

Circadian rhythmicity persists through the Polar night and midnight sun in Svalbard reindeer+

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+Dedication in memoriam Prof. Dr. Serge Daan (1940-2018), one of the greatest thinkers in Chronobiology

Head position changes

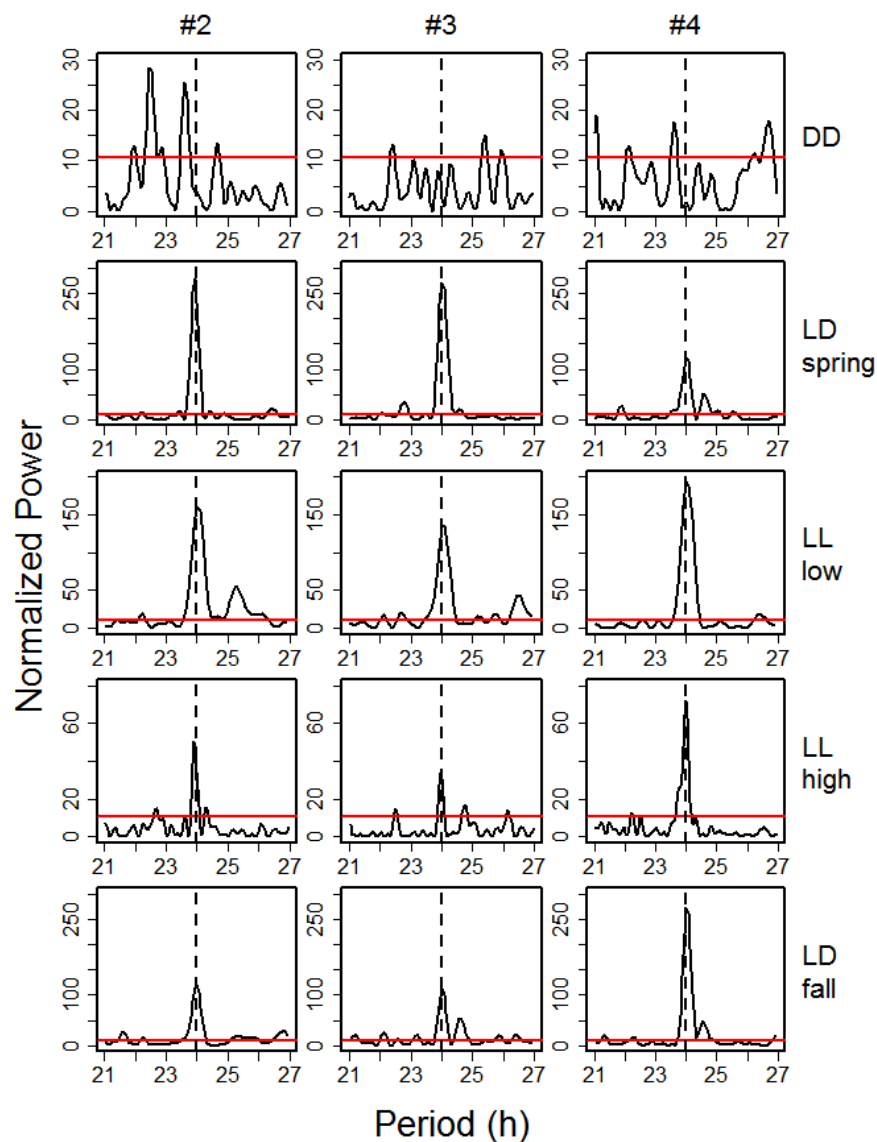


Figure S1 Comparison of rhythms of head position changes with period lengths (τ) between 21 and 27 hours of study animals #2, #3, and #4 between Nov 15, 2012 and Nov 15, 2013. Plotted are normalized powers of rhythms of activity. Each row of panels represents the different time periods: Polar Night (DD), daylight and night (LD), continual light (Midnight Sun, LL) before the onset of new vegetation growth with NDVI values <0 (LL low), and continual light with above-ground new vascular plant growth (NDVI >0 , LL high). Horizontal red lines indicate the significance threshold of $p=0.001$.

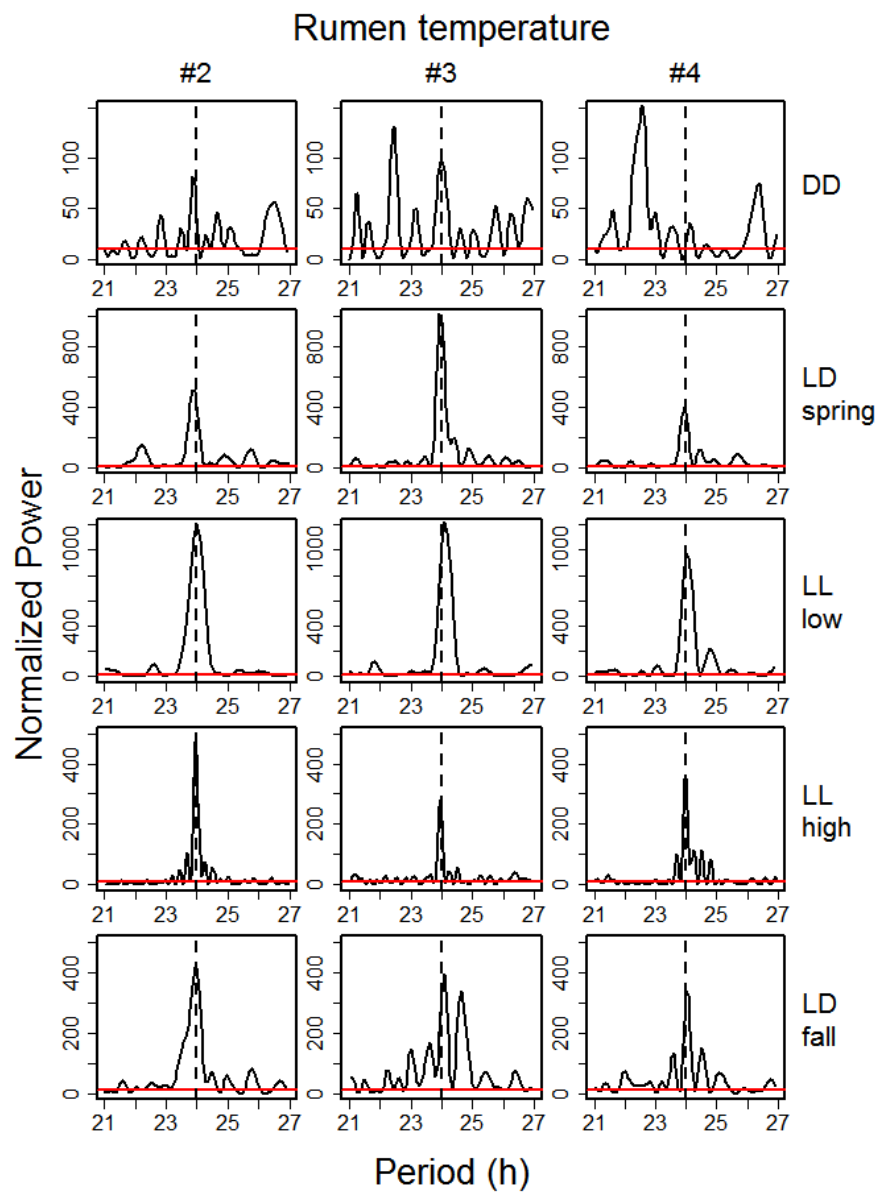


Figure S2 Comparison of rhythms of rumen temperature with period lengths (τ) between 21 and 27 hours of study animals #2, #3, and #4 between Nov 15, 2012 and Nov 15, 2013. Plotted are normalized powers of rhythms of activity. Each row of panels represents the different time periods: Polar Night (DD), daylight and night (LD), continual light (Midnight Sun, LL) before the onset of new vegetation growth with NDVI values <0 (LL low), and continual light with above-ground new vascular plant growth (NDVI >0 , LL high). Horizontal red lines indicate the significance threshold of $p=0.001$.

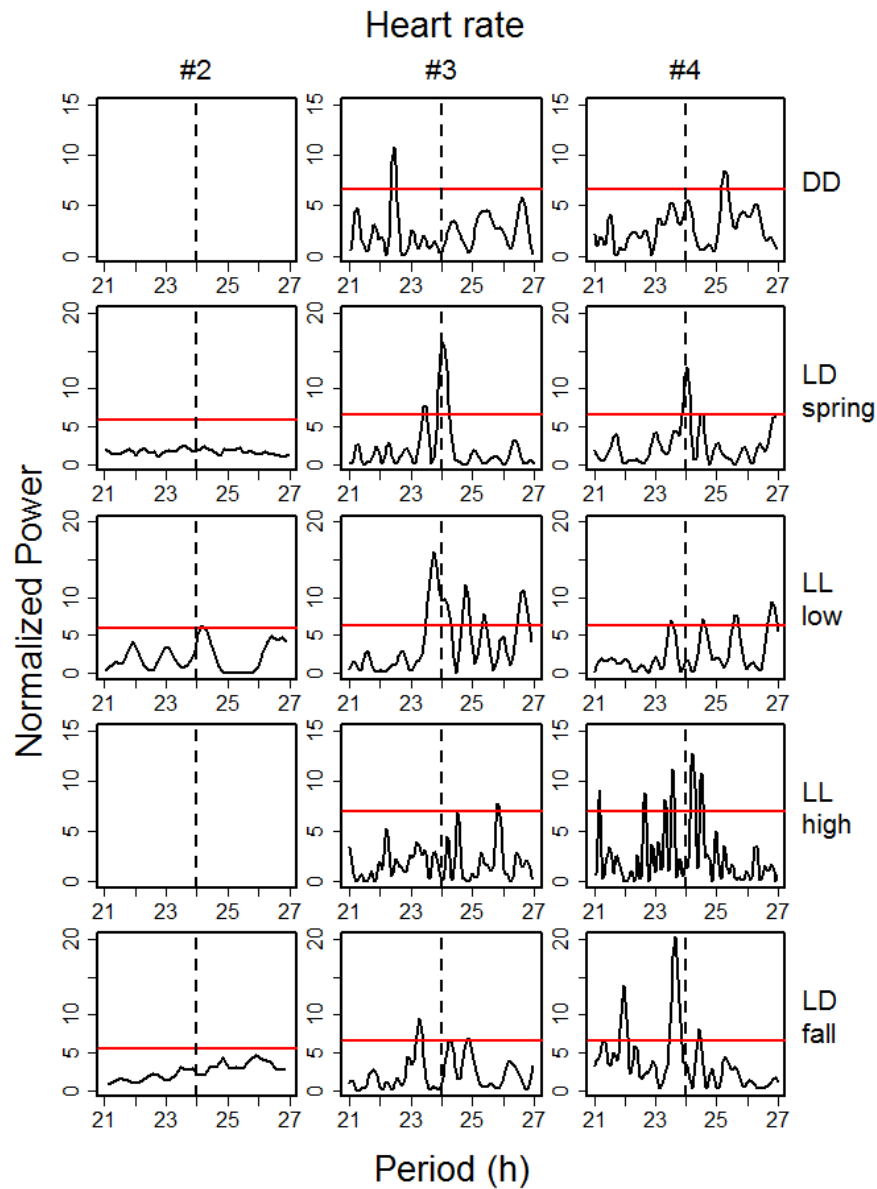


Figure S3 Comparison of rhythms of heart rate with period lengths (τ) between 21 and 27 hours of study animals #2, #3, and #4 between Nov 15, 2012 and Nov 15, 2013. Plotted are normalized powers of rhythms of activity. Each row of panels represents the different time periods: Polar Night (DD), daylight and night (LD), continual light (Midnight Sun, LL) before the onset of new vegetation growth with NDVI values <0 (LL low), and continual light with above-ground new vascular plant growth (NDVI >0 , LL high). Horizontal red lines indicate the significance threshold of $p=0.05$.

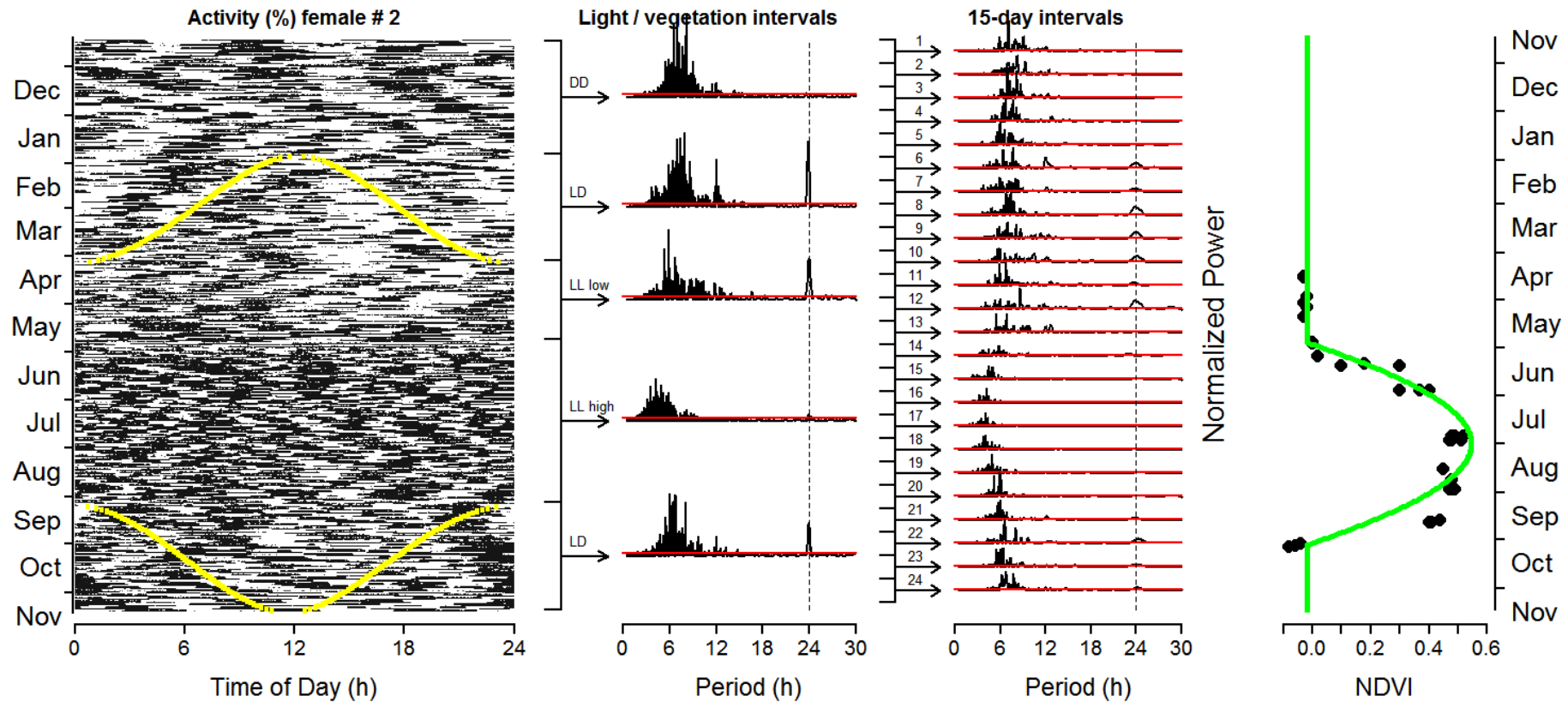


Figure S4 24 hour patterns of activity per 3-minute measurement interval and changes between Nov 15, 2012 and Nov 15, 2013 of individual #2. Panels from left to right: Actogram, yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p < 0.001$. For details see legend to Fig. 5.

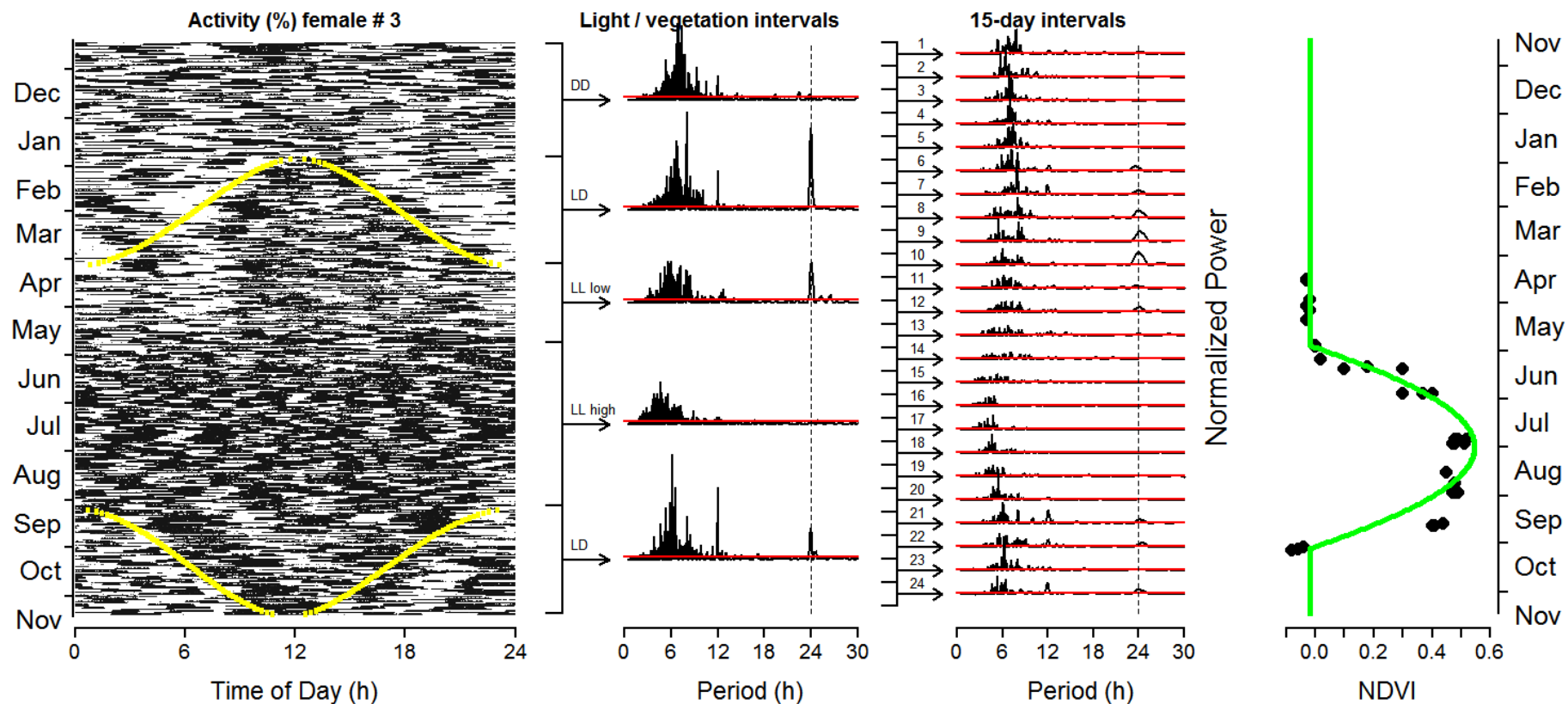


Figure S5 24 hour patterns of activity per 3-minute measurement interval and changes between Nov 15, 2012 and Nov 15, 2013 of individual #3. Panels from left to right: Actogram, yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p < 0.001$. For details see legend to Fig. 5.

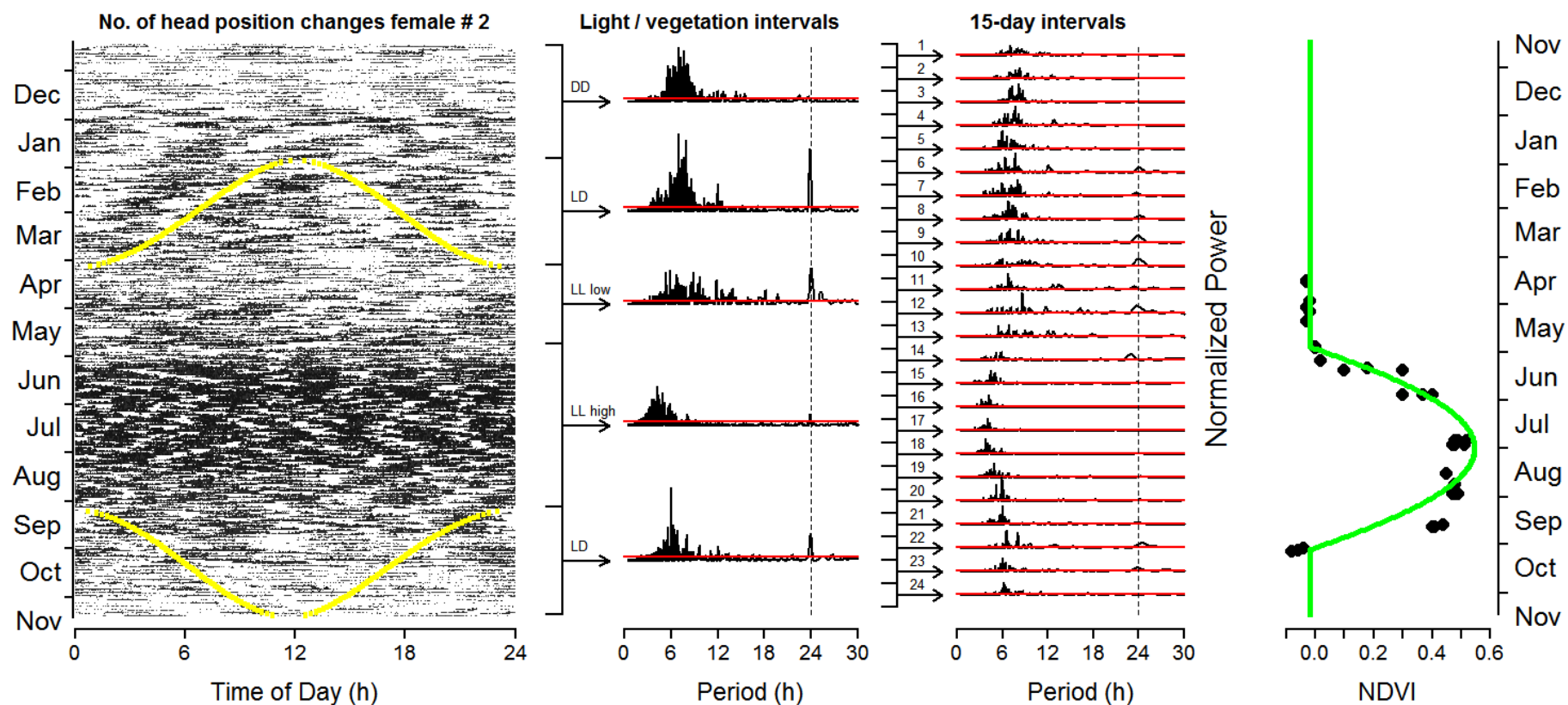


Figure S6 24 hour patterns of the number of head position changes per 3-minute measurement interval and changes between Nov 15, 2012 and Nov 15, 2013 of individual #2. Panels from left to right: Actogram, yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.001$. For details see legend to Fig. 5.

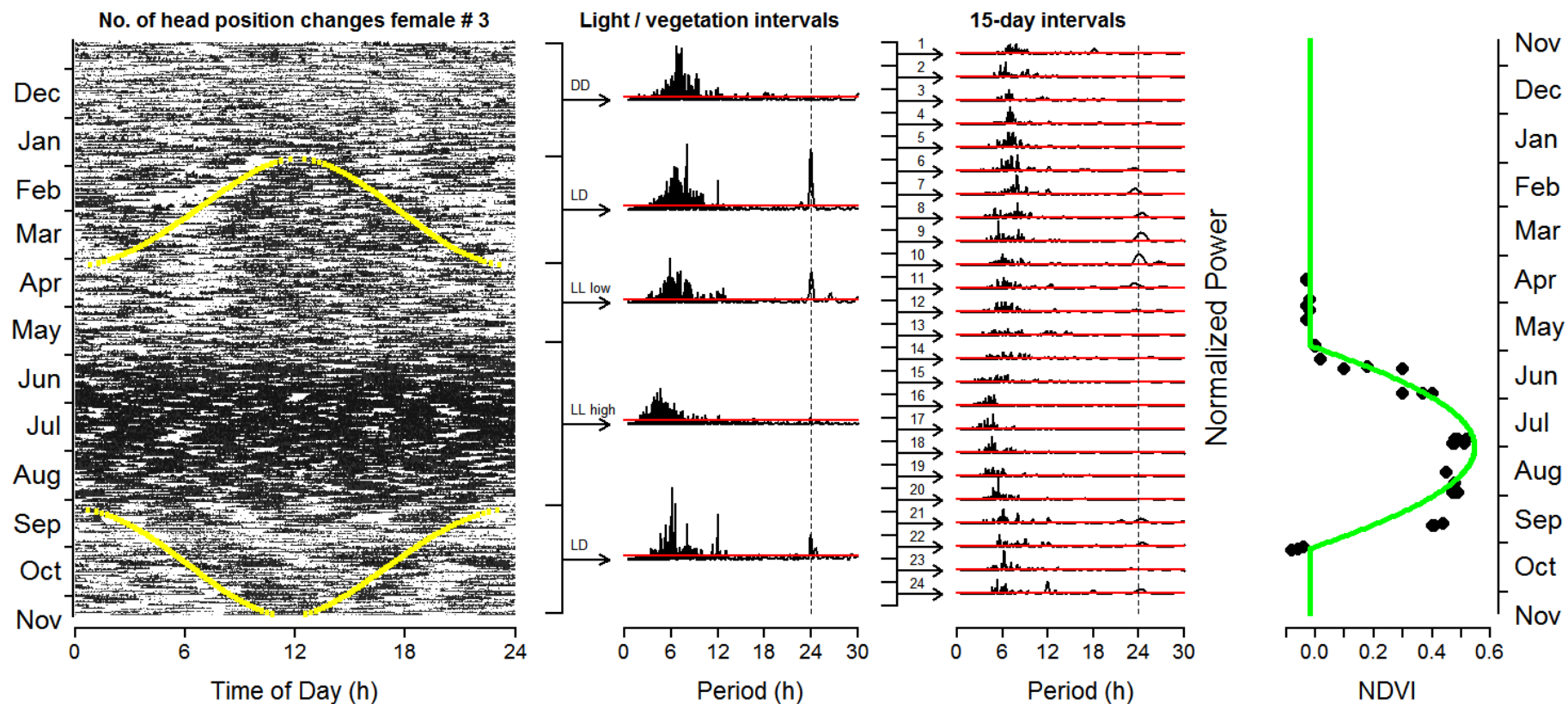


Figure S7 24 hour patterns of the number of head position changes per 3-minute measurement interval and changes between Nov 15, 2012 and Nov 15, 2013 of individual #3. Panels from left to right: Actogram, yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.001$. For details see legend to Fig. 5.

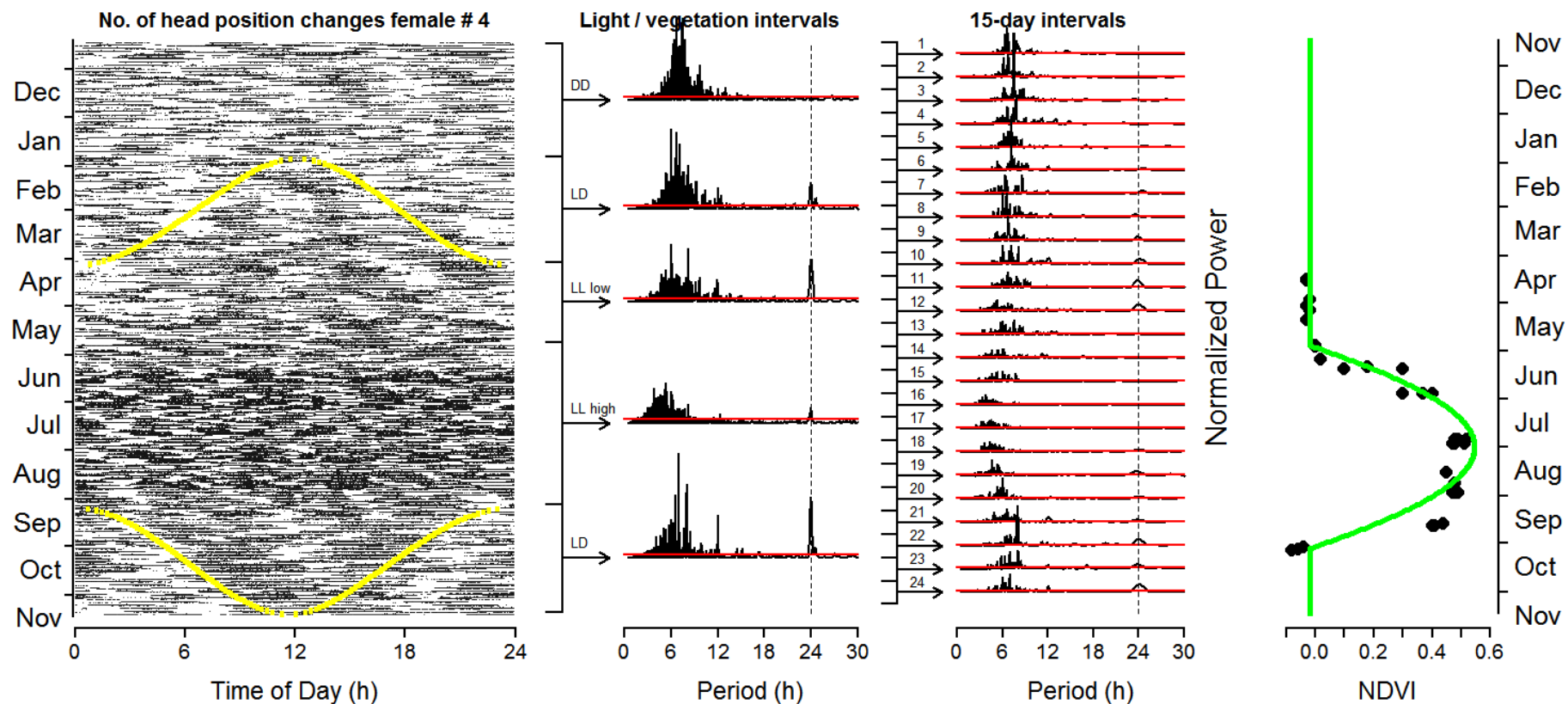


Figure S8 24 hour patterns of the number of head position changes per 3-minute measurement interval and changes between Nov 15, 2012 and Nov 15, 2013 of individual #4. Panels from left to right: Actogram, yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.001$. For details see legend to Fig. 5.

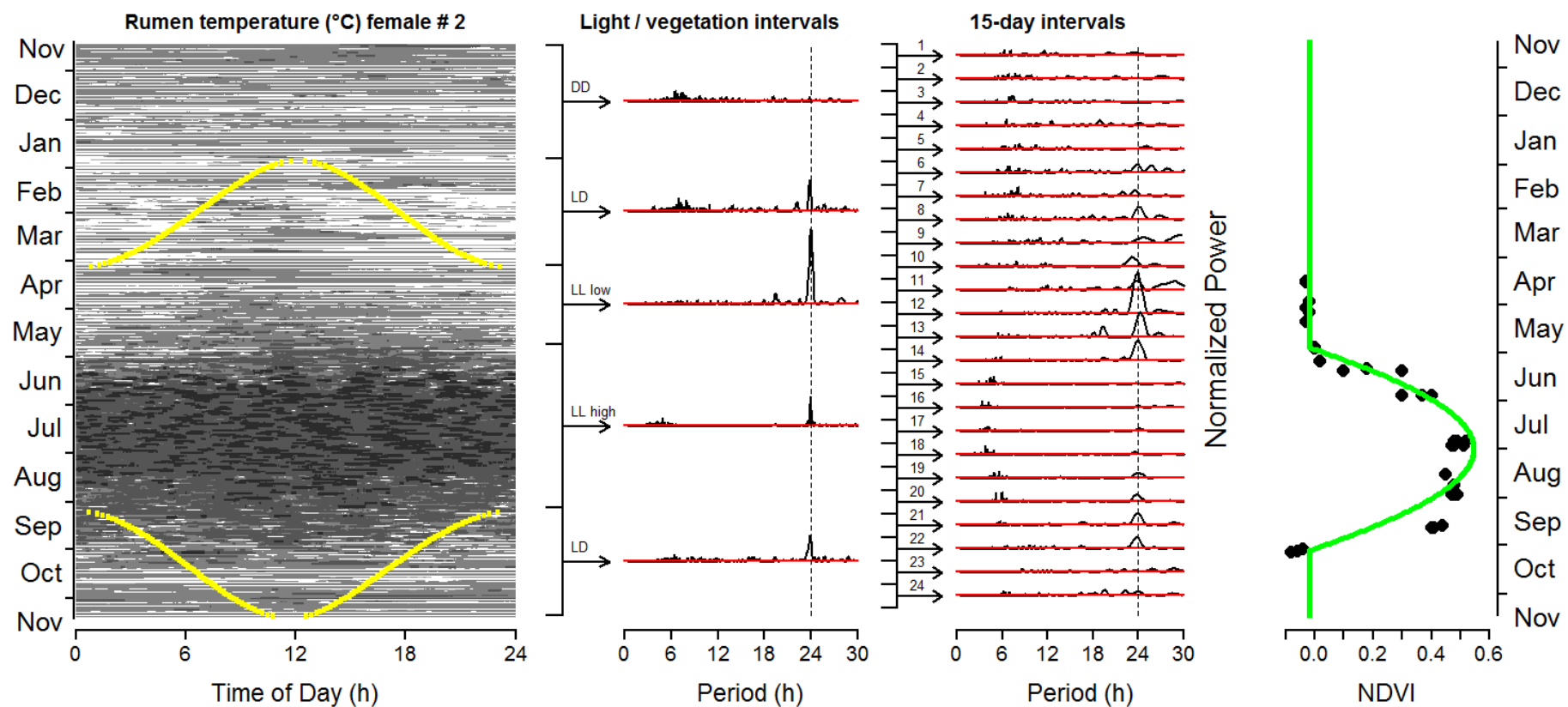


Figure S9 24 hour patterns of temperatures in the rumen, T_{rumen} , measured every 3-minutes and changes between Nov 15, 2012 and Nov 15, 2013 of individual #2. Panels from left to right: Actogram-like pattern of daily changes in T_{rumen} , with height of bars and their degree of darkness proportional to T_{rumen} , yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.001$. For details see legend to Fig. 5.

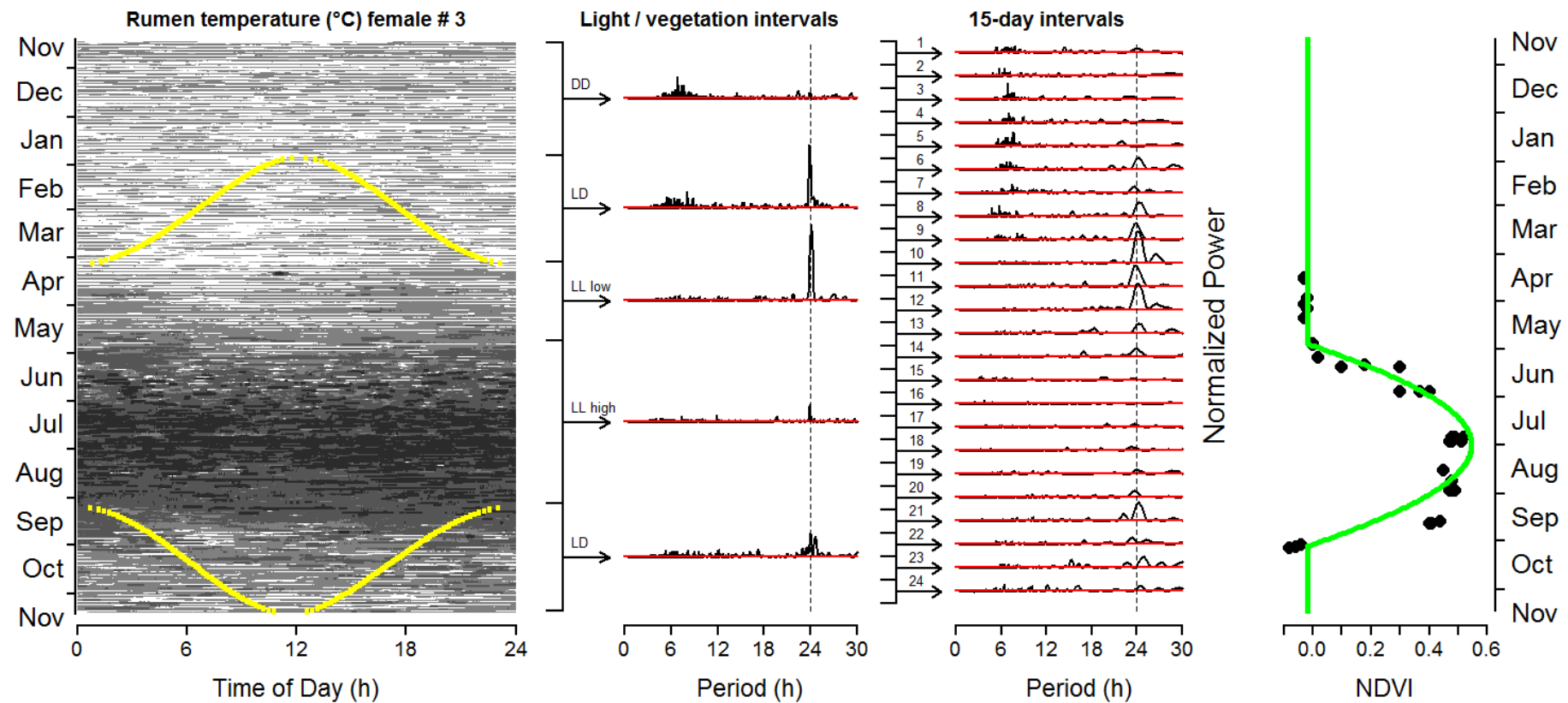


Figure S10 24 hour patterns of temperatures in the rumen, T_{rumen} , measured every 3-minutes and changes between Nov 15, 2012 and Nov 15, 2013 of individual #3. Panels from left to right: Actogram-like pattern of daily changes in T_{rumen} , with height of bars and their degree of darkness proportional to T_{rumen} , yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.001$. For details see legend to Fig. 5.

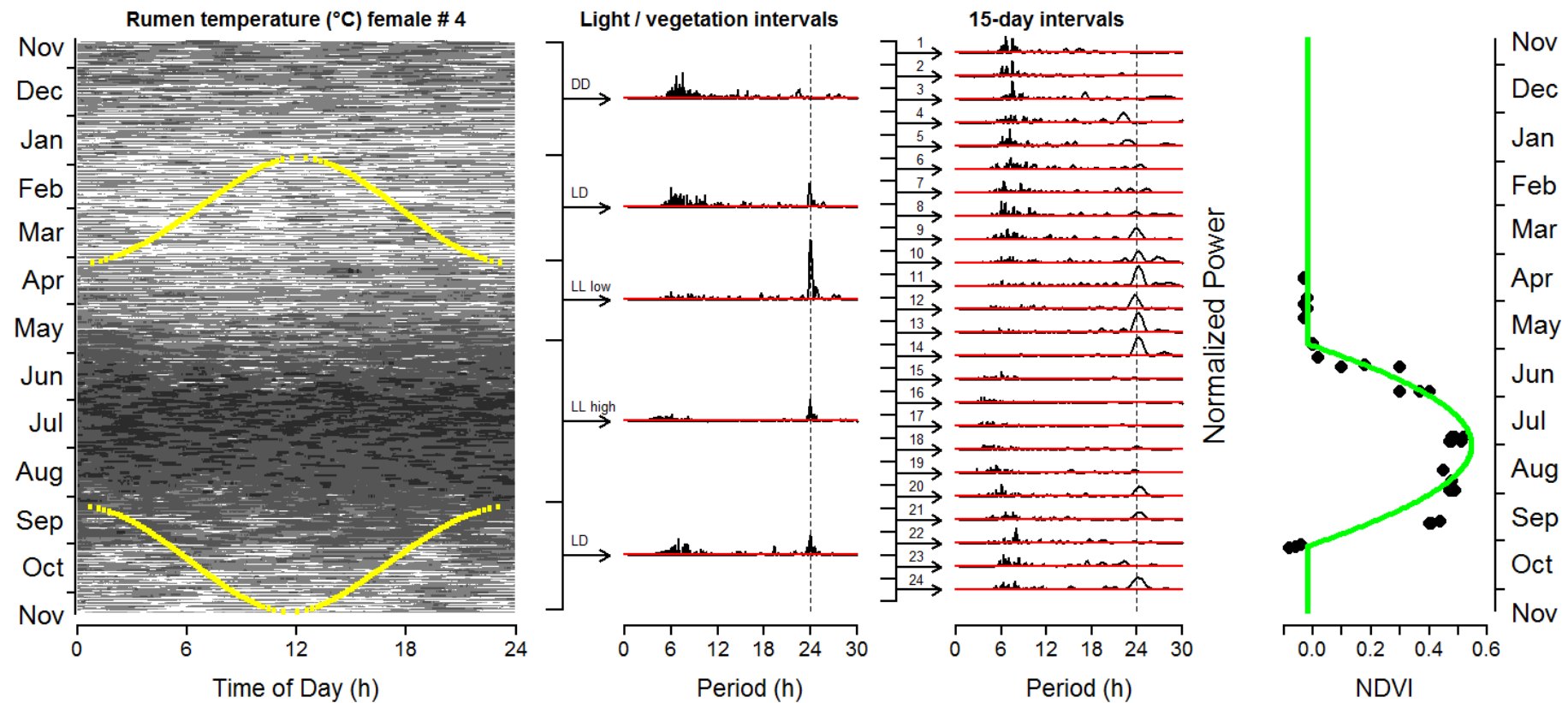


Figure S11 24 hour patterns of temperatures in the rumen, T_{rumen} , measured every 3-minutes and changes between Nov 15, 2012 and Nov 15, 2013 of individual #4. Panels from left to right: Actogram-like pattern of daily changes in T_{rumen} , with height of bars and their degree of darkness proportional to T_{rumen} , yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.001$. For details see legend to Fig. 5.

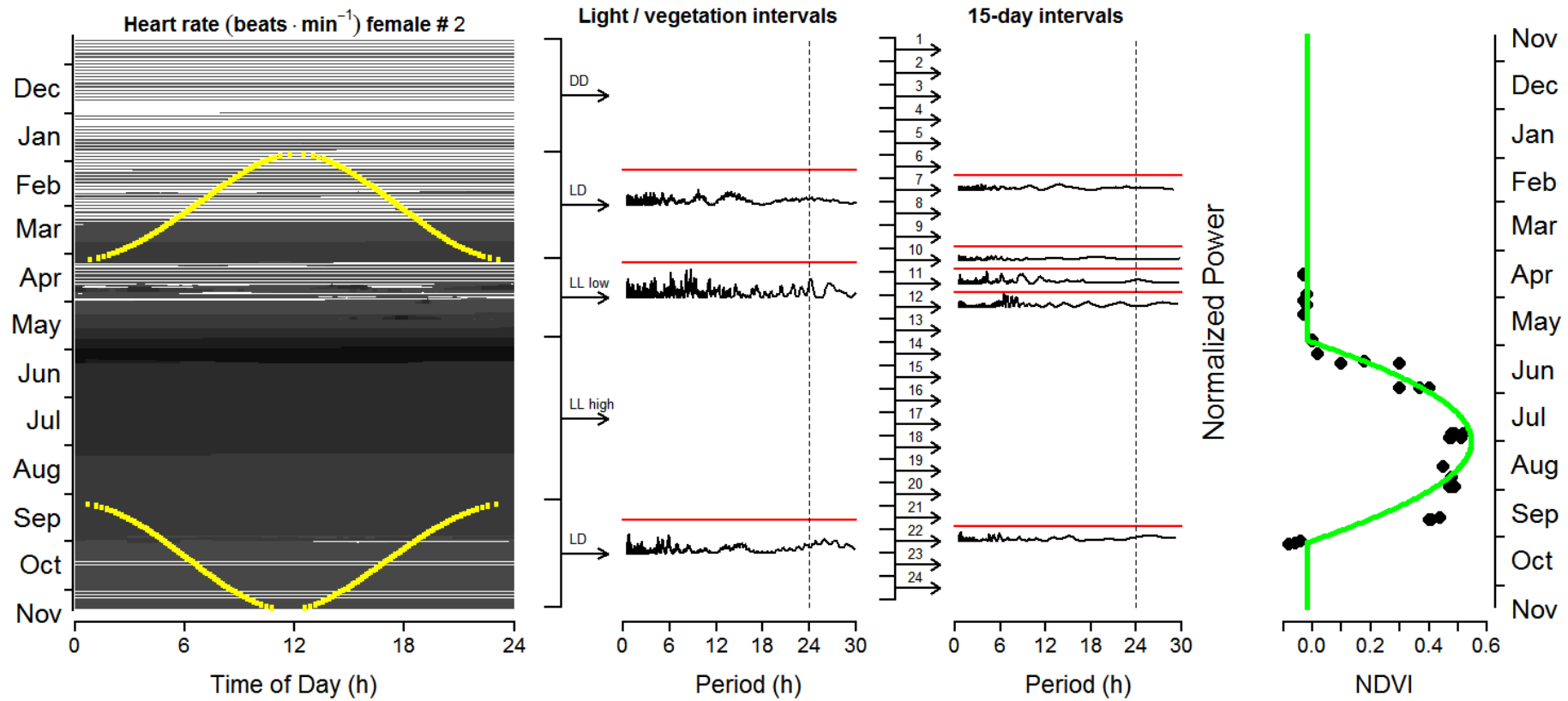


Figure S12 24 hour patterns of stationary heart rate, HR_s , measured every 21 minutes during a 3-minute interval, and changes between Nov 15, 2012 and Nov 15, 2013 of individual #2. Panels from left to right: Actogram-like pattern of daily changes in HR_s , with height of bars and their degree of darkness proportional to HR_s , yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals, missing lines indicate insufficient sample size for Lomb-Scargle periodogram analysis; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.05$. For details see legend to Fig. 5.

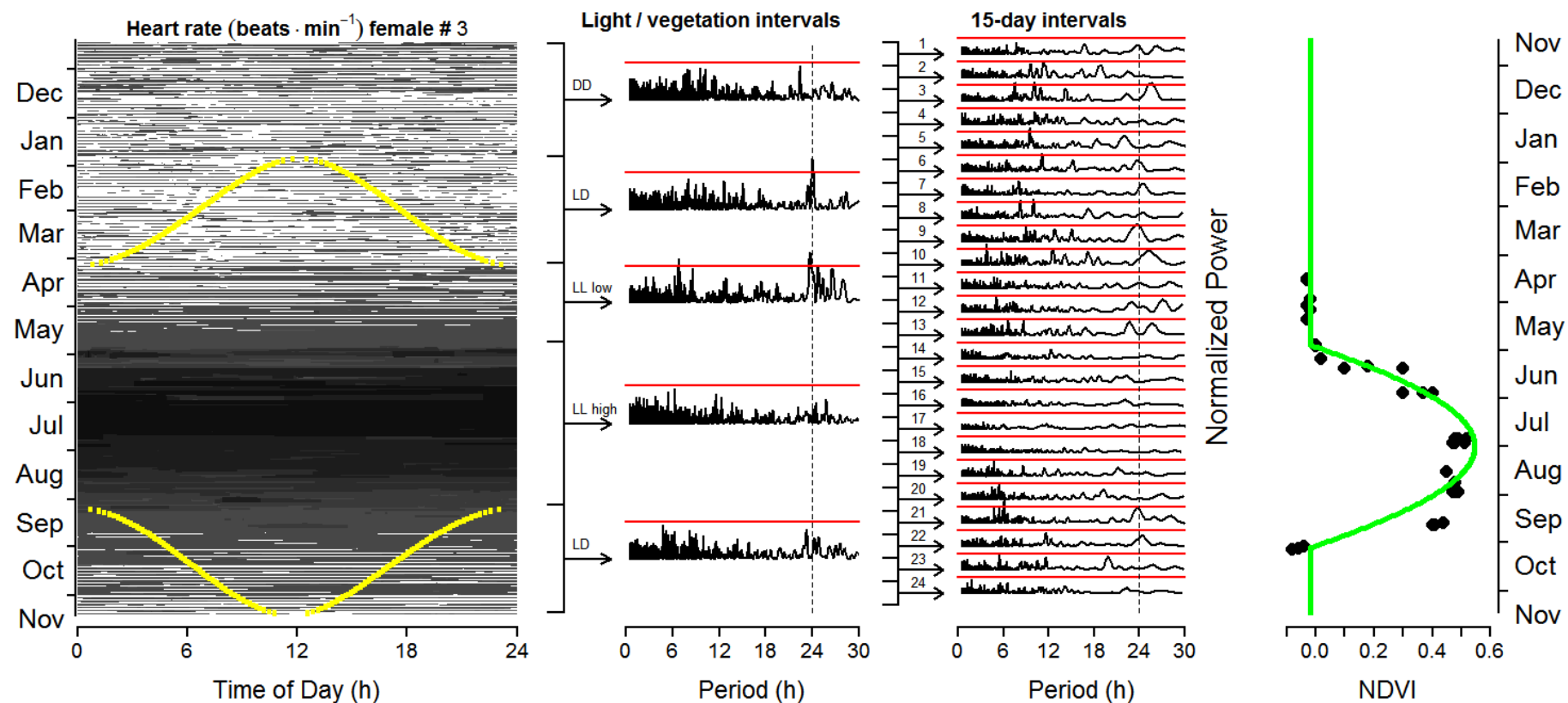


Figure S13 24 hour patterns of stationary heart rate, HR_s , measured every 21 minutes during a 3-minute interval, and changes between Nov 15, 2012 and Nov 15, 2013 of individual #3. Panels from left to right: Actogram-like pattern of daily changes in HR_s , with height of bars and their degree of darkness proportional to HR_s , yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals, missing lines indicate insufficient sample size for Lomb-Scargle periodogram analysis; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.05$. For details see legend to Fig. 5.

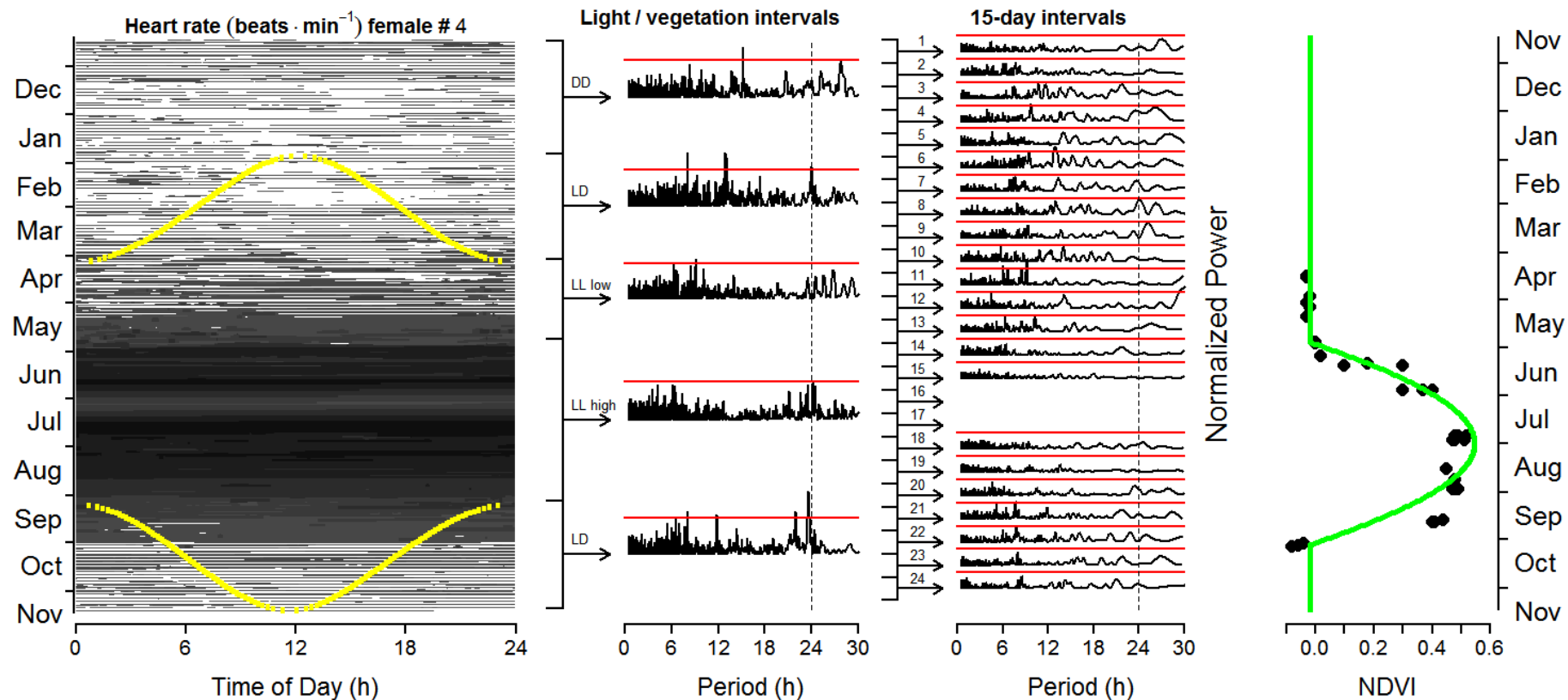


Figure S14 24 hour patterns of stationary heart rate, HR_s , measured every 21 minutes during a 3-minute interval, and changes between Nov 15, 2012 and Nov 15, 2013 of individual #4. Panels from left to right: Actogram-like pattern of daily changes in HR_s , with height of bars and their degree of darkness proportional to HR_s , yellow lines indicate beginning and end of civil twilight; periodograms for periods with different photic/vegetation conditions; periodograms for 15-day intervals, missing lines indicate insufficient sample size for Lomb-Scargle periodogram analysis; seasonal course of NDVI values. Horizontal red lines indicate the significance threshold of $p=0.05$. For details see legend to Fig. 5.