**Appendix S2**. Summary of studies included in the review that have investigated trophic cascades (TC) involving at least one felid species (highlighted in bold) by type of trophic cascade. The location of the study, the environmental context (C) of the study site (*i.e.*, well-preserved [P] vs degraded [D]), the methodological approach (M) (*i.e*., hypothetical [H], spatial [S], temporal [T], spatiotemporal [ST], experimental [E]), their assessment of alternative hypotheses (AH) (*i.e*., untested [0], at least one tested but not bottom-up mechanisms [1], at least one tested including bottom-up mechanisms [2], controlled [3]), the type of cascading impacts studied (*i.e*., behaviorally-mediated [B], density-mediated [D]), a description of the focal trophic levels, the cascading impacts (positive, negative or neutral) within the food web, and whether the study identified a trophic cascade, are presented. Species that were not the direct focus of the study are shown in parentheses. The observed effects are represented by ‘↗’ or ‘↘’ when the populations of the trophic level mentioned before increased or decreased locally; by ‘(↗)’ or ‘(↘)’ when the risk of predation associated with the trophic level mentioned before and perceived by the trophic level mentioned after increased or decreased; by ‘─’ when no effect was demonstrated between trophic levels on either side of the symbol; by ‘nd’ when no robust data on their population trend were available. Results for which the authors acknowledged that other hypotheses could possibly explain the effects observed further down the trophic chain are marked with an asterisk. ‘Experimental’ studies that have identified a trophic cascade - and which are the closest to offering concrete evidence for causal relationships - are highlighted in grey.

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| **TC type** | **Continent** | **Country** | **C** | **M** | **AH** | **T** | **Trophic level 1** |  | **Trophic level 2** |  | **Trophic level 3** |  | **TC** | **References** |
| **Classic** |  | Kenya | P | S | 2 | B | (**Lion**, spotted hyena,  | (↘) | Mesoherbivores | ↗ | Grasses | ↘  | X | Riginos & Grace 2008 |
| **cheetah**) | Forbs | ↗ |
| Tanzania | P | E | 3 | B | **Lion** | (↗) | Mesoherbivores | ─ | Tree seedlings | ─ |   | Donaldson et al. 2022 |
| Kenya | P | E | 3 | B | **Leopard**, wild dog | (↘) | Impala | ↗ | Less-thorny trees  | ↘  | X | Ford et al. 2014 |
| Thorny trees | ↗ |
| Mozambique | D | E | 3 | B | (**Leopard**, spotted hyena, wild dog) | ↘ | Bushbuck | ↗ | *Bergia mossambicensis* | ↘  | X | Atkins et al. 2019 |
| Asia | Malaysia | D | H | 0 | D | (**Tiger**, **leopard**)\* | ↘ | Wild boar | ↗ | Sapling growth, density and richness | ↘  | X | Ickes et al. 2001 |
| Malaysia | D | H | 0 | D | (**Tiger**, **leopard**)\* | ↘ | Wild boar | ↗ | Dipterocarpaceae | ↘  | X | Ickes et al. 2005 |
| Europe | Poland | P | H | 0 | B | (**Eurasian lynx**) | (↗) | (Eurasian beaver) | ↘  | Aspen | ↗ | X | Rosell & Czech 2000 |
| Switzerland | P | T | 1 | D | **Eurasian lynx** | ↗ | Ungulates | ↘  | Silver fir | ↗ | X | Schnyder et al. 2016 |
| Germany | P | E | 3 | B | (Wolf, **eurasian lynx**) | (↗) | Red deer | ↘  | Silver fir, Rowan | ↗ | X | van Beeck Calkoen et al. 2021 |
| Norway | P | E | 3 | D | **Eurasian lynx** | ↗ | Roe deer | ↘  | Vegetation, soil nutriments | ─ |   | Teurlings et al. 2020 |
| North America | USA | D | H | 0 | D | **Puma** | ↘ | Mule deer | ↗ | Riparian cottonwood trees | ↘  | X | Ripple & Beschta 2006 |
| USA | P | H | 0 | D | **Puma** | ↘ | (Mule deer) | ↗ | Oak | ↘  | X | Ripple & Beschta 2008 |
| USA | P | S | 1 | B | **Puma** | (↗) | Donkey | ↘  | Wetland vegetation | ↗ | X | Lundgren et al. 2022 |
| USA | D | H | 0 | B | (**Bobcat**) | (↗) | (Woodchuck) | nd | Fruit trees | ↗ | X | Swihart 1991 |
| USA | D | H | 1 | B | (**Bobcat**, coyote, red fox) | (↗) | (Oldfield mice) | nd | Seeds | ─ |   | Orrock et al. 2004 |
| USA | D | E | 3 | B | (**Bobcat**, coyote, red fox) | (↗) | Meadow vole | ─ | Red mapple seedlings | ─ |   | Pusenius & Ostfeld 2002 |
| USA | P | T | 0 | D | **Bobcat** | ↗ | White-tailed deer | ↘  | Oak | ↗ | X | Diefenbach et al. 2009 |
| Canada | P | E | 3 | D | **Canada lynx** | ↘ | Snowshoe hare | ↗ | Willow, birch seedlings | ─ |   | Sinclair et al. 2000 |
| Panama | D | H | 0 | D | **(Jaguar**, **puma)**\* | ↘ | (Mid-sized mammals) | nd  | Seed predation | ↗ | X | De Steven & Putz 1984 |
| Panama | D | S | 0 | D | **Jaguar**, **puma** | ↘ | Mid-sized mammals | ─ | Vegetation | ─ |   | Wright et al. 1994 |
| Panama | D | H | 0 | D | **(Jaguar**, **puma)** | ↘ | (Mid-sized mammals) | nd  | Seed predation | ↗ | X | Asquith et al. 1997 |
| Panama | D | E | 3 | B | **Ocelot** | (↗) | Agouti | ↘  | American oil palm | ↘  | X | Gálvez & Hernández 2022 |
| South America | Venezuela | D | S | 2 | D | **Jaguar**, **puma**, harpy eagle | ↘ | Herbivores, rodents | ↗ | Tree seedling and sapling density and diversity | ↘  | X | Terborgh et al. 2001, 2006 |
| Argentina | P | E | 3 | B | **Puma** | (↗) | Vicuña | ↘  | Herbaceous vegetation | ↗ | X | Donadio & Buskirk 2016 |
| Brazil | D | H | 0 | D | (**Jaguar**, **ocelot**, eagles) | ↘ | Black capuchin | ↗ | Palmito | ↘  | X | Portela & Dirzo 2020 |

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| **TC type** | **Continent** | **Country** | **C** | **M** | **AH** | **T** | **Trophic level 1** |  | **Trophic level 2** |  | **Trophic level 3** |  | **TC** | **References** |
| **Intraguild** | Africa | South Africa | D | H | 0 | D | (**Lion**, spotted hyena, **leopard**, jackal, **caracal**) | ↘ | (Mongoose) | nd | Birds | ─ |   | Lloyd 2007 |
| Ghana | D | ST | 2 | D | **Lion**, **leopard** | ↘ | Olive baboon | ↗ | Small primates and ungulates | ↘  | X | Brashares et al. 2010 |
| Kenya | D | H | 0 | D | (**Leopard**)\* | ↘ | (Mesopredators) | nd | Birds | ↗ | X | Maina & Jackson 2003 |
| (Dog)\* | ↗ |
| Asia | India | P | T | 2 | D | **Tiger** | ↗ | **Leopard** | ↘  | Livestock and small prey | ↘  | X | Harihar et al. 2011 |
| Thaïland | D | S | 2 | D | **Tiger** | ↘ | Dhole\* | ↗ | Muntjac | ↘  | X | Steinmetz et al. 2013 |
| Bhutan | P | S | 0 | B | **Tiger** | ↘ | **Leopard**, dhole | ↗ | Livestock | ↘  | X | Thinley et al. 2018 |
| Wild herbivores | ↗ |
| India | P | T | 2 | D | Dhole | ↘ | **Tiger** | ↗ | **Leopard** | ↘  | X | Reddy et al. 2019 |
| Europe | Finland | P | ST | 2 | D | **Eurasian lynx** | ↗ | Red fox | ↘  | Mountain hare | ↗ | X | Elmhagen et al. 2010 |
| Spain | D | S | 0 | D | **Iberian lynx** | ↗ | Mongoose | ↘  | Rabbit | ↗ | X | Palomares et al. 1995 |
| Spain | P | ST | 2 | D | **Iberian lynx** | ↗ | Red fox, mongoose | ↘  | Rabbit, partridge | ↗ | X | Jiménez et al. 2019 |
| Spain | P | S | 2 | B | **Iberian lynx** | ↗ | Red fox | ↘  | Iberian pear | ↘  | X | Burgos et al. 2022 |
| North America | USA | D | H | 0 | D | (**Puma**, **bobcat**, raptors)\* | ↘ | (Racoon, gray squirrel) | nd | Birds | ↘  | X | Wilcove 1985 |
| USA | P | E | 3 | B | **Puma** | (↗) | **Bobcat**, fisher, gray fox (mesocarnivores) | ↘  | Ringtail, spotted skunk (small carnivores) | ↗ | X | Allen et al. 2015 |
| USA | D | T | 2 | B | **Puma** | ↘ | Coyote | ↗ | Gray fox | ↘  | X | Leempoel et al. 2019 |
| **Bobcat** | ─ | Mule deer  | ↗ |
| USA | D | S | 1 | B | **Puma** | (↘) | Coyote, raccoon | ↗ | Grey fox, striped skunk, opossum | ↘  | X | Wang et al. 2015, 2020 |
| USA | P | E | 3 | D | Coyote | ↘ | **Bobcat**, badger, gray fox | ↗ | Rodent richness | ↘  | X | Henke & Bryant 1999 |
| Rodent & rabbit density | ↗ |
| Panama | D | H | 0 | D | (**Jaguar**, **puma**)\* | ↘ | White-faced capuchin, coati | ↗ | Birds | ↘  | X | Sieving 1992 |
| South America | Amazon region | D | S | 2 | B | **Jaguar**, **puma** | ↘ | **Ocelot**  | ─ | **Northern tigrina**  | ↘  |   | de Oliveira et al. 2010, 2022 |
| Brazil | D | S | 2 | D | **Jaguar**, **puma**, **ocelot**, **jaguarundi**, **margay** | ↘ | Armadillo | ↗ | Herbivorous leafcutter ants | ─ |   | Palmeirim et al. 2021 |
| Peru | P | T | 0 | D | **Jaguar**  | ↘ | **Puma**, **ocelot** | ↗ | Green acouchy | ↘  | X | Whitworth et al. 2022 |
| Argentina | P | T | 0 | D | **Puma**\* | ↗ | Culpeo fox | ↘  | Chilla fox | ↗ | X | Díaz-Ruiz et al. 2020 |
| Argentina | P | E | 3 | B | **Puma** | (↗) | Culpeo fox | ↘  | Chilla fox | ↗ | X | Rodriguez Curras et al. 2021, 2022 |

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| **TC type** | **Continent** | **Country** | **C** | **M** | **AH** | **T** | **Trophic level 1** |  | **Trophic level 2** |  | **Trophic level 3** |  | **Trophic level 4** |  | **TC** | **References** |
| **Human-induced** | Africa | Kenya | D | ST | 2 | D | Human | ↗ | **Lion** | ↘ | Spotted hyena | ↗ | Livestock | ↘  | X | Green et al. 2018 |
| Europe | Switzerland | D | ST | 1 | B | Human | ↗ | **Eurasian lynx** | ↗ | Roe deer | ↘  |   |   | X | Gehr et al. 2018 |
| Poland | D | S | 2 | B | Human | ↗ | **Eurasian lynx** | (↘) | Ungulates | ─ | *Acer* and *Carpinus* seedlings | ─ |   | Bubnicki et al. 2019 |
| Czech Republic | D | S | 2 | B | Human | ↗ | **Eurasian lynx** | ─ | Roe deer, red deer | ↘  |   |   |   | van Beeck Calkoen et al. 2022 |
| North America | Canada | D | S | 2 | B | Human | ↗ | **Puma**, wolf, grizzli bear, black bear | ↘  | Ungulates | ↗ |   |   | X | Muhly et al. 2011 |
| USA | D | S | 1 | B | Human | ↗ | **Puma** | ↘  | Mesocarnivores | ─ |   |   |   | Wang et al. 2015 |
| USA | D | E | 3 | B | Human | ↗ | **Puma** | ↘  | Deer | ↘  |   |   | X | Smith et al. 2015, 2017 |
| USA | D | S | 2 | B | Human | ↗ | **Puma**, **bobcat**, black bear, coyote | ↘  | Mule deer | ↗ |   |   | X | Lendrum et al. 2018 |
| USA | D | E | 3 | B | Human | (↗) | **Puma**, **bobcat**, skunk, oppossum | ↘  | Deer mouse | ↗ |  |  | X | Suraci et al. 2019 |
| USA | D | S | 2 | B | Human | ↗ | **Puma** | ↘  | Mule deer | ↗ |   |   | X | Ditmer et al. 2021 |
| USA | D | S | 2 | B | Human | ↗ | **Puma** | (↘) | Mule deer | ↗ | Woody vegetation | ↘  | X | Yovovich et al. 2021 |
| Bushy vegetation | ↗ |
| South America | Ecuador | D | S | 2 | B | Human | ↗ | **Jaguar** | ↘ | **Puma** | ↗ | **Ocelot**, **jaguarundi**, **margay** | ↘  | X | Gil-Sánchez et al. 2021 |
| Argentina | D | S | 2 | B | Human | ↗ | **Puma** | ↘  | **Geoffroy's cat**, hog-nosed skunk | ↗ |   |   | X | Zanón Martínez et al. 2022 |
| **Pampas cat**, pampas fox | ─ |  |  |  |
| Argentina | D | S | 2 | B | Human | ↗ | **Ocelot**  | ↘  | **Southern tigrina** | ↗ |   |   | X | Cruz et al. 2018 |

Additional references (not cited in the main document)

Asquith NM, Wright SJ, Clauss MJ (1997) Does mammal community composition control recruitment in Neotropical forests? Evidence from Panama. *Ecology* 78: 941–946.

Bubnicki JW, Churski M, Schmidt K, Diserens TA, Kuijper DPJ (2019) Linking spatial patterns of terrestrial herbivore community structure to trophic interactions. *eLife* 8: e44937.

Díaz-Ruiz F, Rodríguez A, Procopio D, Zapata S, Zanón-Martínez JI, Travaini A (2020) Inferring Species Interactions from Long-Term Monitoring Programs: Carnivores in a Protected Area from Southern Patagonia. *Diversity 2020, Vol. 12, Page 319* 12: 319.

Ditmer MA, Stoner DC, Francis CD, Barber JR, Forester JD, Choate DM et al. (2021) Artificial nightlight alters the predator–prey dynamics of an apex carnivore. *Ecography* 44: 149–161.

Ickes K, Dewalt SJ, Appanah S (2001) Effects of native pigs (Sus scrofa) on woody understorey vegetation in a Malaysian lowland rain forest. *Journal of Tropical Ecology* 17: 191–206.

Leempoel K, Meyer J, Hebert T, Nova N, Hadly EA (2019) Return of an apex predator to a suburban preserve triggers a rapid trophic cascade. *bioRxiv*: 564294.

Lloyd P (2007) Predator control, mesopredator release, and impacts on bird nesting success: a field test. *African Zoology* 42: 180–186.

de Oliveira T, Fox-Rosales LA, Paemelaere EAD, de Barros Ferraz KMPM (2022) The dominant mesopredator and savanna formations shape the distribution of the rare northern tiger cat (Leopardus tigrinus) in the Amazon. *Scientific Reports* 12: 18697.

de Oliveira T, Tortato MA, Silveira L, Kasper CB, Mazim FD, Lucherini M et al. (2010) Ocelot ecology and its effect on the small-felid guild in the lowland neotropics. In: Macdonald D, Loveridge A (eds) *Biology and Conservation of Wild Felids*, 559–580. Oxford University Press, Oxford, UK.

Orrock JL, Danielson BJ, Brinkerhoff RJ (2004) Rodent foraging is affected by indirect, but not by direct, cues of predation risk. *Behavioral Ecology* 15: 433–437.

Portela R de CQ, Dirzo R (2020) Forest fragmentation and defaunation drive an unusual ecological cascade: Predation release, monkey population outburst and plant demographic collapse. *Biological Conservation* 252: 108852.

Pusenius J, Ostfeld RS (2002) Mammalian predator scent, vegetation cover and tree seedling predation by meadow voles. *Ecography* 25: 481–487.

Reddy CS, Yosef R, Calvi G, Fornasari L (2019) Inter-specific competition influences apex predator-prey populations. *Wildlife Research* 46: 628–638.

Ripple WJ, Beschta RL (2008) Trophic cascades involving cougar, mule deer, and black oaks in Yosemite National Park. *Biological Conservation* 141: 1249–1256.

Rodriguez Curras M, Donadío E, Middleton AD, Pauli JN (2021) Perceived risk structures the space use of competing carnivores. *Behavioral Ecology* 32: 1380–1390.

Rosell F, Czech A (2000) Responses of foraging Eurasian beavers Castor fiber to predator odours. *Wildlife Biology* 6: 13–21.

Schnyder J, Ehrbar R, Reimoser F, Robin K (2016) Ungulate populations and browsing intensities following the reintroduction of lynx in the canton of St. Gallen. *Schweizerische Zeitschrift fur Forstwesen* 167: 13–20.

Sieving KE (1992) Nest Predation and Differential Insular Extinction among Selected Forest Birds of Central Panama. *Ecology* 73: 2310–2328.

Sinclair ARE, Krebs CJ, Fryxell JM, Turkington R, Boutin S, Boonstra R, Seccombe-Hett P, Lundberg P, Oksanen L (2000) Testing hypotheses of trophic level interactions: A boreal forest ecosystem. *Oikos* 89: 313–328.

Steinmetz R, Seuaturien N, Chutipong W (2013) Tigers, leopards, and dholes in a half-empty forest: Assessing species interactions in a guild of threatened carnivores. *Biological Conservation* 163: 68–78.

De Steven D, Putz FE (1984) Impact of Mammals on Early Recruitment of a Tropical Canopy Tree, Dipteryx panamensis, in Panama. *Oikos* 43: 207–216.

Swihart RK (1991) Modifying Scent-Marking Behavior to Reduce Woodchuck Damage to Fruit Trees. *Ecological Applications* 1: 98–103.

Whitworth A, Beirne C, Basto A, Flatt E, Tobler M, Powell G, Terborgh J, Forsyth A (2022) Disappearance of an ecosystem engineer, the white-lipped peccary (Tayassu pecari), leads to density compensation and ecological release. *Oecologia* 199: 937–949.

Wilcove DS (1985) Nest predation in forest tracks and the decline of migratory songbirds. *Ecology* 66: 1211–1214.

Wright SJ, Gompper ME, DeLeon B (1994) Are Large Predators Keystone Species in Neotropical Forests? The Evidence from Barro Colorado Island. *Oikos* 71: 279–294.