Table S1. Tree-killing bark beetles. Of the roughly 2,000 bark beetle species, less than a dozen are tree-killers. These beetles belong to only four genera (*Dendroctonus*, *Ips*, *Scolytus*, *Tomicus*), all colonize conifers, and most use pheromone-mediated mass attacks to overwhelm host tree defences. Here we summarize several attributes for the species for which the most information exists and that are most often referred to in this review.

Beetle	Host	Colonization strategy	Colonizing sex	Main pheromone components	Gens /yr	Brood size	Over-wintering	Location of feeding	Feeding strategy	Mycangia	References
*Dendroctonus brevicomis**	*Pinus ponderosa*	Aggressive secondary	Female, monogamous	A: exobrevicomin, frontalin AA: trans-verbenol, verbenone, ipsdienol	1–2	Up to 100 eggs	In tree, late-stage larvae	Very little in phloem, most in feeding chambers in outer bark	Fungi-dependent	Sac mycangia, female only	Bracewell & Six (2014); Bracewell *et al*. (2018); Six & Elser (2019); Valerio-Medoza *et al*. (2019); Sullivan *et al*. (2021)
D. frontalis	*Pinus*	Aggressive secondary	Female, monogamous	A: frontalin, trans-verbenol, endo-brevicomin AA: verbenone, myrtenol	1–6	Up to 160 eggs	In tree, all stages	Substantial feeding in phloem switching to chambers in outer bark	Fungi-dependent	Sac mycangia, female only	Ayres *et al*. (2000); Yuceer *et al*. (2011)
D. ponderosae	*Pinus*	Aggressive primary	Female, monogamous	A: trans-verbenol, exobrevicomin AA: frontalin, exo-brevicomin	1	Up to 80 eggs	In tree, late-stage larvae	Phloem	Fungi-dependent	Sac mycangia, female and male	Bleiker & Six (2007); Bleiker *et al*. (2009); Erbilgin *et al*. (2014)
D. rufipennis	*Picea*	Aggressive secondary	Female, monogamous	A: frontalin, 1-methyl-2-cyclohexen-1-ol,	1	Up to 100 eggs	In tree, larvae, diapause	Phloem	Likely fungi-dependent	Unknown, likely pit mycangia	Six & Bentz (2007); Schebeck *et al*.

				suedenol, verbenene AA: 3-methylcyclohex-2-en- 1-one							(2017); Isitt *et al*. (2020)
Ips typographus	*Picea*	Aggressive secondary	Male, polygamous	A: *cis*-verbenol, 2-methyl-3-buten-2-ol AA: verbenol, ipsenol	1–2	Up to 80 eggs, faculta-tive diapause	Adults in duff or in trees	Phloem	Unknown	Unknown	Schlyter *et al*. (1987); Kirisits (2004); Persson *et al*. (2009); Fruhbrodt *et al*. (2023)
I. pini	*Pinus*	Weakly aggressive secondary	Male, polygamous	A: + ipsdienol, – ipsdienol AA: none known	1–3	Up to 60 eggs	Larvae or adults in trees, less commonly adults in duff	Phloem	Fungi-dependent	Pit mycangia, likely female and male	Reid & Roitberg (1994); Furniss *et al*. (1995); Seybold *et al*. (1995); Six & Elser (2020)

*Recently split into two species, *D. brevicomis* and *D. barberi* (Valerio-Medoza *et al*., 2019; Sullivan *et al*., 2021) whose designation is supported by co-divergence of the fungal communities associated with each (Bracewell *et al*., 2018). We use the older synonym as the distribution and many attributes of the two cryptic species have yet to be described.
A = aggregation pheromone; AA = anti-aggregation pheromone; Gens/yr = generations per year.

Table S2. Bark beetle fungus symbionts. Bark beetles carry and develop with an array of filamentous fungi. Most are from Ascomycota in the Ophiostomatales but a few are from Ascomycota in the Microascales or Basidiomycota in the Russulales. Associations range from incidental commensals to antagonistic to facultative or obligate mutualisms. Fungi in obligate mutualisms with a beetle are carried from the natal tree to new trees in specialized structures of the adult exoskeleton (mycangia) that enforce vertical transmission between generations. Incidental and antagonistic fungi are more loosely transported on the exoskeleton or, in some cases, by phoretic mites. The table summarizes various traits for the best-studied fungal associates of tree-killing beetles and those most often referred to in this review.

Beetle	Fungus	Known roles of fungus	Functional classification	Fidelity	References
Dendroctonus brevicomis	*Entomocorticium parmeteri*	Nutritional mutualist	White rot decomposer	Obligate, mycangial	Bracewell *et al*. (2018); Six & Elser (2019); Harrington *et al*. (2021); Araujo *et al*. (2021)
	E. macrovesiculum	Nutritional mutualist	White rot decomposer	Obligate, mycangial	
	E. perryae	Nutritional mutualist	White rot decomposer	Obligate, mycangial	
	E. kirisitsii	Nutritional mutualist	White rot decomposer	Obligate, mycangial	
	Ceratocystiopsis brevicomi	Nutritional mutualist	Non-rot	Obligate, mycangial	
	Ceratocystiopsis sp.	Nutritional mutualist	Non-rot	Obligate, mycangial	
	Ophiostoma minus	Antagonist	Necrotroph	Phoretic incidental, prevalence often driven by mite vectors	
D. frontalis	*E. cobbii*	Nutritional mutualist	White rot decomposer	Obligate, mycangial	Ayres *et al*. (2000); Lombardero *et al*. (2003); Harrington *et al*. (2021)
	C. ranaculosus	Nutritional mutualist	Non-rot	Obligate, mycangial	
	O. minus	Antagonist	Necrotroph	Phoretic incidental, incidence often driven by mite vectors	
D. ponderosae	*O. montium*	Nutritional mutualist	Necrotroph	Obligate, mycangial	Six & Paine (1998); Bleiker & Six (2007);

	Grosmannia clavigera	Nutritional mutualist, detoxifies some terpenes	Necrotroph	Obligate, mycangial	Bleiker *et al*. (2009); DiGuistini *et al*. (2011); Tsui *et al*. (2019)
	Leptographium longiclavatum	Nutritional mutualist	Necrotroph	Obligate, mycangial	
D. rufipennis	*L. abietinum*	Likely nutritional mutualist	Necrotroph	Likely obligate, in pits	Six & Bentz (2007)
Ips typographus	Non-specific fungi including many Ophiostomatales (*Grosmannia penicillata*, *Ophiostoma bicolor*) and *Endoconidiophora polonica* (Microascales)	No apparent nutritional effects, some detoxify terpenes and phenolics	Mix of necrotrophs and non-rot	Unknown, current evidence not sufficient for definite conclusions, incidence often driven by environmental factors, geography, and co-occurring bark beetles and their symbiont communities	Kirisits (2004); Chang *et al*. (2019); Marincowitz *et al*. (2020); Zhao *et al*. (2019)
I. pini	*O. ips*	Nutritional mutualist	Necrotroph	Likely obligate, in pit mycangia	Furniss *et al*. (1995); Six & Elser (2020)

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