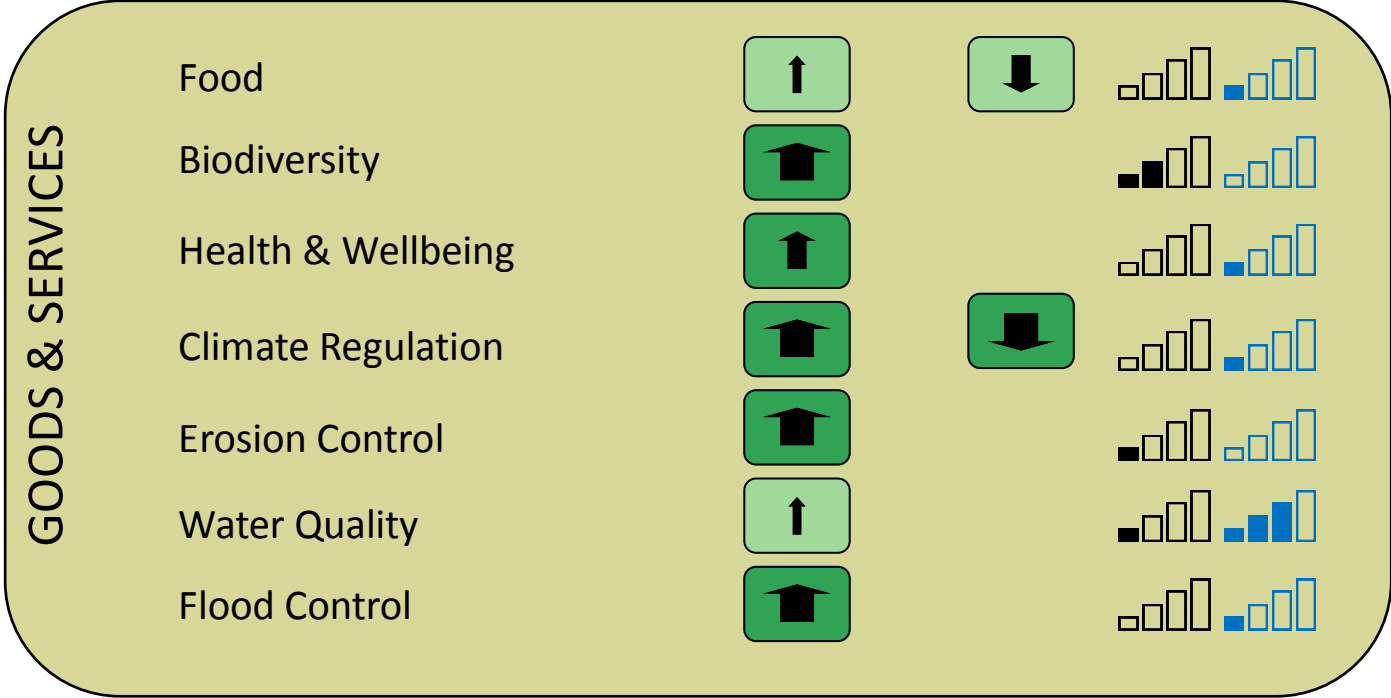


Actively planting vegetation along waterways or allowing natural regeneration of bankside vegetation.

MANAGING ECOSYSTEM SERVICES

FRESHWATER

INCREASE RIPARIAN VEGETATION



These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published work within the selection criteria or geographical range exists. These pages do not provide advice, only review the outcome of what has been studied.

Full data are available in electronic form from the [Evidence Spreadsheet](#).

Data are correct to March 2015.

**KEY**

**Quality of Evidence**

- Good: Dark Green
- Medium: Light Green
- Poor: White

**Quantity of Evidence**

- Number of sources showing direct evidence: 3 bars (black, dark grey, light grey)
- Number of sources showing indirect evidence: 3 bars (blue, light blue, white)

**Magnitude and Direction of Effect**

**Direction**

- Strong: Large up/down arrow
- Medium: Medium up/down arrow
- Low: Small up/down arrow

**Magnitude**

- Strong: Large arrow
- Medium: Medium arrow
- Low: Small arrow

## MANAGING ECOSYSTEM SERVICES

### FRESHWATER

### INCREASE RIPARIAN VEGETATION

**Provisioning Services**—providing goods that people can use.

**Cultural Services**—contributing to health, wellbeing and happiness.

**Regulating Services**—maintaining a healthy, diverse and functioning environment.

## PROVISIONING

**Food: *Strong Evidence***:- The area or width of buffer strips planted in North American catchments to capture Nitrogen run-off can take land out of production and consequently reduce overall yields<sup>1</sup>. This study provides evidence of the trade-off between buffer strips to control pollution and land removed from production. ***Moderate Evidence***:- Broadleaved riparian forestry makes an important contribution to the invertebrate food supply for brown trout in upland Welsh streams, more so than conifers<sup>2</sup>, though there is no proven link between this and commercial fisheries. The same effect occurs in Alaskan coho salmon streams, with deciduous vegetation providing a higher quantity of terrestrial invertebrates as food for juvenile salmon<sup>3</sup>.

## CULTURAL

**Biodiversity: *Strong Evidence***:- There is strong evidence from temperate North America that allowing riparian buffer zones to naturally regenerate significantly increase diversity in birds, with a 30 m wide buffer of grass, shrubs and trees producing a significant increase in bird species richness<sup>4</sup>. In the UK, carabid beetle diversity was lower where bankside vegetation was allowed to grow and habitat heterogeneity was necessary to maximise diversity<sup>5</sup>. ***Moderate evidence***:- A Hungarian study shows that some bird species benefit from the regeneration of thick marsh vegetation<sup>6</sup>.

**Health & Wellbeing: *Strong evidence***:- In the UK where there is strong evidence that riparian vegetation can reduce the amounts of *E. coli* from cattle faecal matter discharging into bathing waters<sup>7</sup>. The same effect is shown by a study from Canada where vegetated strips at the outflow of municipal wastewater plants reduces not only the level of nitrogen and phosphorus, but also the levels of *E. coli* bacteria discharged into water courses which may affect human health<sup>8</sup>.

**Climate Regulation: Strong evidence:-** The stock of carbon stored in riparian systems is much larger than other terrestrial habitats, with up to 354 t ha<sup>-1</sup> stored both above and below ground (up to 1 m below the surface) in Austrian wetlands<sup>9</sup>. This quantity depends on the nature of the vegetation, with hardwood floodplain forests storing the most carbon, and floodplain meadows the least (212 t ha<sup>-1</sup>)<sup>9</sup>. Evidence from controlled field experiments has shown that nitrous oxide (a greenhouse gas) can be released by *Phragmites australis* from experimental control plots flooded with municipal sewage<sup>10</sup>. There is also strong evidence that methane emission is enhanced by the growth of sedges at a wetland nature reserve in the Netherlands<sup>11</sup> which appears to be due to the plants transporting the gas to the surface and also enhancing the development of methanogens. In terms of thermal management of river systems, there is evidence from the UK that shading by trees has a beneficial effect on the control of water temperature for brown trout<sup>12,13</sup>.

**Water Quality: Strong evidence:-** In the USA, it was found that a buffer strip 20-30 m wide along a river could reduce diffuse agricultural nitrate run-off by up to 100% through denitrification<sup>14</sup>. Narrower riparian strips of 5-8 m were also found to be almost 100% effective at removing nitrates through denitrification of diffuse agricultural run-off in an Italian watershed<sup>15</sup>. Restored wetlands planted with *Phragmites australis*, *Typha latifolia* and *Scirpus lacustris* receiving run-off from rice-fields in Spain were able to remove almost all of the nitrogen throughput by a mix of denitrification, plant uptake and detritus accumulation<sup>16</sup>. Vegetated filter strips used in combination with other filters can be very effective in nutrient, pollutant and bacterial removal from municipal sewage waste<sup>17</sup>. An additional benefit is that shading of a water course by bankside vegetation reduces phytoplankton load by as much as 44%, increasing water clarity<sup>18</sup>. **Moderate evidence:-** Vegetation in small ditches away from larger water bodies can also absorb nutrients<sup>19</sup>. This means that smaller water bodies, ditches and seepage areas can remove significant amounts of nitrates.

**Flood Control: Moderate evidence:-** A study in California found that allowing woody shrubs and small trees to grow on levees increases their structural integrity and hence reduces flood risk caused by flood defence failure<sup>20</sup>. In the UK, models show that floodplain forest can slow flow rates of flooding, increasing flood storage capacity between 15-71% which would alleviate downstream flooding<sup>21</sup>.

**Erosion Control: Strong evidence:-** A North American study found that a riparian buffer strip reduces the amount of sediment entering a stream by 4.8 tonnes per hectare per year<sup>22</sup>. Some of the sediment accumulations amounted to 4cm in three years within the strip.

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