Appendix S1

Large river floodplain as a natural laboratory: non-native macroinvertebrates benefit from elevated temperatures

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**Fig. S1.** Conceptual drawing showing the lateral dimension of a floodplain and the link with the hydrological connectivity. The gradient of lateral connectivity is composed of a succession of channels from permanently connected to totally disconnected channels (a. main river channel, b. permanently connected = eupotamal channel, c. upstream disconnected = parapotamal channel, d. upstream and downstream disconnected = plesiopotamal channels).
Fig. S2. Water-air temperature relationships along year 2009. Y values represent water temperature and X values represent air temperature of Belley (bel) or Brégnier-Cordon (BC) sectors. Temperature was recorded hourly in six sites of the main river channel (M1 – M6) and in 5 sites permanently connected with the main river channel (EUP1 – EUP5). Graphs show daily average temperature, and high homogeneity in terms of thermal regimes along the longitudinal dimension of the river from the upstream part of Belley sector (M1 to M3) to the downstream part of the next sector (Brégnier-Cordon, M4 to M6). Eupotamal channels show a similar relationship as the main river channel.
Fig. S3. Water-air temperature relationships in 11 parapotamal channels in 2009. Temperature was recorded hourly in 11 sites of permanently connected channels by their downstream part with the main river channel, but disconnected in their upstream part (PARA1 – PARA11).
Fig. S4. Water-air temperature relationships of 15 plesiopotamal channels in 2009.

Temperature was recorded hourly in 15 sites totally disconnected with the main river channel (PLES1 – PLES15).
**Fig. S5.** Principal component analysis based on thermal variables recorded within sites in 2009. (a) Ordination of the sites according to their thermal regimes. (b) Cluster analysis identifies 4 groups of sites. Group 4 contains sites from the main river channel and eupotamal channels, mixed with some plesiopotamal channels. Group 3 contains sites with a similar thermal regime to sites in group 4. Group 2 contains para and plesiopotamal channels, and group 1 contains sites with a different thermal regime from the rest of the sites.
Fig. S6. Principal component analyses (PCA) combining data from 2009 and 2010. 1) PCA combining variables expressing the level of lateral hydrological connectivity of the sites (a: circle of correlation, c: sites ordination), 2) PCA combining variables expressing the thermal regime of the sites (b: circle of correlation, d: sites ordination). Eleven variables were used to perform the second PCA (b) (see Table S1) and five for the first PCA (a) (cond: conductivity; sub_div: diversity of mineral substrate, NH3-N: azote ammonium in water, veg: channel coverage by aquatic vegetation, om: organic matter in sediment). The first and the second PCA were performed with the same sites. Only the sites with a strong water-air relationship (NSE>0.70, Table S2) were used in the two PCA.
**Fig. S7.** Generalised additive models of non-native (a-b), native (c-d), EPT species (e-f) richness, and EPT density (g-h) along a gradient of lateral hydrological connectivity from connected (x axis: -2) to disconnected sites (x axis: 2), and a gradient of thermal regime from warm sites in summer (x axis: -2) to cold sites (x axis: 6). X values represent the scores along the first axis of PCA combining variables expressing the level of lateral hydrological connectivity of the sites (Fig. S6, a-c) or the thermal regime of the sites (Fig. S6, b-d). Y values represent the response of density and richness to the smooth of the gradient of thermal regime (i.e. ther_1) and hydrological gradient (i.e. hyd_1). Grey areas represent 95% confidence interval.
**Table S1.** Thermal variables used in the models to describe the thermal heterogeneity among river and floodplain sites.

| Variable                                    | Code  | Note | Formula and details | Reference                        |
|----------------------------------------------|-------|------|---------------------|----------------------------------|
| Asymptotic maximum for air-water relationship| as\_max | 1    | Logistic regression | (Mohseni et al. 1998, Caissie et al. 2001) |
| Inflexion value for air-water relationship   | infl  | 1    | Logistic regression | (Mohseni et al. 1998)           |
| Maximum slope for air-water relationship     | slope | 1    | Logistic regression | (Mohseni et al. 1998)           |
| Maximum water temperature                    | max   | 2    | T\_max             |                                   |
| Minimum water temperature                    | min   | 3    | T\_min             |                                   |
| Kamler coefficient                           | Tkamler | T\_max/T\_min | (Arscott et al. 2001)   |
| Amplitude                                    | T ampl | 4    | T\_max-T\_min     | (Arscott et al. 2001)           |
| Year average temperature                     | mean\_year | 5    | 01.01.09 – 31.12.09 | (Arscott et al. 2001)           |
| Average temperature in summer                | mean\_sum | 6    | 21.06.09 – 22.09.09 | (Daufresne et al. 2004)         |
| Average temperature in spring                | mean\_spring | 7    | 20.03.09 – 21.06.09 | (Daufresne et al. 2004)         |
| Average temperature in winter                | mean\_wint  | 8    | 21.12.08 – 20.03.09 | (Daufresne et al. 2004)         |

**Notes:**

1. Three parameters were derived from the logistic regressions (as\_max : asymptotic maximum of the model ; infl : value of inflexion of the model ; slope : maximum slope of the model).

2. The maximum water temperature can differ between channels even if the slope of regression between air and water temperature are identical.

3. The minimum water temperature will differ between channels. It can be critical if the water freeze, however certain channels with an upwelling can warm-up during winter. This specific patterns can be showed when we study the regression between air and water temperature.

4. Difference between maximum and minimum water temperature.

5. The average was calculated for the period: 01.01.09 – 31.12.09

6. The average was calculated for the period: 21.06.09 – 22.09.09

7. The average was calculated for the period: 20.03.09 – 21.06.09

8. The average was calculated for the period: 21.12.08 – 20.03.09
Table S2. Assessment of logistic models between water and air temperature in 2009 and 2010 measured hourly or daily. NSE: Nash-Sutcliffe efficiency; RMSE: root-mean-square error.

Models that performed better with three parameters rather than four are named LR3 (i.e. Logistic Regression with 3 parameters). Models that do not fit with observations (NSE < 0.70) are highlighted by two stars (**).

| Codes | Names             | 2009 hourly | 2009 daily | 2010 hourly | 2010 daily |
|-------|-------------------|-------------|------------|-------------|------------|
| Main1 | RCC_LUS           | 0.7225      | 3.0031     | 0.8159      | 2.4547     |
| Main2 | RCC_Balme         | 0.7179      | 3.1125     | 0.8508      | 2.2626     |
| Main3 | RH_CHAN           | 0.7458      | 2.9214     | 0.8451      | 2.2558     |
| Main4 | RCC_Cordon        | 0.7446      | 3.0178     | 0.8677      | 2.1614     |
| Main5 | RCC_Cordon        | 0.7348      | 3.0191     | 0.8523      | 2.2585     |
| Main6 | RH_Evreu          | 0.7511      | 2.9323     | 0.8932      | 2.3402     |
| Evo1  | LUCE_AM           | 0.6866      | 2.565      | 0.7828      | 2.1305     |
| Evo2  | ENIL_AM           | 0.7732      | 2.7698     | 0.8547      | 2.2051     |
| Evo3  | CHAN_AV           | 0.7767      | 2.8798     | 0.8693      | 2.1097     |
| Evo4  | VACH_AM           | 0.724       | 3.0684     | 0.8462      | 2.2974     |
| Evo5  | TONK_AM           | 0.7611      | 2.8823     | 0.8662      | 2.1605     |
| Para 1| LUSV_AV           | 0.8734      | 0.8003     | 0.9301      | 0.587      |
| Para 2| MOIR_AV           | 0.8349      | 2.1052     | 0.9431      | 1.2408     |
| Para 3| FOUR_AM           | 0.5001      | 2.6118     | 0.5269      | 2.5097     |
| Para 4| FOUR_AV           | 0.86       | 1.6669     | 0.9401      | 0.5035     |
| Para 5| CHAN_AV           | 0.7718      | 2.8486     | 0.8633      | 2.1262     |
| Para 6| ROSS_AM           | 0.8469      | 1.934      | 0.9425      | 1.1679     |
| Para 7| ROSS_AV           | 0.775       | 1.9437     | 0.9173      | 1.1621     |
| Para 8| VILO_AV           | 0.7998      | 1.9752     | 0.916       | 1.1818     |
| Para 9| MOLO_AV           | 0.7855      | 2.7741     | 0.9202      | 1.681      |
| Para 10| MORT_AV          | 0.8124     | 2.5149     | 0.9329      | 1.4849     |
| Para 11| PONT_AV           | 0.7862      | 2.9374     | 0.8978      | 2.0265     |
| Plesio 1| LUIS_AM         | 0.8548      | 0.5298     | 0.8371      | 0.5615     |
| Plesio 2| MOIR_AMM         | 0.8185      | 0.526      | 0.782       | 0.5659     |
| Plesio 3| BEAR_AM          | 0.7853      | 1.9235     | 0.9128      | 1.2343     |
| Plesio 4| BEAR_AVN         | 0.8798      | 1.38       | 0.9515      | 0.8618     |
| Plesio 5| BEAR_AV           | 0.8584      | 1.4875     | 0.9408      | 0.9566     |
| Plesio 6| GRAN_AM          | 0.7311      | 2.2751     | 0.8467      | 1.7163     |
| Plesio 7| GRAN_AV           | 0.8028      | 2.3615     | 0.9171      | 1.5225     |
| Plesio 8| VILO_AV           | 0.4956      | 1.0621     | 0.5722      | 1.0187     |
| Plesio 9| CRBL_AV          | 0.7947      | 2.8337     | 0.9075      | 1.872      |
| Plesio 10| MOLO_AM           | 0.8964      | 1.8729     | 0.9549      | 1.2001     |
| Plesio 11| NAPP_AM         | 0.7682      | 2.4403     | 0.9209      | 1.4216     |
| Plesio 12| MORT_CT          | 0.909       | 2.3512     | 0.9645      | 1.3771     |
| Plesio 13| PLAI_AM          | 0.7945      | 2.6383     | 0.9349      | 1.4792     |
| Plesio 14| PLAI_AV          | 0.8029      | 3.0345     | 0.9411      | 1.6502     |
| Plesio 15| PONT_AM         | 0.8312      | 2.3080     | 0.9434      | 1.3253     |

Supporting Information
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