Table X. Information on cause of range contraction for species with extreme contractions at the leading range edge. For the species with extreme range contractions at their leading range edge (n = 25 species; n = 29 range shift observations), we searched the literature for information about the cause of the contraction and include our findings here.

|  |  |  |
| --- | --- | --- |
| Species | Range shift rate (km/y) | Comment & reference |
| *Cathartes aura*  (turkey vulture) | -25.31 | Many reports of species range expanding in the literature; no evidence to support extreme contraction1,2 |
| *Troglodytes aedon*  (house wren) | -20.92 | No information available |
| *Plegadis falcinellus*  (glossy ibis) | -17.05 | Many reports of species range expanding in the literature; no evidence to support extreme contraction3 |
| *Chlidonias niger*  (black tern) | -16.6667 | Threatened by loss or degradation of wetland habitat used for breeding and foraging4 |
| *Aegithalos caudatus*  (long-tailed tit) | -15.8333 | Known decline in Finland, where study took place, due to forestry management practices and loss of habitat due to agriculture5 |
| *Sterna dougallii*  (roseate tern) | -15.125,  -5.5238 | Suffered significant decline and range contraction that has been attributed to human disturbance, depredation by gulls and rats, displacement from nesting sites by gulls and high tides and coastal erosion, and trapping in the African wintering grounds6 |
| *Progne subis*  (purple martin) | -12.704 | Population decline linked to decline in insects, predation, parasites, competitors for nest sites, and habitat changes, as well as the indirect effect of cold on insect populations7,8 |
| *Poecile palustris*  (marsh tit) | -10.4845 | Cause of northern range edge contraction not known, but hypothesized to be because of forest fragmentation, specialist diet, deer grazing on habitat, and increased competition9 |
| *Lissotriton vulgaris*  (smooth newt) | -8.8794,  -5.5714 | No information available |
| *Bubo virginianus*  (great horned owl) | -8.4956 | No information available |
| *Sturnus vulgaris*  (European startling) | -8.3333 | Contraction at north of range in Finland, where study took place, due to abandonment of dairy farms10 |
| *Hylocichla mustelina*  (wood thrush) | -7.9148 | Range-wide decline due to loss of habitat and connectivity11 |
| *Buteo regalis*  (Ferruginous hawk) | -7.6 | Contraction of leading edge of breeding distribution has been documented, as has population decline across much of the range. Attributed to habitat alteration, availability of nest sites, and human disturbance12 |
| *Streptopelia turtur* (European turtledove) | -7.5,  -6.7948,  -6.2857 | Dramatic declines in Britain, where study took place, in association with habitat loss and hunting13 |
| *Linaria cannabina* (common linnet) | -7.5 | Declining in Finland, where study took place, potentially as a result of increased intensity of agriculture14 |
| *Gallinula chloropus* (common moorhen) | -7.0833 | No information available |
| *Carduelis carduelis* (European goldfinch) | -6.6667 | No information available |
| *Bufo bufo*  (common toad) | -6.5229 | No information available |
| *Anas acuta*  (northern pintail) | -6.375 | Reduction in breeding range size in Britain, where study took place, but cause is unknown15 |
| *Rana temporaria*  (common frog) | -5.9581 | Decline in Britain, where study took place, associated with viral infection16 |
| *Sylvia communis*  (common whitethroat) | -5 | Decline in Finland, where study took place, but cause is unknown17 |
| *Molothrus ater*  (brown-headed cowbird) | -4.5491 | Decline in Ontario, where study took place, but cause is not known18 |
| *Asio otus*  (long-eared owl) | -4.1667 | No information available |
| *Valeriana officinalis* (valerian) | -3.9869 | No information available |
| *Falco sparverius*  (American kestrel) | -3.87 | Widespread decline, with causes speculated to be declines in insect prey, habitat loss, and agricultural intensification19 |

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