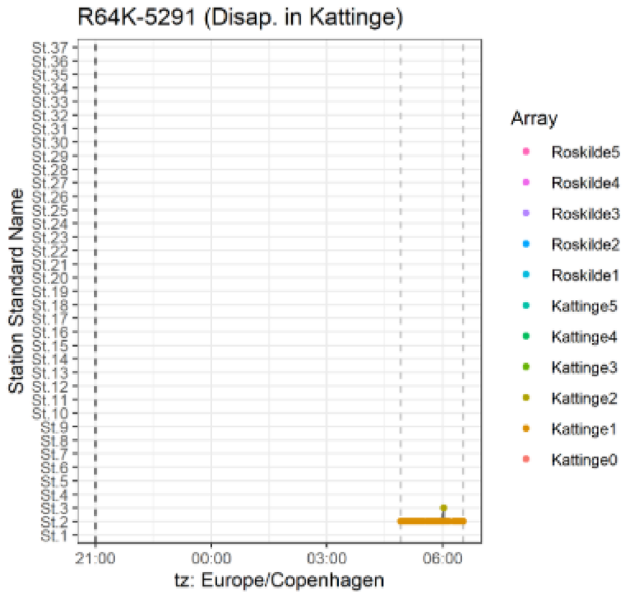
Time of release					Summary	
Day		Night			ID	
Date	**ID**	**Date**	**ID**		**Day**	**Night**
08-04-2019	*5310*	07-04-2019	*5305*		*5289*	*5291*
08-04-2019	*5306*	07-04-2019	*5297*		*5290*	*5293*
08-04-2019	*5313*	07-04-2019	*5312*		*5292*	*5295*
08-04-2019	*5314*	07-04-2019	*5311*		*5294*	*5296*
08-04-2019	*5309*	07-04-2019	*5301*		*5298*	*5297*
08-04-2019	*5318*	07-04-2019	*5304*		*5299*	*5300*
09-04-2019	*5299*	08-04-2019	*5315*		*5306*	*5301*
09-04-2019	*5290*	08-04-2019	*5320*		*5307*	*5302*
09-04-2019	*5294*	08-04-2019	*5302*		*5308*	*5303*
09-04-2019	*5292*	08-04-2019	*5316*		*5309*	*5304*
09-04-2019	*5307*	08-04-2019	*5296*		*5310*	*5305*
09-04-2019	*5308*	08-04-2019	*5293*		*5313*	*5311*
10-04-2019	*5346*	09-04-2019	*5300*		*5314*	*5312*
10-04-2019	*5325*	09-04-2019	*5291*		*5318*	*5315*
10-04-2019	*5337*	09-04-2019	*5317*		*5321*	*5316*
10-04-2019	*5289*	09-04-2019	*5303*		*5323*	*5317*
10-04-2019	*5327*	09-04-2019	*5295*		*5324*	*5319*
10-04-2019	*5348*	09-04-2019	*5319*		*5325*	*5320*
11-04-2019	*5321*	10-04-2019	*5330*		*5326*	*5322*
11-04-2019	*5323*	10-04-2019	*5331*		*5327*	*5328*
11-04-2019	*5335*	10-04-2019	*5340*		*5333*	*5329*
11-04-2019	*5341*	10-04-2019	*5322*		*5335*	*5330*
11-04-2019	*5343*	10-04-2019	*5336*		*5337*	*5331*
11-04-2019	*5339*	10-04-2019	*5334*		*5338*	*5332*
12-04-2019	*5326*	11-04-2019	*5332*		*5339*	*5334*
12-04-2019	*5324*	11-04-2019	*5342*		*5341*	*5336*
12-04-2019	*5333*	11-04-2019	*5328*		*5343*	*5340*
12-04-2019	*5338*	11-04-2019	*5329*		*5344*	*5342*
12-04-2019	*5298*	11-04-2019	*5347*		*5346*	*5345*
12-04-2019	*5344*	11-04-2019	*5345*		*5348*	*5347*

Station.Name	Receiver	Longitude	Latitude	Array
St.1	134381	1.201.173	5.566.689	Kattinge0
St.2	104628	1.201.180	5.566.820	Kattinge1
St.3	106074	1.201.363	5.567.043	Kattinge2
St.4	134378	1.201.455	5.567.158	Kattinge2
St.5	134380	1.201.272	5.567.219	Kattinge2
St.6	132665	1.202.032	5.567.717	Kattinge3
St.7	131068	1.201.906	5.567.711	Kattinge3
St.8	132668	1.203.483	5.567.933	Kattinge4
St.9	124173	1.203.633	5.567.452	Kattinge4
St.10	106080	1.205.058	5.567.627	Kattinge5
St.11	106072	1.205.085	5.567.530	Kattinge5
St.12	134379	1.205.291	5.567.805	Kattinge5
St.13	132669	1.205.315	5.567.690	Kattinge5
St.14	132666	1.205.302	5.567.625	Kattinge5
St.15	131071	1.205.315	5.567.525	Kattinge5
St.16	131078	1.206.487	5.573.330	Roskilde1
St.17	131080	1.206.497	5.573.466	Roskilde1
St.18	131073	1.206.697	5.573.312	Roskilde1
St.19	131077	1.206.705	5.573.408	Roskilde1
St.20	106073	1.206.712	5.573.558	Roskilde1
St.21	131076	1.210.075	5.572.817	Roskilde2
St.22	100480	1.210.245	5.572.860	Roskilde2
St.23	103411	1.210.063	5.572.895	Roskilde2
St.24	131069	1.210.167	5.572.928	Roskilde2
St.25	106078	1.210.150	5.572.987	Roskilde2
St.26	131079	1.210.262	5.573.022	Roskilde2
St.27	131070	1.210.368	5.572.977	Roskilde2
St.28	132671	1.206.372	5.580.378	Roskilde3
St.29	100478	1.204.785	5.583.222	Roskilde4
St.30	124172	1.205.138	5.583.317	Roskilde4
St.31	131075	1.204.680	5.583.360	Roskilde4
St.32	103419	1.205.013	5.583.470	Roskilde4
St.33	131072	1.203.508	5.590.203	Roskilde5
St.34	123478	1.203.253	5.590.250	Roskilde5
St.35	132664	1.203.278	5.590.257	Roskilde5
St.36	103417	1.203.445	5.590.347	Roskilde5
St.37	104627	1.203.612	5.590.338	Roskilde5

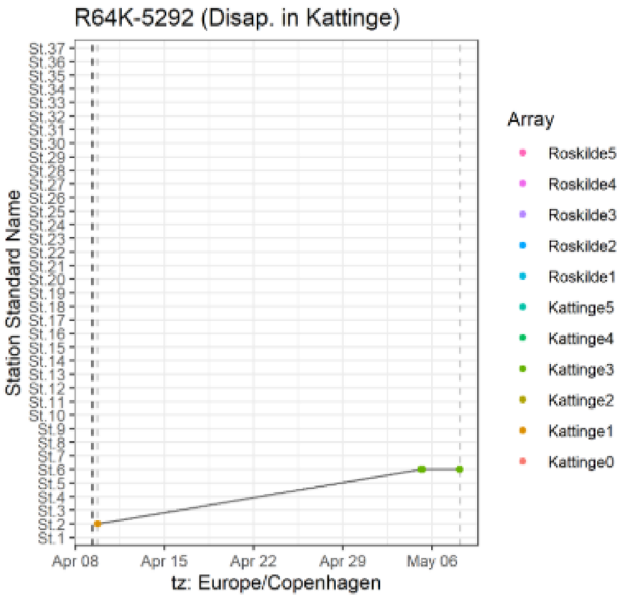

Detections (n)
To Kattinge (m/s)
In Kattinge (Days)
To Roskilde (m/s)
In Roskilde (Days)
R64K-5289
R64K-5291
R64K-5292
R64K-5293
R64K-5294
R64K-5295
R64K-5296
R64K-5297
R64K-5298
R64K-5300
R64K-5301
R64K-5302
R64K-5303
R64K-5304
R64K-5305
R64K-5306
R64K-5307
R64K-5308
R64K-5309
R64K-5310
R64K-5311
R64K-5312
R64K-5314
R64K-5315
R64K-5316
R64K-5317
R64K-5318
R64K-5320
R64K-5321
R64K-5323
R64K-5324
R64K-5325
R64K-5326
R64K-5327
R64K-5328
R64K-5329
R64K-5330
R64K-5331
R64K-5332
R64K-5333
R64K-5334
R64K-5335
R64K-5336
R64K-5338
R64K-5339
R64K-5340
R64K-5341
R64K-5343
R64K-5344
R64K-5345
R64K-5346
R64K-5347
R64K-5348
0
2000
4000
6000
8000
0
5
10
15
20
0
20
40
60
0.0020
0.0025
0.0030
0.0035
4
6
8
10



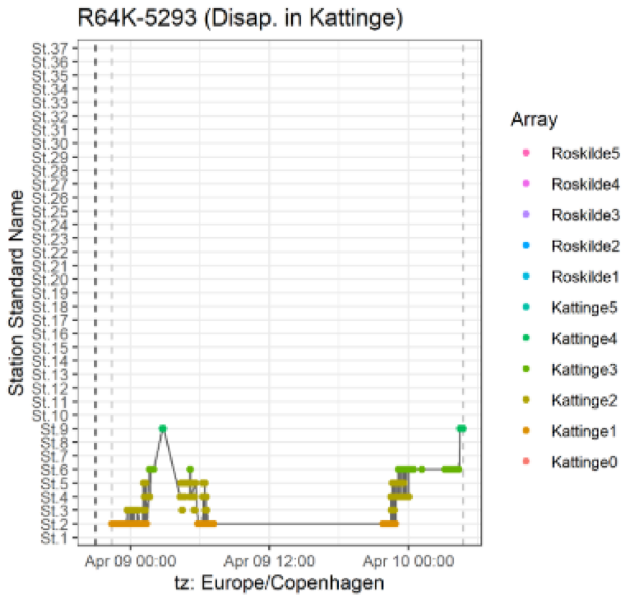
R64K-5289 (Disap. in Kattinge)
Station Standard Name
Apr 11
Apr 12
Apr 13
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0



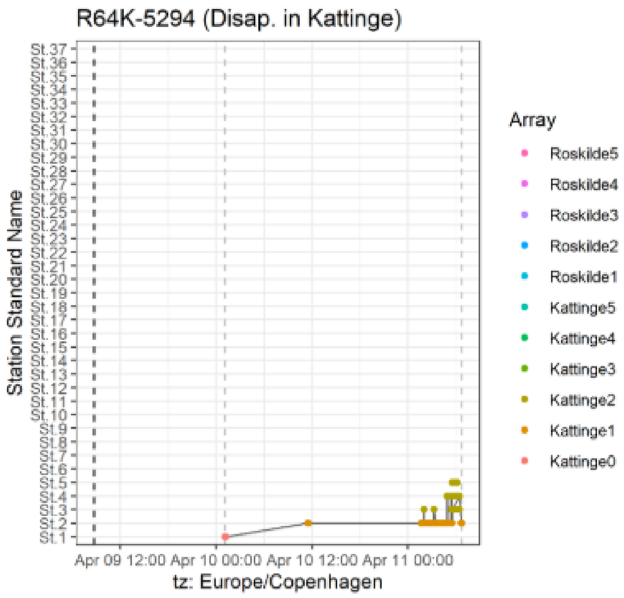
R64K-5291 (Disap. in Kattinge)
Station Standard Name
21:00
00:00
03:00
06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

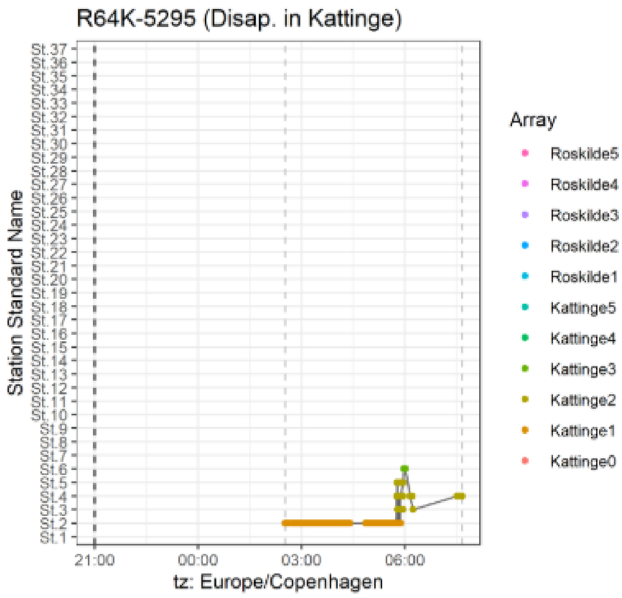


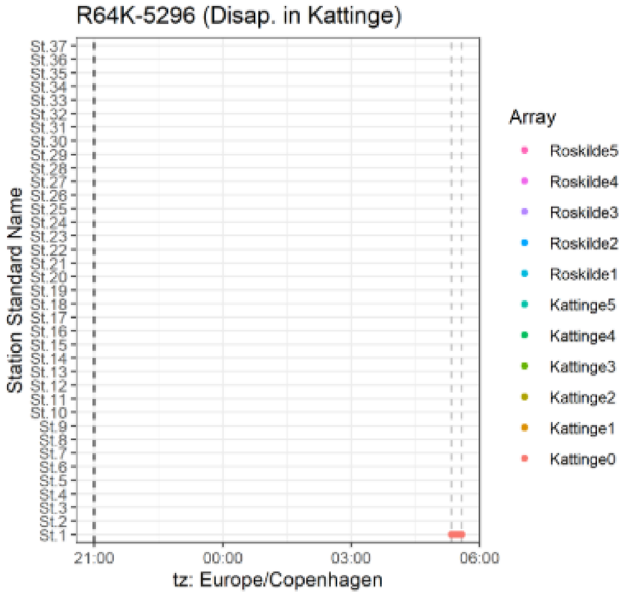
R64K-5292 (Disap. in Kattinge)
Station Standard Name
Apr 08
Apr 15
Apr 22
Apr 29
May 06
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

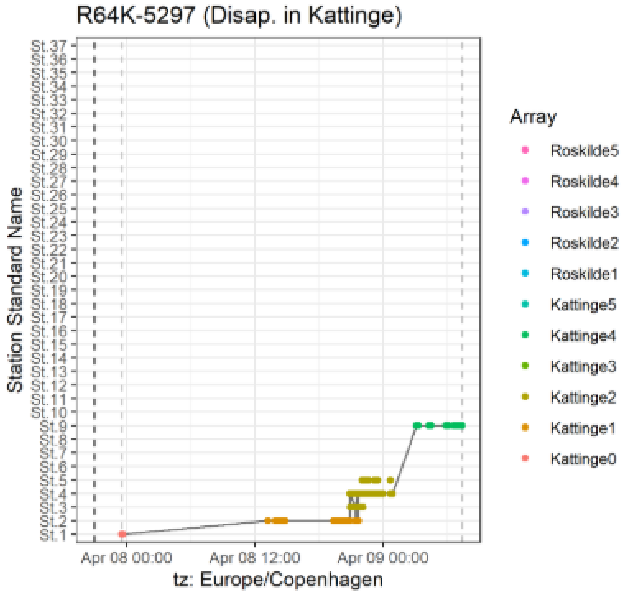


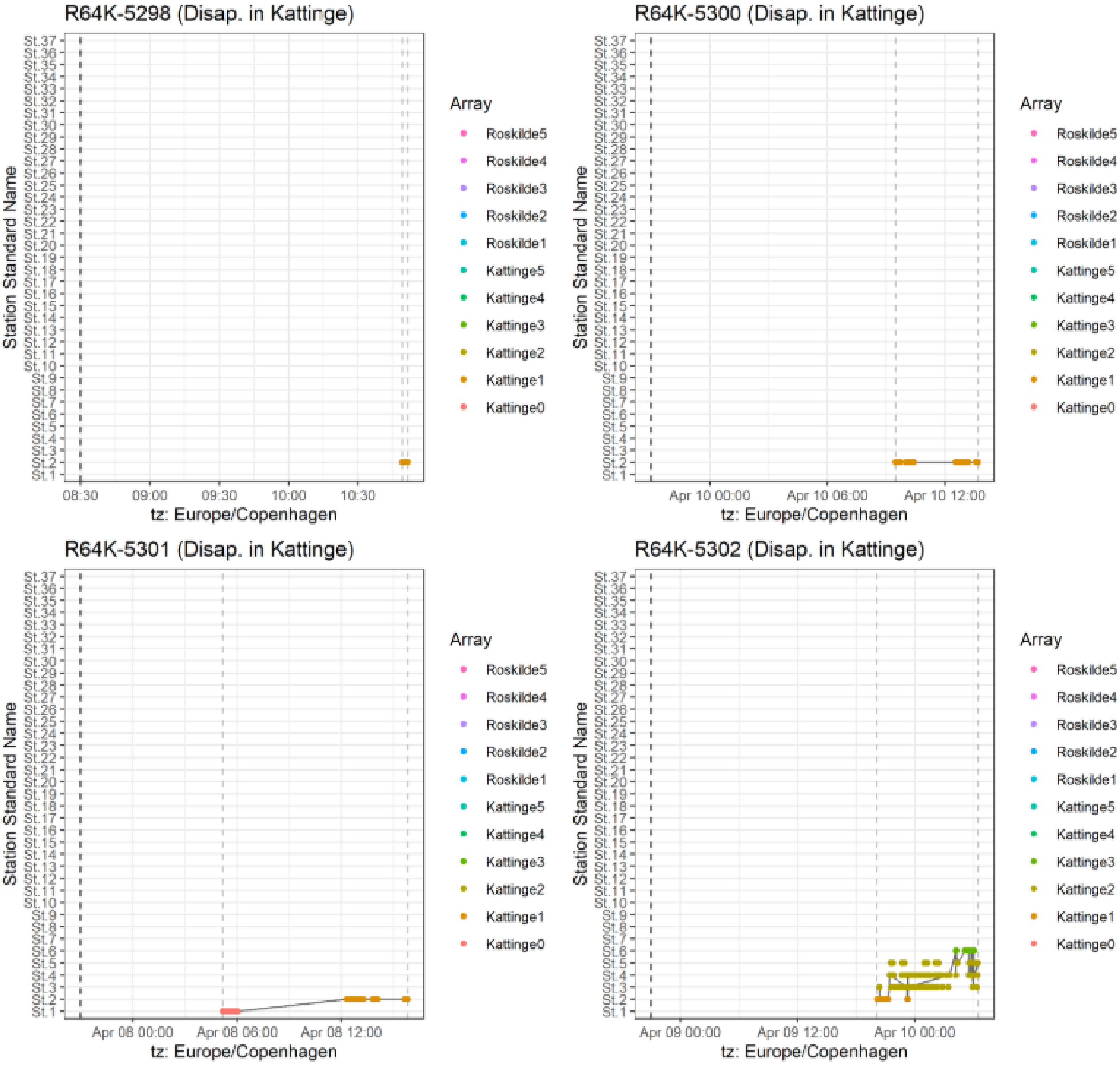
R64K-5293 (Disap. in Kattinge)
Station Standard Name
Apr 09 00:00
Apr 09 12:00
Apr 10 00:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

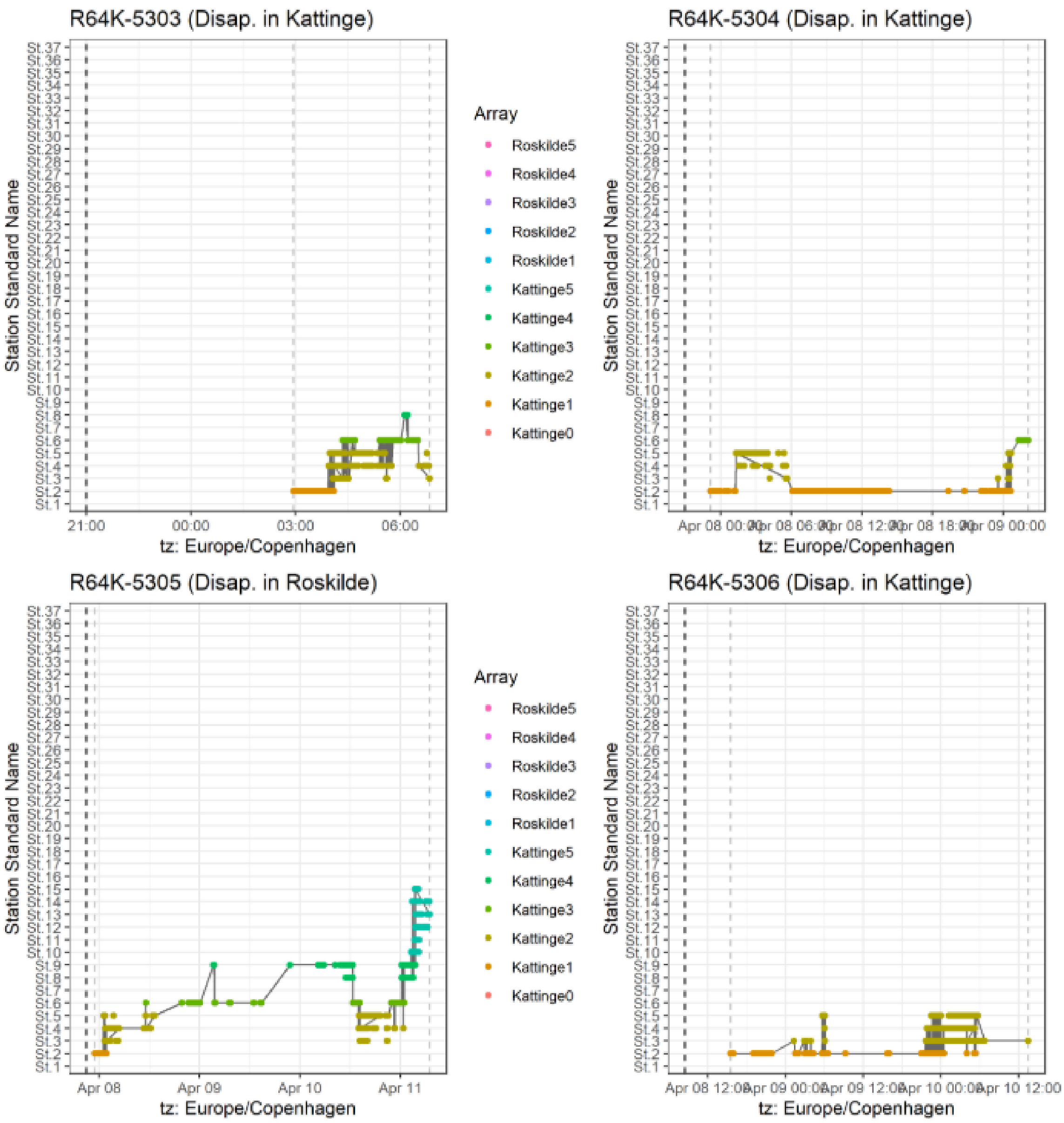

R64K-5294 (Disap. in Kattinge)
Station Standard Name
Apr 09 12:00
Apr 10 00:00
Apr 10 12:00
Apr 11 00:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

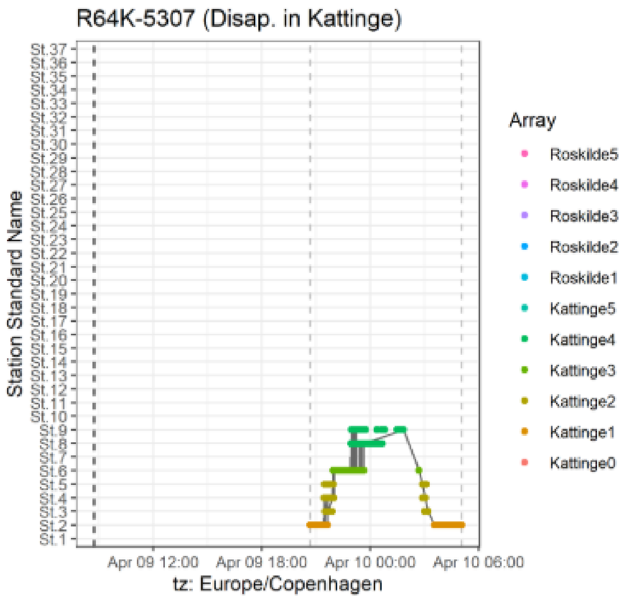

R64K-5295 (Disap. in Kattinge)
Station Standard Name
21:00
00:00
03:00
06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

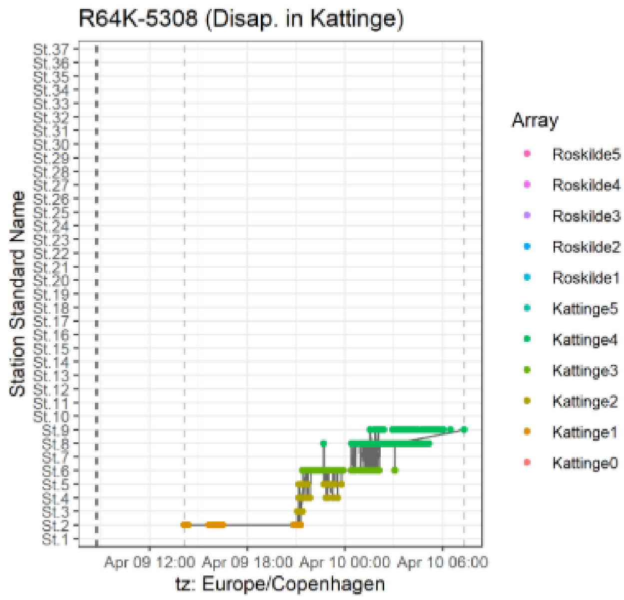

R64K-5296 (Disap. in Kattinge)
Station Standard Name
21:00
00:00
03:00
06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

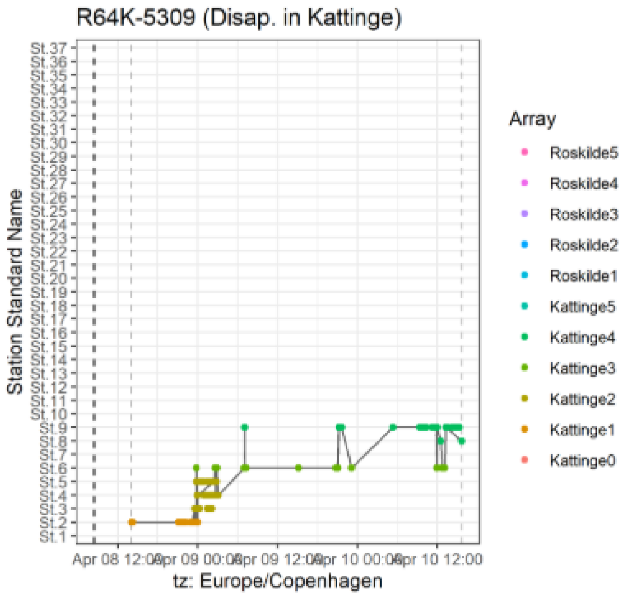

R64K-5297 (Disap. in Kattinge)
Station Standard Name
Apr 08 00:00
Apr 08 12:00
Apr 09 00:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

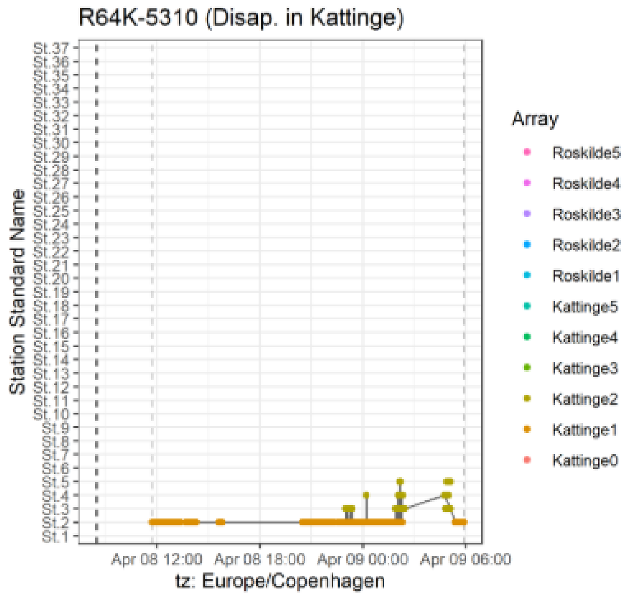

R64K-5298 (Disap. in Kattinge)
Station Standard Name
08:30
09:00
09:30
10:00
10:30
tz: Europe/Copenhagen
R64K-5300 (Disap. in Kattinge)
Apr 10 00:00
Apr 10 06:00
Apr 10 12:00
R64K-5301 (Disap. in Kattinge)
Apr 08 00:00
Apr 08 06:00
Apr 08 12:00
R64K-5302 (Disap. in Kattinge)
Apr 09 00:00
Apr 09 12:00
Apr 10 00:00
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

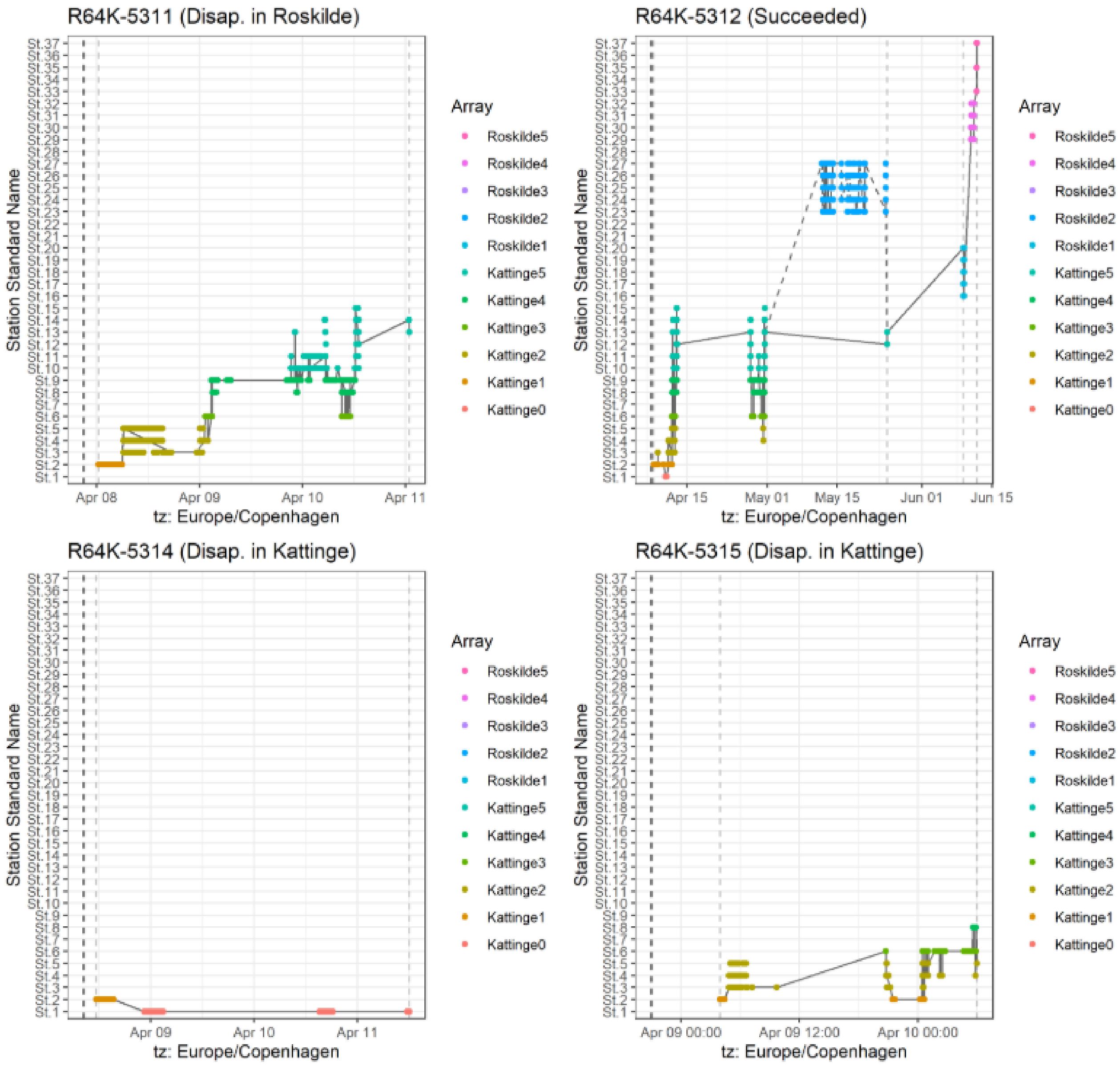

R64K-5303 (Disap. in Kattinge)
R64K-5304 (Disap. in Kattinge)
R64K-5305 (Disap. in Roskilde)
R64K-5306 (Disap. in Kattinge)
Station Standard Name
St.1 … St.37
tz: Europe/Copenhagen
21:00
00:00
03:00
06:00
Apr 08 00:00
Apr 08 06:00
Apr 08 12:00
Apr 08 18:00
Apr 09 00:00
Apr 08
Apr 09
Apr 10
Apr 11
Apr 08 12:00
Apr 09 00:00
Apr 09 12:00
Apr 10 00:00
Apr 10 12:00
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0


R64K-5307 (Disap. in Kattinge)
Station Standard Name
Apr 09 12:00
Apr 09 18:00
Apr 10 00:00
Apr 10 06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

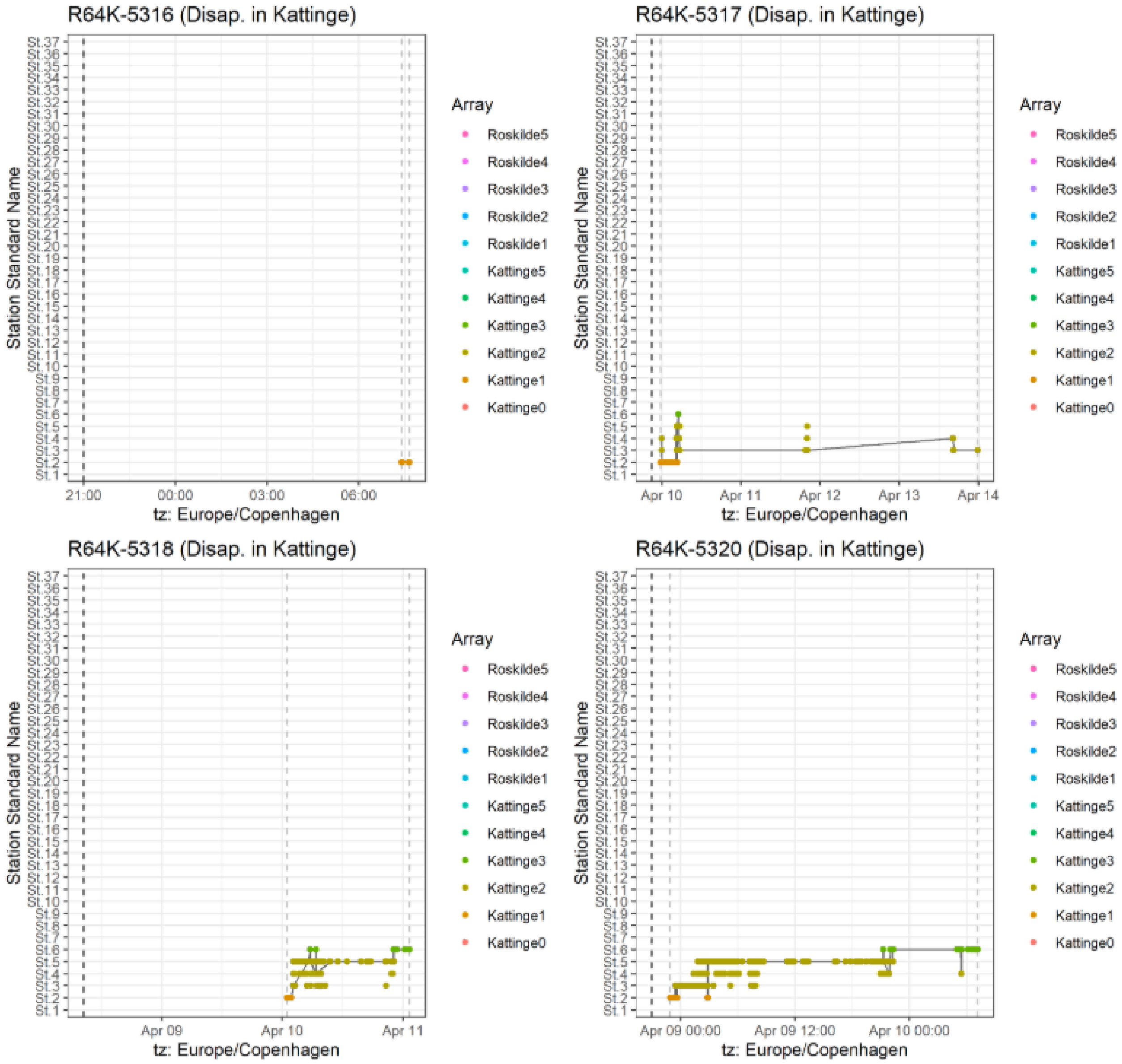

R64K-5308 (Disap. in Kattinge)
Station Standard Name
Apr 09 12:00
Apr 09 18:00
Apr 10 00:00
Apr 10 06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

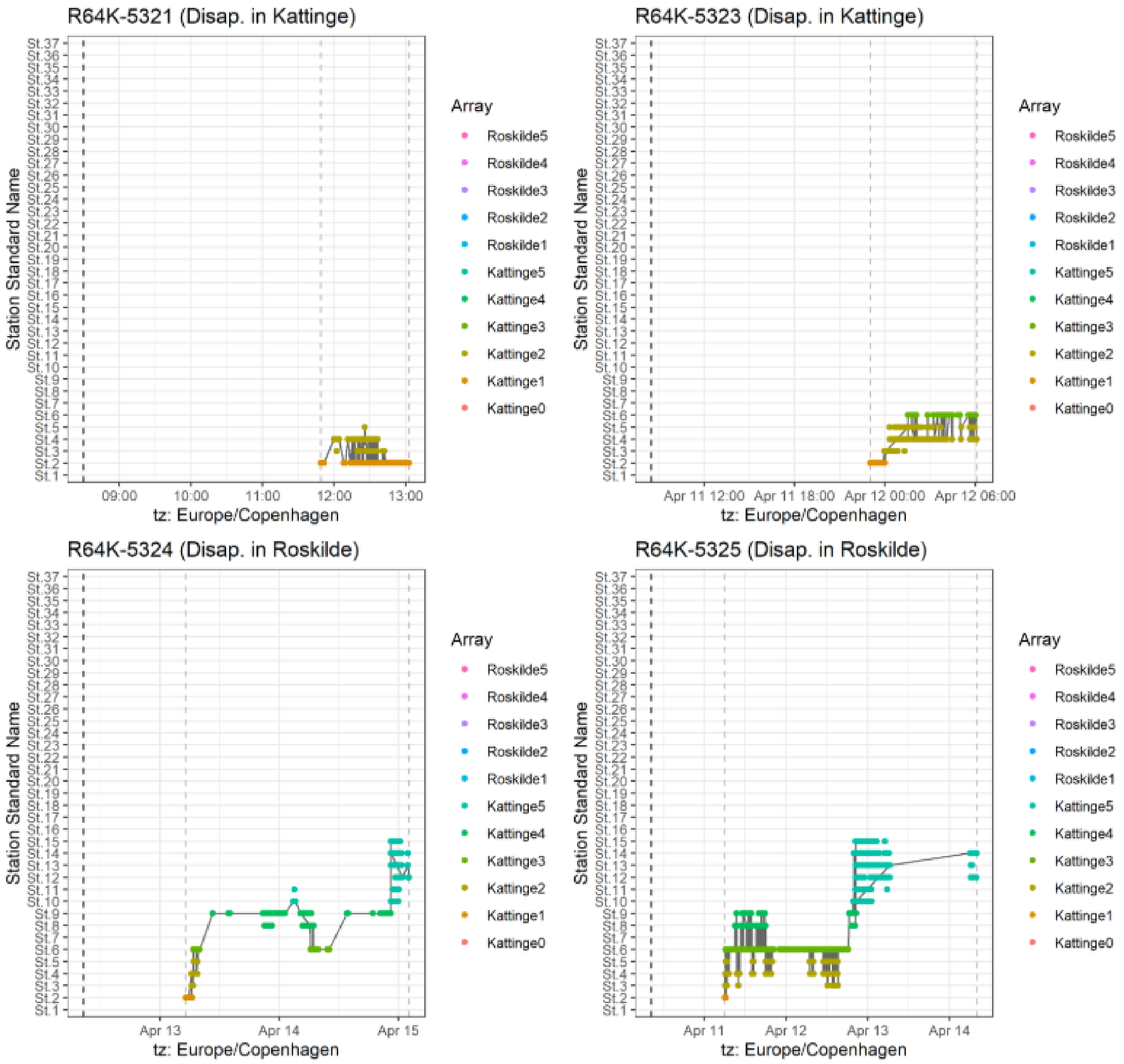

R64K-5309 (Disap. in Kattinge)
Station Standard Name
Apr 08 12:00
Apr 09 00:00
Apr 09 12:00
Apr 10 00:00
Apr 10 12:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

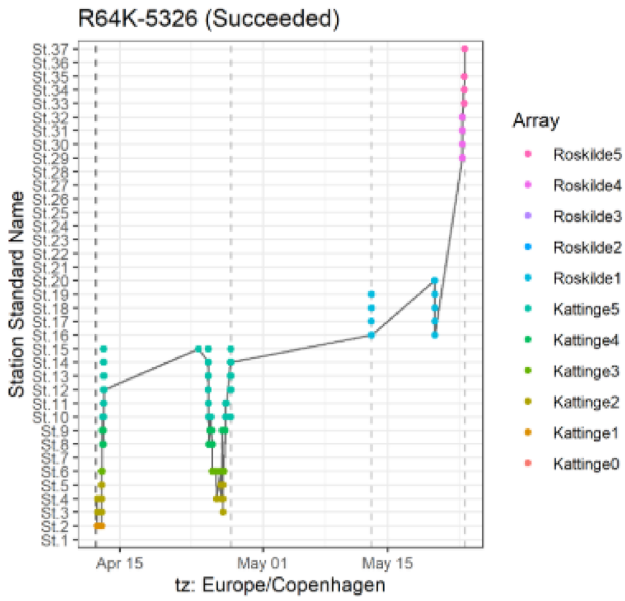

R64K-5310 (Disap. in Kattinge)
Station Standard Name
Apr 08 12:00
Apr 08 18:00
Apr 09 00:00
Apr 09 06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

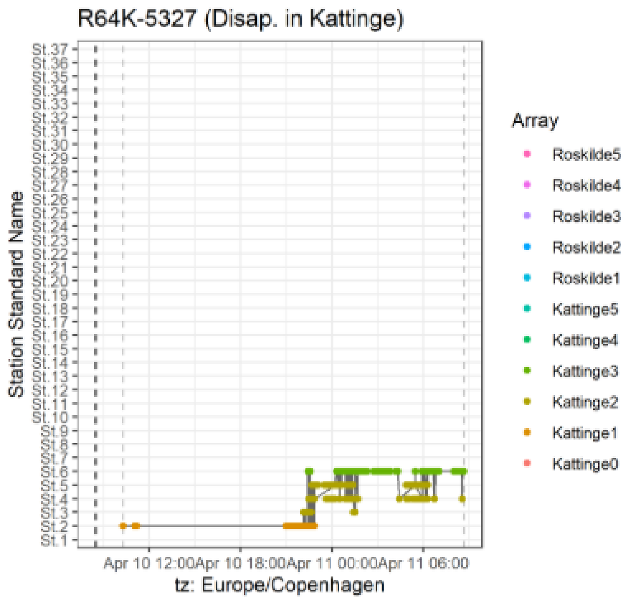


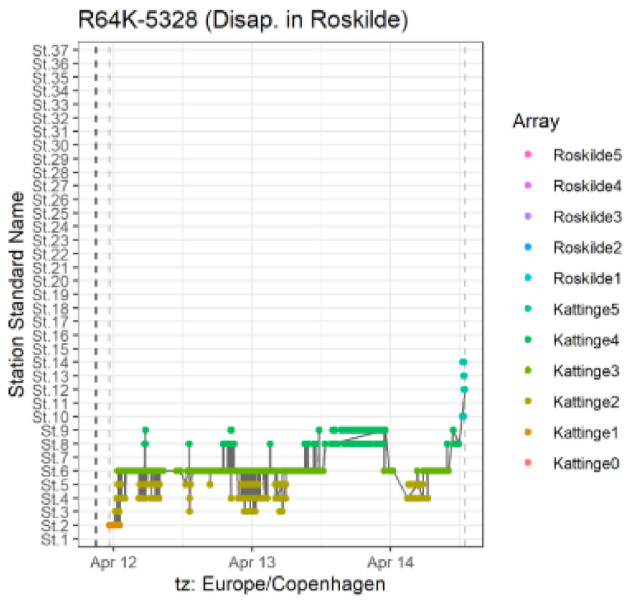
R64K-5311 (Disap. in Roskilde)
R64K-5312 (Succeeded)
R64K-5314 (Disap. in Kattinge)
R64K-5315 (Disap. in Kattinge)
Station Standard Name
tz: Europe/Copenhagen
Apr 08
Apr 09
Apr 10
Apr 11
Apr 15
May 01
May 15
Jun 01
Jun 15
Apr 09 00:00
Apr 09 12:00
Apr 10 00:00
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

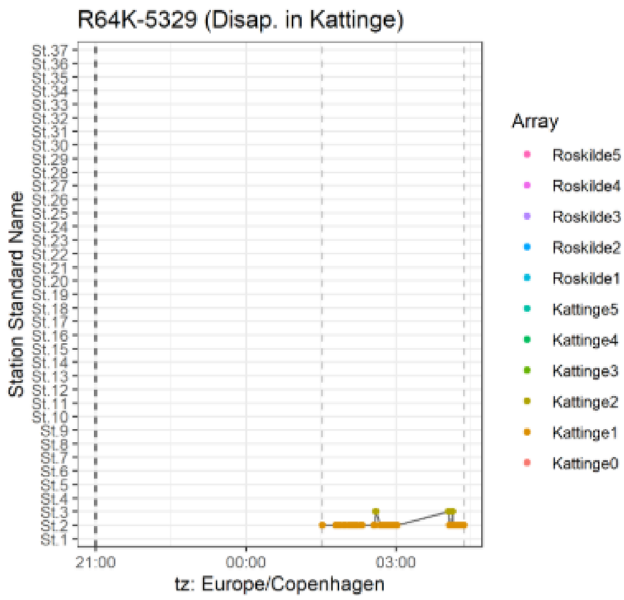

R64K-5316 (Disap. in Kattinge)
R64K-5317 (Disap. in Kattinge)
R64K-5318 (Disap. in Kattinge)
R64K-5320 (Disap. in Kattinge)
Station Standard Name
tz: Europe/Copenhagen
21:00
00:00
03:00
06:00
Apr 09
Apr 10
Apr 11
Apr 12
Apr 13
Apr 14
Apr 09 00:00
Apr 09 12:00
Apr 10 00:00
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

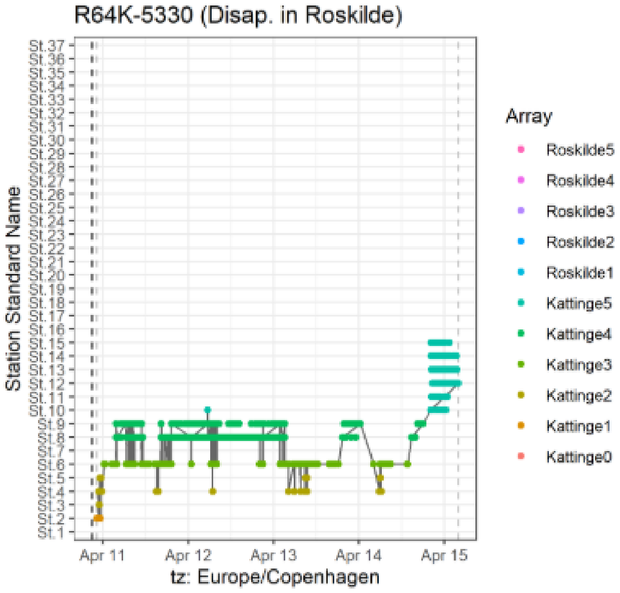

R64K-5321 (Disap. in Kattinge)
R64K-5323 (Disap. in Kattinge)
R64K-5324 (Disap. in Roskilde)
R64K-5325 (Disap. in Roskilde)
Station Standard Name
tz: Europe/Copenhagen
09:00
10:00
11:00
12:00
13:00
Apr 11 12:00
Apr 11 18:00
Apr 12 00:00
Apr 12 06:00
Apr 13
Apr 14
Apr 15
Apr 11
Apr 12
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

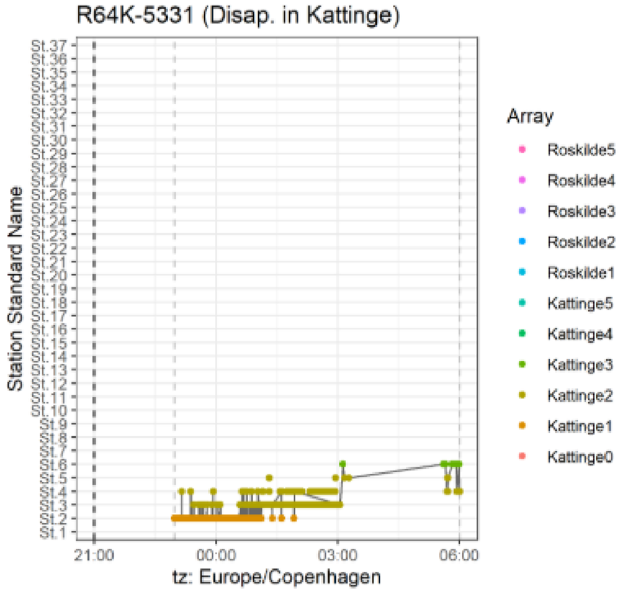

R64K-5326 (Succeeded)
Station Standard Name
Apr 15
May 01
May 15
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

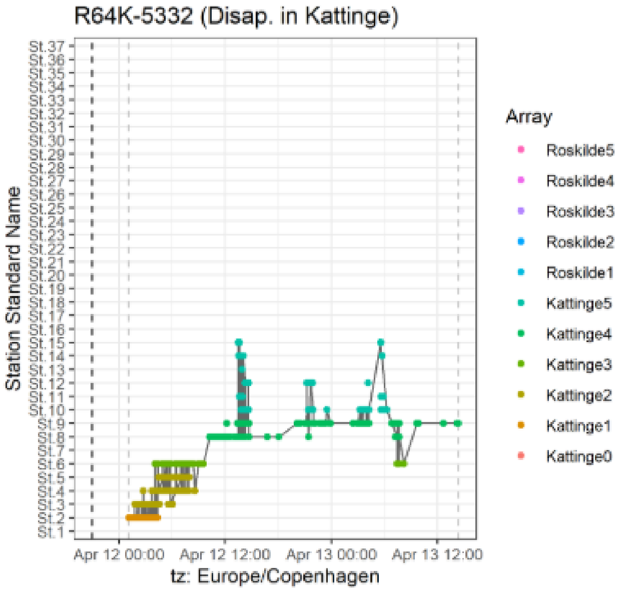

R64K-5327 (Disap. in Kattinge)
Station Standard Name
Apr 10 12:00
Apr 10 18:00
Apr 11 00:00
Apr 11 06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

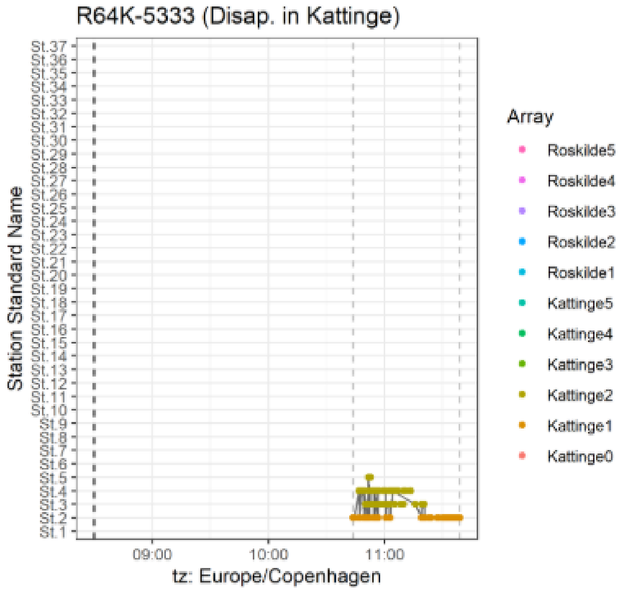

R64K-5328 (Disap. in Roskilde)
Station Standard Name
Apr 12
Apr 13
Apr 14
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

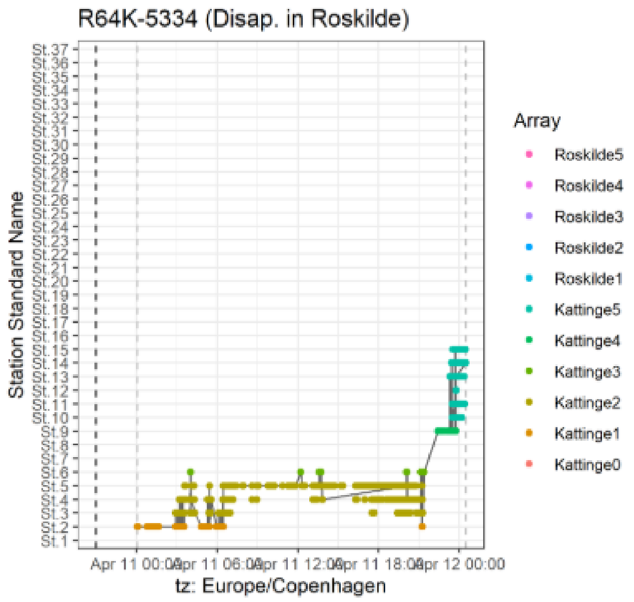

R64K-5329 (Disap. in Kattinge)
Station Standard Name
21:00
00:00
03:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

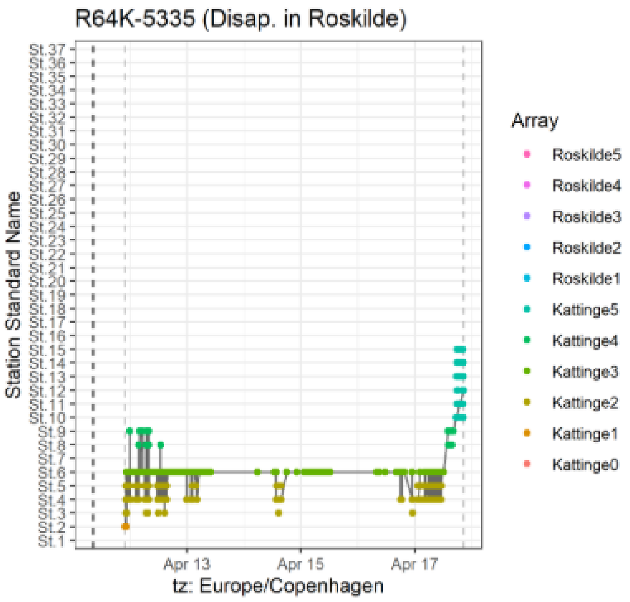

R64K-5330 (Disap. in Roskilde)
Station Standard Name
Apr 11
Apr 12
Apr 13
Apr 14
Apr 15
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

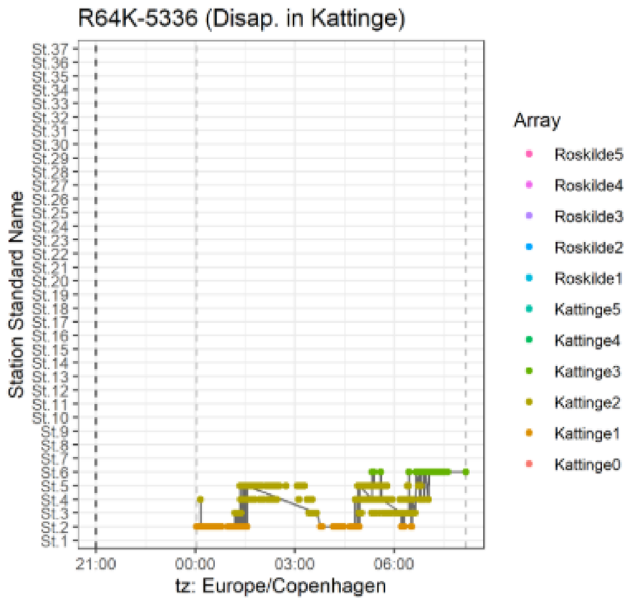

R64K-5331 (Disap. in Kattinge)
Station Standard Name
21:00
00:00
03:00
06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

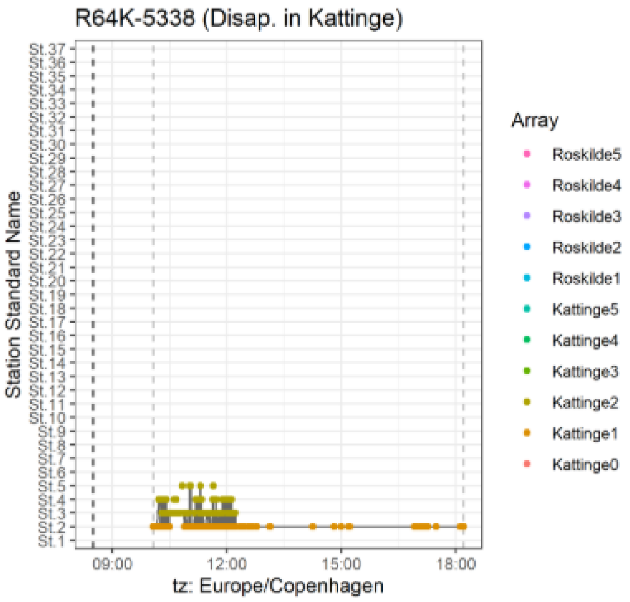

R64K-5332 (Disap. in Kattinge)
Station Standard Name
Apr 12 00:00
Apr 12 12:00
Apr 13 00:00
Apr 13 12:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

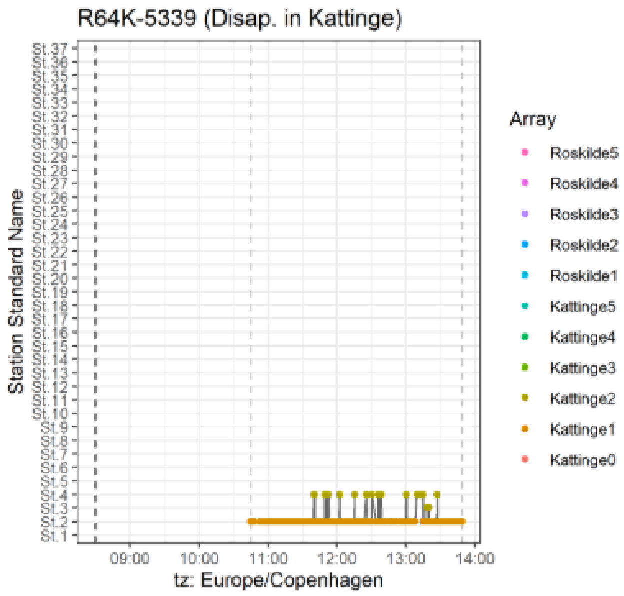

R64K-5333 (Disap. in Kattinge)
Station Standard Name
09:00
10:00
11:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

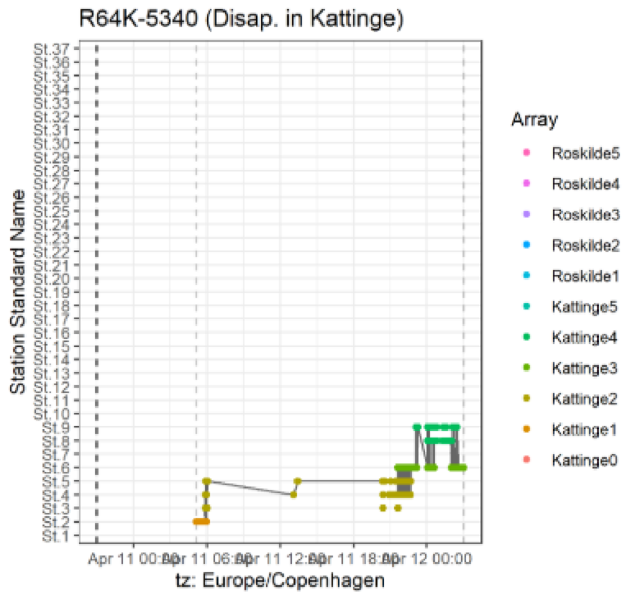

R64K-5334 (Disap. in Roskilde)
Station Standard Name
Apr 11 00:00
Apr 11 06:00
Apr 11 12:00
Apr 11 18:00
Apr 12 00:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

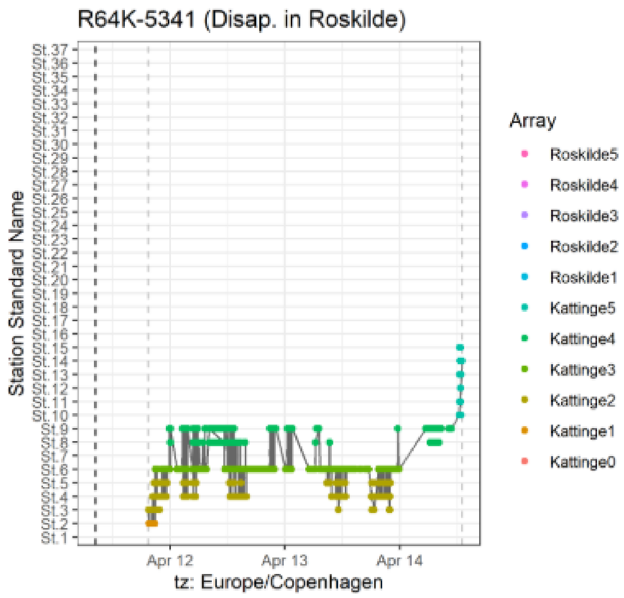

R64K-5335 (Disap. in Roskilde)
Station Standard Name
Apr 13
Apr 15
Apr 17
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

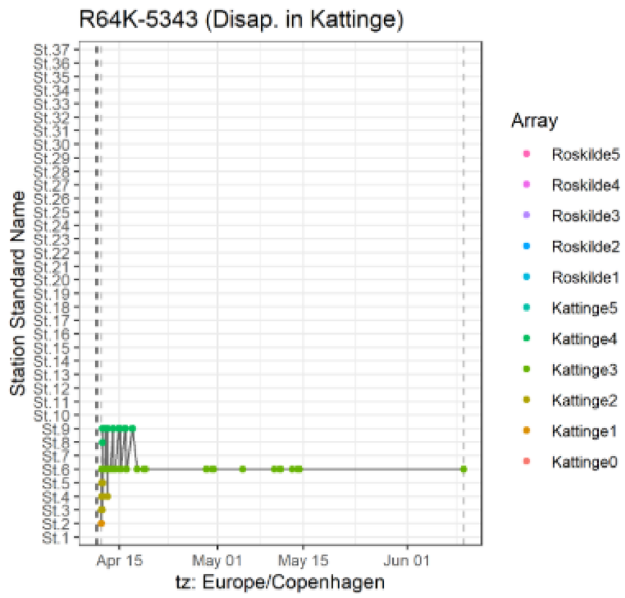

R64K-5336 (Disap. in Kattinge)
Station Standard Name
21:00
00:00
03:00
06:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

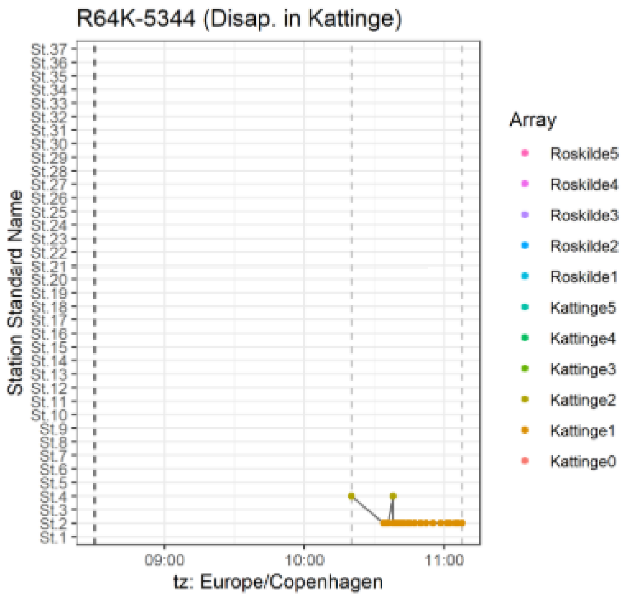

R64K-5338 (Disap. in Kattinge)
Station Standard Name
09:00
12:00
15:00
18:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

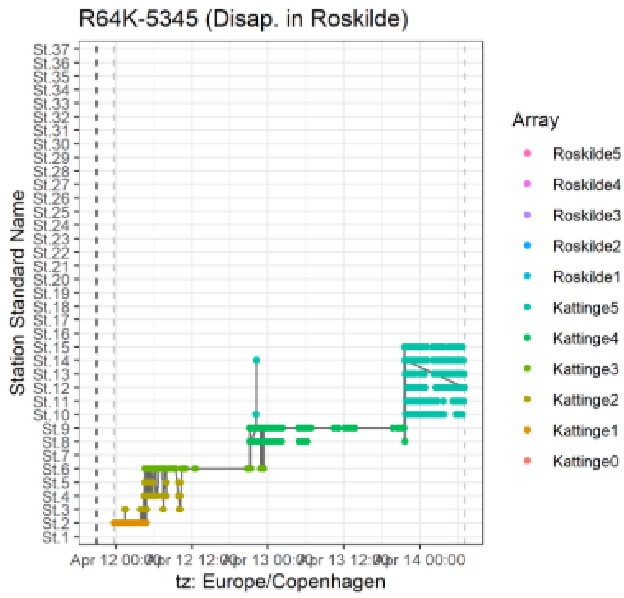

R64K-5339 (Disap. in Kattinge)
Station Standard Name
tz: Europe/Copenhagen
09:00
10:00
11:00
12:00
13:00
14:00
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

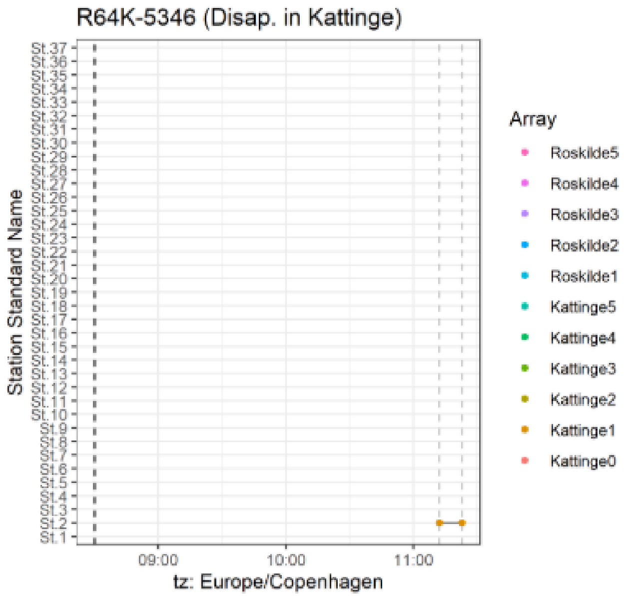

R64K-5340 (Disap. in Kattinge)
Station Standard Name
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

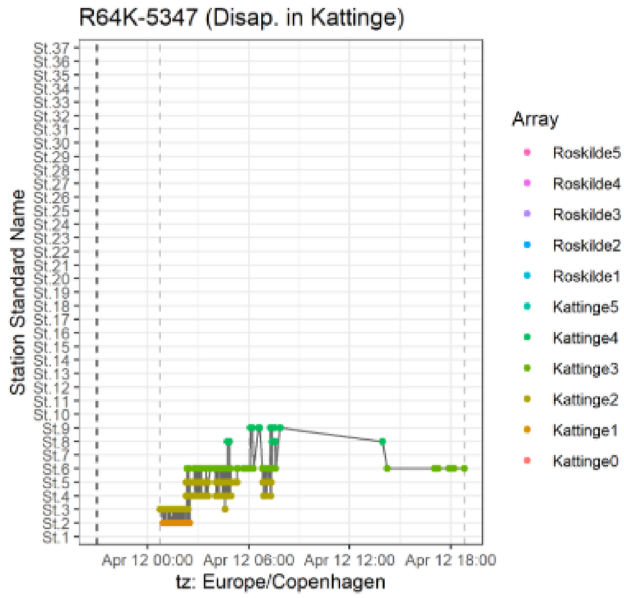

R64K-5341 (Disap. in Roskilde)
Station Standard Name
tz: Europe/Copenhagen
Apr 12
Apr 13
Apr 14
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0

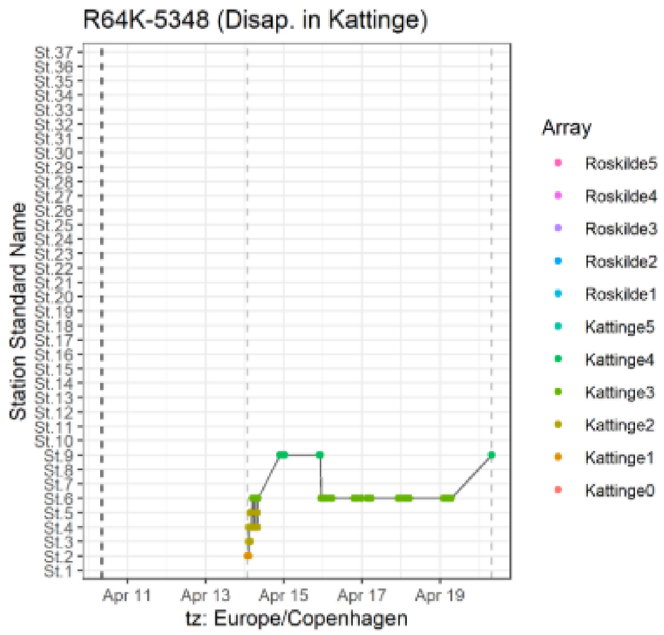

R64K-5343 (Disap. in Kattinge)
Station Standard Name
tz: Europe/Copenhagen
Apr 15
May 01
May 15
Jun 01
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0


R64K-5344 (Disap. in Kattinge)
Station Standard Name
09:00
10:00
11:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0


R64K-5345 (Disap. in Roskilde)
Station Standard Name
Apr 12 00:00
Apr 12 12:00
Apr 13 00:00
Apr 13 12:00
Apr 14 00:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0


R64K-5346 (Disap. in Kattinge)
Station Standard Name
09:00
10:00
11:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0


R64K-5347 (Disap. in Kattinge)
Station Standard Name
Apr 12 00:00
Apr 12 06:00
Apr 12 12:00
Apr 12 18:00
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0


R64K-5348 (Disap. in Kattinge)
Station Standard Name
St.37
St.36
St.35
St.34
St.33
St.32
St.31
St.30
St.29
St.28
St.27
St.26
St.25
St.24
St.23
St.22
St.21
St.20
St.19
St.18
St.17
St.16
St.15
St.14
St.13
St.12
St.11
St.10
St.9
St.8
St.7
St.6
St.5
St.4
St.3
St.2
St.1
Apr 11
Apr 13
Apr 15
Apr 17
Apr 19
tz: Europe/Copenhagen
Array
Roskilde5
Roskilde4
Roskilde3
Roskilde2
Roskilde1
Kattinge5
Kattinge4
Kattinge3
Kattinge2
Kattinge1
Kattinge0