Australia/New Zealand Weed Risk Assessment adapted for United States (see Gordon and Gantz 2008)

Data used for analysis published in: Gordon, D.R., K.J. Tancig, D.A. Onderdonk and C.A. Gantz. In press. Assessing the invasive potential of biofuel species proposed for Florida and the United States using the Australian weed risk assessment. Biomass and Bioenergy. doi:10.1016/j.biombioe.2010.08.029.

Eucalyptus camaldulensis -- United States test			
	Question	**Answer**	**Score**
1.01	Is the species highly domesticated?	n	0
1.02	Has the species become naturalised where grown?		
1.03	Does the species have weedy races?		
2.01	Species suited to U.S. climates (USDA hardiness zones; 0-low, 1-intermediate, 2-high)	2	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	2	
2.03	Broad climate suitability (environmental versatility)	?	
2.04	Native or naturalized in regions with an average of 11-60 inches of annual precipitation	y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	y	2
3.02	Garden/amenity/disturbance weed	n	0
3.03	Weed of agriculture	n	0
3.04	Environmental weed	y	4
3.05	Congeneric weed	y	2
4.01	Produces spines, thorns or burrs	n	0
4.02	Allelopathic	?	
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	?	
4.05	Toxic to animals	n	0
4.06	Host for recognised pests and pathogens	?	
4.07	Causes allergies or is otherwise toxic to humans	n	0

4.08	Creates a fire hazard in natural ecosystems		
4.09	Is a shade tolerant plant at some stage of its life cycle	?	
4.10	Grows on one or more of the following soil types: alfisols, entisols, or mollisols	y	1
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets	y	1
5.01	Aquatic	n	0
5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat	n	0
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally	y	1
6.04	Self-compatible or apomictic	?	
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative fragmentation	n	-1
6.07	Minimum generative time (years)	3	0
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
7.02	Propagules dispersed intentionally by people	y	1
7.03	Propagules likely to disperse as a produce contaminant	n	-1
7.04	Propagules adapted to wind dispersal	?	
7.05	Propagules water dispersed	y	1
7.06	Propagules bird dispersed		
7.07	Propagules dispersed by other animals (externally)	n	-1
7.08	Propagules dispersed by other animals (internally)		
8.01	Prolific seed production	?	
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	n	-1
8.03	Well controlled by herbicides	?	

8.04	Tolerates, or benefits from, mutilation or cultivation	y	1
8.05	Effective natural enemies present in U.S.		
Total Score			12

Outcome	Reject

section	# questions answered	satisfy minimum?
A	10	Yes
B	7	Yes
C	16	Yes
total	33	Yes

Data collected 2008

Question number	Reference	Source data
1.01		Cultivated, but no evidence of selection for reduced weediness.
1.02		
1.03		
2.01	1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lgnd.tif). 2. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 3. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network-(GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?15867 Accessed June 2, 2008. 4. Wagner, WL et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum	1. Global plant hardiness zones (8?-)9-12. 2. "Its natural distribution area covers most of the Australian mainland, ranging from 12°48'S in the tropical Northern Territory to 38°15'S in cool, temperate Victoria."; "Mean annual temperatures from 13-28°C." 3. "Distributional range: Native: Australasia; Australia- New South Wales, Northern Territory, Queensland, South Australia, Victoria, Western Australia. Other: widely cultivated elsewhere." 4. "Native to much of mainland Australia, particularly in drier areas". 5. "Origin: Australia (all states except Tasmania)." 6. "Widely grown throughout the low rainfall areas of tropical Africa; indigenous in extensive parts of the Australian mainland". 7.

	Press, Honolulu. 5. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 6. Edwards, S, et al, eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 7. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 8. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 9. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 10. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 11. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 12. Nieto, VM, Rodriguez, J. *Eucalyptus camaldulensis* Dehnh. Corparacion Nacional de Investigacion of Forestal Santafe de Bogata, Colombia.	"Distribution: Native to most parts of Australia." 8. "Its range of latitude is from 12° 48'S on the Mary River in the Northern territory to 38° 15'S in south-western Victoria."; "*E. camaldulensis* seedlings survive winter frosts to about -10°C in the higher reaches of streams in the south-east of Australia and about -7°C in the semi-desert areas near the centre of the continent. The lowest temperatures on record within the range of *E. camaldulensis* are -9°C at Yass, New South Wales, -7°C at Alice Springs, Northern Territory, and -8°C near Lake Albacutya, Victoria." 9. "The most widespread eucalypt on the mainland of Australia; found in all states except Tasmania; there is a southern (temperate zone) form and a tropical form." [*E. camaldulensis* var. *camaldulensis*]; "Latitudinal range. 15.5°-38°S."; "Mean minimum of coldest month: 11-20°C."; "In Turkey frosts of -7°C for a single day are considered as usually fatal to young trees." 10. "Temperature, Minimum (°F): 17." 11. "Hardy down to 3°C though some provenances can withstand -5°C and as many as 20 frosts a year." 12. "*Eucalyptus camaldulensis* is native to Australia."; "The trees grow in temperatures ranging from 20 to 28°C".
2.02		
2.03	1. Köppen-Geiger climate map (http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf). 2. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 3. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network-(GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?15867 Accessed June 2, 2008. 4. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition.	1. Possibly 3 climatic groups, but uncertain of exact distribution in Australia that would determine exact groups. 2. "Its natural distribution area covers most of the Australian mainland, ranging fom 12°48'S in the tropical Northern Territory to 38°15'S in cool, temperate Victoria.". 3. "Distributional range: Native: Australasia; Australia- New South Wales, Northern Territory, Queensland, South Australia, Victoria, Western Australia. Other: widely cultivated elsewhere." 4. "Native to much of mainland Australia, particularly in drier areas". 5. "Origin: Australia (all states except Tasmania)."

	Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 5. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 6. Edwards, S, et al., eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 7. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 8. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 9. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 10. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C.	6. "Widely grown throughout the low rainfall areas of tropical Africa; indigenous in extensive parts of the Australian mainland". 7. "Distribution: Native to most parts of Australia." 8. "Its range of latitude is from 12° 48'S on the Mary River in the Northern territory to 38° 15'S in south-western Victoria.". 9. "The most widespread eucalypt on the mainland of Australia; found in all states except Tasmania; there is a southern (temperate zone) form and a tropical form." [*E. camaldulensis* var. *camaldulensis*]; "Latitudinal range. 15.5°-38°S." 10. "Hardy down to 3°C though some provenances can withstand -5°C and as many as 20 frosts a year."
2.04	1. Australian Government, Bureau of Meteorology (http://www.bom.gov.au/cgi-bin/climate/cgi_bin_scripts/annual-monthly-rainfall.cgi). 2. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 4. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 5. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 6. Kenyon, CE (2005) Vegetation, fire and aboriginal impact on the mid-holocene moira marshes, New South Wales, Australia. Proceedings of the Royal Society of Victoria 117(1): 41-59. 7. USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 8. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 9. Nieto, V M, Rodriguez, J. *Eucalyptus camaldulensis* Dehnh. Corparacion Nacional de Investigacion of Forestal Santafe	1. For New South Wales: average annual precipitation ranges from 0 inches/year -- 94.49 inches/year; For the Northern Territory: average annual precipitation ranges from 0 inches/year -- 78.74 inches/year; For Queensland: average annual precipitation ranges from 0 inches/year -- 125.98 inches/year; For South Australia: average annual precipitation ranges from 0 inches/year -- 39.37 inches/year; For Victoria: average annual precipitation ranges from 0 inches/year -- 94.49 inches/year; For Western Australia: average annual precipitation ranges from 0 inches/year -- 78.74 inches/year. 2. "Annual rainfall in natural stands varies from 250-2500 mm [9.84 in -- 98.43 in], but planted trees can survive in areas with as little as 150 mm [5.91 in] annually." 3. "It is a drought resistant species and grows in areas receiving 200 mm [7.87 in] rainfall per annum, though growth is better where the annual rainfall exceeds 400 mm. [15.75 in]" 4. "Rainfall from 200 mm [7.87 in] to more than 1100 mm [43.31 in] annually". 5. "A minimum rainfall of about 400 mm. [15.75 in]"; "Rainfall 700-

	de Bogata, Colombia.	900 mm [27.56 in -- 35.43 in]". 6. "Annual precipitation of approximately 400 mm. [15.75 in]". 7. "Precipitation, Minimum: 20. Precipitation, Maximum: 100." 8. "In its native habitat the species is found both in areas of low and high rainfall (200-1,250 mm) [7.87 - 49.21 inches]. A lower limit for commercial plantations is 400 mm [15.75 inches] annual rainfall". 9. In Colombia, the species has been planted where precipitation is between 600 [23.62 inches] and 2900 mm [114.17 inches] and it can endure 4-to 8-month-long droughts."
2.05	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 3. Edwards, S, et al., eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 4. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 5. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 6. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 7. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 8. *Eucalyptus camaldulensis* from B & T World Seeds. URL: http://www.b-and-t-world-seeds.com/carth.asp?species=Sorghum%20bicolor&sref=5508. Accessed July 15, 2008.	1. *"E. camaldulensis* is planted in many tropical and subtropical countries and is probably the world's most widely planted tree in arid and semi-arid lands." 2. *Eucalyptus camaldulensis* has proven to be an excellent commercial crop in temperate, Mediterranean (Morocco and Spain), and tropical regions. 3. "In parks, trial plots and pilot plantations, woodlots, shelter belts, large scale plantations, and as single trees on farmland"; "Tried successfully at Alemaya, Menagesha and Beleta; planted at Mojo. One of the early introduced species of *Eucalyptus* and recorded by Breitenback as widely cultivated throughout Eritrea and Ethiopia, also in Eritrea in the Italian colonial period. *E. camaldulensis* is reported to be one of the most widely planted species in the Flora Zambesiaca area, and indeed in large parts of Africa where it is probably the most common tree planted in woodlots, shelter belts, and fuelwood plots; it is considered less important in large scale plantations." 4. "Cultivated throughout Malesia and in many tropical and subtropical parts of the world." 5. "Most widely planted eucalypts in the world." 6. "Over half a million hectares of plantations have been established, mainly in the Mediterranean region and particularly in Spain and

		Morocco using southern Australian provenances...Planting in the tropics, especially in south-east Asia and Brazil, is increasing with the increased availability of the climactically adapted northern Australian provenances." 7. "*E. camaldulensis* was one of the first species of eucalypts to be planted overseas. It was recorded planted as specimen trees in Naples in 1803 and was probably introduced to Italy before that; the first forest plantations in Italy were established in 1870. Its introduction into Pakistan was in 1867, and it was introduced into a number of African countries toward the end of the nineteenth century or the beginning of the twentieth. In Kenya it was one of the first species to be introduced and was recorded in 1903. The world plantation area at present is of the order of half a million hectares. It is the dominant species around the Mediterranean. Spain has reported over 114,000 hectares, mainly in the southwestern provinces, and Morocco over 87,000 hectares." 8. *Eucalyptus camaldulensis* seeds are for sale online.
3.01	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. Forsyth, GG, et al. (2004) A rapid assessment of the invasive status of *Eucalyptus* species in two South African provinces. South African Journal of Science 100: 75-77.	1. "It is naturalized in many areas." 2. *E. camaldulensis* is naturalized in Western Cape and Mpumalanga, South Africa.
3.02		No evidence.
3.03		No evidence.
3.04	1. Forsyth, GG, et al. (2004) A rapid assessment of the invasive status of *Eucalyptus* species in two South African provinces. South African Journal of Science. Vol. 100. Pp. 75-77. 2. Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council.	1. "Red river gum [*E. camaldulensis*] has transformed long stretches of rivers and its importance as a major weed has been underestimated in previous reviews of alien plant invasions in South Africa...Red river gum was found to be highly invasive along river courses in

		both the Western Cape (46% of observations classified as invasive) and in Mpumalanga (28% of observations classified as invasive). In the middle reaches of the Berg River and the lower reaches of the Sonderend River, this species now dominates the riverine vegetation and is clearly in the 'transformer' category...Red river gum is a major environmental weed." 2. "Invades: Perennial, seasonal and intermittent watercourses. Invasive status: transformer."
3.05	1. Holm, L, et al. (1979) A Geographical Atlas of World Weeds. John Wiley and Sons, New York. 2. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 3. Weber (2003) Invasive Plant Species of the World. CABI Publishing.	1. *Eucalyptus cambageana* is a Principal weed of agriculture in Australia. 2. *E. cladocalyx, E. diversicolor, E. grandis, E. lehmannii, E. paniculata, E. sideroxylon* are all considered invaders in South Africa. 3. E. cladocalyx is considered an environmental weed in southern Africa and Australia; E. diversicolor in southern Africa; and E. globulus in southern Europe, southern Africa, western US, and Hawaii.
4.01		No description of these traits.
4.02	1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Inderjit, et al. eds. (1999) Principles and Practices in Plant Ecology: Allelochemical Interactions. CRC Press, Boca Raton. 3. Water for a Healthy Country. Taxon Attribute Profiles: *Eucalyptus camaldulensis* Dehnh. URL: http://www.csiro.au/files/files/pbsl.pdf. Accessed July 18, 2008. 4. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C.	1. "Known Allelopath: Yes." 2. "Cremer (1990) reports that *E. camaldulensis* Dehnh. may exert a negative effect on the grazing yield of pasture in Western Australia"; "From an experiment in plantation mixed stands of...*Eucalyptus camaldulensis*…found that beans can be incompatible with eucalypts"; "According to Lisanework and Michelsen (1993), aqueous leaf extracts of...E. camaldulensis...significantly reduced both germination and radicle growth of tested crops such as chickpea (*Cicer arietinum* L.), maize (*Zea mays* L.), pea (*Pisum sativum* L.), and teff (*Eragrostis tef* Trotter) mostly starting from a concentration of 1 or 2.5 percent." 3. "It has been suggested that the relatively low species richness underneath *E. camaldulensis* stands in the Barmah forest may be a result of allelopathic

		suppression from the overstorey. However, others suggest it may be a result of flooding regimes and water stress." 4. "the tree kills other plants around it" [only actual data given involved concentrated extracts]
4.03		No description of parasitism.
4.04	1.National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 2. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 3. Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. (http://www.csiro.au/files/files/pbsl.pdf).	1. "The leaves are not favored by livestock or wildlife". 2. "Palatable Browse Animal: Low. Palatable Graze Animal: Low." 3. "Rabbits and kangaroos heavily graze seedlings during prolonged dry periods when feed is scarce (Dexter, 1978)...However, sapling growth is not, or rarely, grazed by stock unless animals are starved of other forage (Cunningham et al., 1981)."
4.05		No evidence.
4.06	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 3. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome.	1. "The heartwood is resistant to termites, but the sapwood is susceptible to attack by *Lyctus* borers."; "In the nursery, *E. camaldulensis* is susceptible to various fungi causing damping-off and leaf diseases."; "In South-East Asia, *E. camaldulensis* may be defoliated by fungi including *Cylindrocladium* spp. during the rainy season." 2. "Young trees and those weakened by drought can be badly infected by moth larvae, *eucalyptus* snout beetle, termites, and eucalypt borer." 3. "*E. camaldulensis* is susceptible to termite damage during its early years."; "In South Africa it is considered as not being very susceptible to attack by the snout beetle *Gonipterus*. It has however been attacked at Muguga in Kenya and also in Uruguay, where the parasite has been imported to combat the pest. *Phoracantha semipunctata* has attacked trees in Israel, mainly those weakened by drought. Additional pests recorded in Uruguya are species of *Platypus*, *Pantomorus*, and *Atta*."; "susceptible to the fungus *Oidium* in the nursery, especially during the early

		autumn rains."
4.07	1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 3. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 4. Food and Agriculture Organization of the United Nations. (1979) Eucalypts for Planting. Rome.	1. "Toxicity: None."; "Palatable Human: No." 2. "The flowers produce a first grade honey." 3. "Honey produced from the nectar is clear or pale in color, with a mild, pleasant flavor." 4. "Valuable for...honey". [and no other evidence of toxicity]
4.08		
4.09	1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands.	1. "Shade Tolerance: Intermediate." 2. "Shading is needed for the first week after transplanting, thereafter plants should be fully exposed."
4.10	1. USDA, National Resources Conservation Services (NRCS), Soil Survey Division, World Soil Resources (http://soils.usda.gov/use/worldsoils/mapindex/order.html). 2. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 4. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 5. National Academy of Sciences (1980) Firewood crops: Shrub and Tree Species for Energy Production. Washington, D.C. 6. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 7. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 8. Nieto, VM, Rodriguez, J. *Eucalyptus camaldulensis* Dehnh. Corparacion Nacional de Investigacion of Forestal Santafe	1. New South Wales: mostly aridisols and entisols with some ultisols and small amounts of inceptisols and mollisols (and also small amounts of oxisols and spodosols); Northern Territory: mostly entisols with some aridisols, inceptisols, and ultisols and a small amount of alfisols (and also with some shifting sands and a small amount of oxisols); Queensland: mostly alfisols, aridisols and ultisols with some entisols, a small amount of inceptisols, and a very small amount of mollisols (and also small amounts of oxisols and shifting sands); South Australia: mostly aridisols with some alfisols and entisols, a small amount of mollisols, and very small amounts of inceptisols and ultisols (and also small amounts of shifting sands and spodosols); Victoria: mostly alfisols with some ultisols, a small amount of aridisols, and very small amounts of entisols and mollisols (and also very small amounts of oxisols and spodosols); Western Australia: mostly aridisols and

	de Bogata, Colombia.	entisols with some alfisols, a small amount of inceptisols, and very small amounts of mollisols and ultisols (and also a small amount of shifting sands and a very small amount of spodosols). 2. "*E. camaldulensis* occurs on a variety of soils, commonly on sandy and silty alluvial soils, but occasionally on heavy clays in southern Australia...It is not adapted to calcareous soils, except for a few populations in southern and western Australia growing on shallow soils over limestone." 3. "Relatively poor soils...tolerates periodic waterlogging." 4. "Adapted to Coarse Textured Soils: Yes. Adapted to Fine Textured Soils: Yes. Adapted to Medium Textured Soils: Yes." 5. "It has the ability to thrive on relatively poor soils". 4. "The tree adapts well to a wide variety of soils". 6. "On a variety of soil types. Soils are typically alluvial silts and sands. Except for a few populations in South Australia and Western Australia that occur on shallow soils over limestone, the species is not adapted to calcareous soils." 7. "Relatively poor soils"; "The species is adapted to a wide variety of soils." 8. "The species adapts to a wide range of soils, from very poor to periodically flooded. It also grows in soils that are compacted by overpasturing or low annual humidity"; "In the first stages of establishment, the presence of underbrush, vertisols, calcareous soils, or sandy soils with low moisture retention limit growth."
4.11	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 3. USDA, NRCS. (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-	1. "Tree, commonly up to 20 m tall occasionally reaching 50 m with a trunk diameter of 1(-2) m; in open formations with a short, thick bole and a large, spreading crown". 2. "Tree 20-45 m tall." 3. "Growth Habit: Tree. Growth Form: Single Stem." 4. "Evergreen tree 18-40 m high with a spreading crown". 5. "Tree usually to 20 m high, sometimes reaching 40 m." 6. "A small to medium-sized, sometimes large tree of up to 20(-

	4490 USA. 4. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 5. Edwards, S, et al., eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 6. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 7. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 8. Nieto, VM, Rodriguez, J. *Eucalyptus camaldulensis* Dehnh. Corparacion Nacional de Investigacion of Forestal Santafe de Bogata, Colombia. 9. *Eucalyptus Camaldulensis* in Water for a Healthy Country. URL: http://www.anbg.gov.au/cpbr/WfHC/Eucalyptus-camaldulensis/index.html. Accessed July 15, 2008.	45) m tall." 7. "Tree height in Australia: 25-50 m...the crown tends to be thin." 8. "*Eucalyptus camaldulensis* is a fast-growing tree 25 to 30 m in height and 1 m d.b.h." 9. "*Eucalyptus camaldulensis* is a perennial, single-stemmed, large-boled, medium-sized to tall tree to 30 m high, although some authors record trees to 45 m."
4.12	Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. (http://www.csiro.au/files/files/pbsl.pdf).	"Dense stands of young plants appear over extensive areas after floods, at times forming impenetrable thickets."
5.01		Terrestrial.
5.02	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?15867 Accessed June 2, 2008.	*Myrtaceae*
5.03	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?15867 Accessed June 2, 2008.	*Myrtaceae*
5.04	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. Wagner, WL et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop	1. "Tree, commonly up to 20 m tall occasionally reaching 50 m with a trunk diameter of 1(-2) m; in open formations with a short, thick bole and a large, spreading crown". 2. "Tree 20-45 m tall." 3. "Growth Habit: Tree."; "Propagated by

	Museum special publication and University of Hawai'i Press/Bishop Museum Press, Honolulu. 3. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 4. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 5. Edwards, S, et al., eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 6. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 7. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 8. Nieto, VM, Rodriguez, J. *Eucalyptus camaldulensis* Dehnh. Corparacion Nacional de Investigacion of Forestal Santafe de Bogata, Colombia. 9. *Eucalyptus Camaldulensis* in Water for a Healthy Country. URL: http://www.anbg.gov.au/cpbr/WfHC/Eucalyptus-camaldulensis/index.html. Accessed July 15, 2008.	Bulb: No. Propagated by Corm: No. Propagated by Tubers: No." 4. "Evergreen tree 18-40 m high with a spreading crown." 5. "Tree usually to 20 m high, sometimes reaching 40 m." 6. "Tree usually to 20 m high, sometimes reaching 40 m." 6. "A small to medium-sized, sometimes large tree of up to 20(-45) m tall." 7. "Tree height in Australia: 25-50 m...the crown tends to be thin." 8. "*Eucalyptus camaldulensis* is a fast-growing tree 25 to 30 m in height and 1 m d.b.h." 9. "*Eucalyptus camaldulensis* is a perennial, single-stemmed, large-boled, medium-sized to tall tree to 30 m high, although some authors record trees to 45 m."
6.01		No evidence.
6.02	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 3. National Academy of Sciences (1980) Firewood crops: Shrub and Tree Species for Energy Production. Washington, D.C. 4. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 5. Nieto, VM, Rodriguez, J. *Eucalyptus camaldulensis* Dehnh. Corparacion Nacional de Investigacion of Forestal Santafe de Bogata, Colombia.	1. "Seedling with epigeal germination and bilobed cotyledons"; "The germination rate is generally high and can reach almost 100%."; "Usually propagated by seed." 2. "Propagated by Seed: Yes." 3. "Seed germination is high and seeds are long-lived". 4. "Viable seeds per gram: 773." 5. "Normally, the seeds of this species present high germination percentages (greater than 90 percent) without pregermination treatment."
6.03	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. Edwards, S, et al.,	1. "Where both species [*E. camaldulensis* and *E. tereticornis*] grow naturally, as in eastern Victoria and Queensland, hybridization and

	eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 3. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 4. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome.	subsequent introgression occurs." 2. "It is reported to hybridize with *E. tereticornis, E. grandis,* and *E. saligna*." 3. "It has been recognized for a long time that where the distributions of *E. camaldulensis* and *E. tereticornis* make contact there are zones of introgression where the shape of buds and fruits is intermediate between the two species."; "Natural hybrids between *E. camaldulensis* and *E. alba* have been commonly recorded in northern Australia." 4. "*E. camaldulensis* hybridizes freely with a number of species. The hybrid *E. camaldulensis* × *E. botryoides* is common and has been given the name *E.* × *trabutti*. In Portugal a hybrid, *E. camaldulensis* × *E. maidenii*, has been reported and in both Australia and Pakistan the hybrid *E. camaldulensis* × *E. rudis*."
6.04	Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. (http://www.csiro.au/files/files/pbsl.pdf).	"Although eucalypts are commonly self-compatible, self-pollination generally results in a reduction in capsule production, seed yield and seedling vigour (see House, 1997). Analyses of the breeding system of E. camaldulensis indicate a predominantly outcrossing mating system (CAB International, 2000)."
6.05	Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands.	"Pollination is mainly by insects but also by birds and small mammals."
6.06	USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	"Vegetative Spread Rate: None."
6.07	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh.	1. "In South-East Asia, the period from planting to production of the first seed crop may be as short as three years. In Thailand, *E. camaldulensis* may start flowering when 16-38 months old, but 24-28 months is common." 2. "Generation time may be as short as

	(http://www.csiro.au/files/files/pbsl.pdf).	three years from planting to the production of the first seed crops (CAB International, 2000). Precocious flowering may occur as early as six months (Khan, 1965, cited in House, 1997). For wild trees the time to first flowering is more likely to be five years for a few scattered individuals and 7-10 years for general flowering."
7.01		
7.02	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 2. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 3. Edwards, S, et al., eds. (1989) Flora of Ethiopia and Eritrea. National Herbarium, Addis Ababa, Ethiopia and Dept. of Systematic Botany, Uppsala University, Uppsala, Sweden. 4. Soerianegara, I, Lemmens, RHMJ, eds. (1994) Plant Resources of South-East Asia. No 5. Timber Trees: Major Commercial Timbers. Bogor, Indonesia. 5. National Academy of Sciences (1980) Firewood crops: Shrub and Tree Species for Energy Production. Washington, D.C. 6. Eldridge, K, et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 7. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 8. *Eucalyptus camaldulensis* from B & T World Seeds. URL: http://www.b-and-t-world-seeds.com/carth.asp?species=Sorghum%20bicolor&sref=5508. Accessed July 15, 2008.	1. "*E. camaldulensis* is planted in many tropical and subtropical countries and is probably the world's most widely planted tree in arid and sem-arid lands." 2. Eucalyptus camaldulensis has proven to be an excellent commercial crop in temperate, Mediterranean (Morocco and Spain), and tropical regions. 3. "In parks, trial plots and pilot plantations, woodlots, shelter belts, large scale plantations, and as single trees on farmland"; "Tried successfully at Alemaya, Menagesha and Beleta; planted at Mojo. One of the early introduced species of Eucalyptus and recorded by Breitenback as widely cultivated throughout Eritrea and Ethiopia, also in Eritrea in the Italian colonial period. *E. camaldulensis* is reported to be one of the most widely planted species in the Flora Zambesiaca area, and indeed in large parts of Africa where it is probably the most common tree planted in woodlots, shelter belts, and fuelwood plots; it is considered less important in large scale plantations." 4. "Cultivated throughout Malesia and in many tropical and subtropical parts of the world." 5. "Most widely planted eucalypts in the world." 6. "Over half a million hectares of plantations have been established, mainly in the Mediterranean region and particularly in Spain and Morocco using southern Australian provenances...Planting in the tropics, especially in south-east Asia and Brazil, is increasing with the increased availability of the climactically adapted

		northern Australian provenances." 7. "Already widely planted."; "*E. camaldulensis* was one of the first species of eucalypts to be planted overseas. It was recorded planted as specimen trees in Naples in 1803 and was probably introduced to Italy before that; the first forest plantations in Italy were established in 1870. Its introduction into Pakistan was in 1867, and it was introduced into a number of African countries toward the end of the nineteenth century or the beginning of the twentieth. In Kenya it was one of the first species to be introduced and was recorded in 1903. The world plantation area at present is of the order of half a million hectares. It is the dominant species around the Mediterranean. Spain has reported over 114,000 hectares, mainly in the southwestern provinces, and Morocco over 87,000 hectares." 8. *Eucalyptus camaldulensis* seeds are for sale online.
7.03		No evidence.
7.04	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden. 2. Williams, JE and JCZ Woinarski, eds (1997) Eucalypt Ecology: Individuals to Ecosystems. Cambridge University Press, Cambridge, UK.	1. "Fruit a dry thin-walled capsule enclosed in a woody hypanthium, opening with 3-5 strongly exserted valves, hemispherical or ovoid, the hypanthium 3-6 mm x 4-10 mm; disk broad, ascending. Seed minute, about 15 per fruit, smooth, yellow-brown." 2. "it is thought that wind may be the most important agent of dispersal"; "The passive release of seed is aided by wind and results in a generally low dispersal distance."; "Seed is mainly dispersed by wind and gravity following release from canopy-stored capsules...Virtually all seed [is] deposited within a radius of twice the tree or canopy height" [genus level - wind is the main dispersal agent, but dispersal is still not far from parent tree]
7.05	1. Williams, JE and JCZ Woinarski, eds (1997) Eucalypt Ecology: Individuals to Ecosystems.	1. "dispersal is enhanced by water (e.g. E. camaldulensis)" 2. "Eucalyptus

	Cambridge University Press, Cambridge, UK. 2. Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. (http://www.csiro.au/files/files/pbsl.pdf).	camaldulensis seeds sank within 36 hours of being dropped into still water in laboratory tests and it was suggested that under field conditions they would sink more rapidly (Dexter, 1978). However, McEvoy (1992) found that seeds remained buoyant for at least 17 days after sowing. He suggested that there might be a potential for floodwaters to act as a dispersal agent."
7.06		
7.07	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden. 2. Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council.	1. "Fruit a dry thin-walled capsule enclosed in a woody hypanthium, opening with 3-5 strongly exserted valves, hemispherical or ovoid, the hypanthium 3-6 mm x 4-10 mm; disk broad, ascending. Seed minute, about 15 per fruit, smooth, yellow-brown." 2. "Capsules 7-8 mm long, with prominent rims and protruding triangular valves." [No evidence of adaptation to external dispersal.]
7.08		
8.01	1. USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. URL: http://www.csiro.au/files/files/pbsl.pdf. Accessed July 18, 2008.	1. "Fruit/Seed Abundance: Medium." 2. "Number of viable seeds per unit weight of a seedlot: mean 698,000/kg"; "Eucalyptus camaldulensis is a free producer of seed."
8.02	1. Williams, JE and JCZ Woinarski, eds (1997) Eucalypt Ecology: Individuals to Ecosystems. Cambridge University Press, Cambridge, UK. 2. Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. (http://www.csiro.au/files/files/pbsl.pdf).	1. "there is no dormancy barrier to the germination of eucalypt seed" 2. "Eucalyptus species store little or none of their seed in the soil."
8.03	Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council.	"Symbol: Herbicide registered for chemical control".
8.04	1. Faridah, H, van der Maesen, LJG, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden. 2. El Bassam, N. (1998) Energy plant species: Their Use and Impact on Environment and Development. James & James 3. USDA,	1. "Coppice rotations give higher yields than the initial seedling rotation (e.g. 25-30 m^3/ha per year versus 17-20 m^3/ha per year in Turkey)". 2. "*E. camaldulensis* is a vigorous coppicer and has several uses." 3. "Coppice

	NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 10 July 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 4. National Academy of Sciences. (1980) Firewood crops: Shrub and Tree Species for Energy Production. Washington, D.C. 5. Eldridge, K et al. (1994) Eucalypt Domestication and Breeding. Clarendon Press, Oxford. 6. Food and Agriculture Organization of the United Nations (1979) Eucalypts for Planting. Rome. 7. Water for a Healthy Country. Taxon Attribute Profiles: Eucalyptus camaldulensis Dehnh. (http://www.csiro.au/files/files/pbsl.pdf).	Potential: Yes." 4. "Some of its provenances coppice well for six or more rotations." 5. "Good coppicing ability" 6. "A vigorous coppicer."; "Coppice rotations"; "*E. camaldulensis* is considered fairly fire resistant in a number of countries, e.g., Spain and Turkey. Younger trees are most susceptible, but old ones usually recover and even severely damaged trees, if felled immediately, will coppice successfully." BUT 7. "Eucalyptus camaldulensis is very fire sensitive and even low intensity fires may cause cambial injury (Dexter, 1978). Fire kills regeneration and even mature trees are susceptible if the fire is intense enough since E. camaldulensis lacks a lignotuber."
8.05		