

Appendix 1: Bibliographic List of Plant Species Interactions in the Sonoran Desert

Kinds of interactions and respective citations (in the same order as presented in the main text): two forms of antagonism, (i) plant-herbivore and (ii) plant host-parasite interactions, and five forms of mutualism, (iii) plant-pollinator, (iv) plant-seed disperser, (v) plant-protective agent, (vi) plant-plant, and (vii) plant-microbe interactions.

(i) Plant-Herbivore Interactions

- Mammal herbivory (e.g., McAuliffe 1986; Brown et al. 1972; Steenbergh and Lowe 1977; Hayes et al. 2013)
- Insect herbivory, in general (e.g., Lightfoot and Whitford 1989, 1990, 1991; Karban 1993; Duval and Whitford 2008; Miller et al. 2009)
- Insect herbivory by leaf cutter ants (Mintzer 1979; Wetterer et al. 2001)
- Florivory (McIntosh 2002)
- Pollen plundering (Ness 2006; Holland et al. 2011)
- Nectar robbing (Richardson 2004a,b)
- Seed consumption (Davidson 1977; Brown and Davidson 1977; Mares and Rosenzweig 1978; Brown et al. 1979; Reichman 1979; Inouye et al. 1980; Davidson et al. 1984; McAuliffe 1990; Price and Joyner 1997; Brown 1998)
- Frugivory (review by Bronstein et al. 2007)
- Galling insects (see next section, ii)

(ii) Plant Host-Parasite Interactions

- Desert mistletoe (*Phoradendron californicum*, Glazner et al. 1988; Aukema and Martínez del Rio 2002; Aukema 2003, 2004)
- Broomrape (*Orobanche ludoviciana*, Musselman 1980)
- Sandfood (*Pholisma sonora*, Nabhan 1980)
- Galling wasps (Fernandes and Price 1988; Price et al. 1994; Marchosky and Craig 2004)

(iii) Plant-Pollinator Mutualisms

- Pollinators (Chambers et al. 2004)
- Pollination by bees, with focus on plants (Waser 1979; McIntosh 2005; Cane et al. 2013)
- Pollination by bees, with focus on bees (e.g., Alcock 1980; Chappell 1982; Cooper et al. 1985; Alcock and Smith 1987; Buchmann et al. 1996; Minckley et al. 2003)
- Pollination by hawkmoths (e.g., Raguso and Willis 2003, 2005; Raguso et al. 2003)
- Pollination of yuccas (*Yucca* and *Hesperoyucca*) by yucca moths (*Tegeticula* and *Parategeticula*) (Keeley et al. 1984; Kiester et al. 1984; Addicott 1986; Turner et al. 1995, 2005; Pellmyr 1999, 2003; Good-Avila et al. 2006; Althoff et al. 2007; Smith et al. 2008)
- Pollination of figs by fig wasps (Gates and Nason 2012; Smith and Bronstein 1996)
- Pollination of columnar cacti by bats (Fleming et al. 2001; Simmons and Wetterer 2002; Bustamante et al. 2010; Fleming and Kress 2011), hawkmoths (Clark-Tapia and Molina-Freaner 2003, 2004), moths (Holland and Fleming 1999), hummingbirds (Johnsgard 1983), and other birds (McGregor et al. 1962)

(iv) Plant-Seed Disperser Mutualisms

- Dispersal by bats, rodents, and other mammals (Sherbrooke 1976; McAuliffe 1990; Fleming and Sosa 1994; Rojas-Aréchiga and Vázquez-Yanes 2000; Muscarella and Fleming 2007)
- Dispersal by birds (e.g., Larson 1996; Aukema 2004; Carlo and Tewksbury 2014)
- Dispersal by lizards (Sosa-Fernandez 1997)
- Dispersal by ants (Ness and Bressmer 2005)

(v) Plant-Protective-Agent Mutualisms (i.e., extrafloral nectary [EFN]-ant protection mutualisms)

- Protection mutualisms in cacti (*Ferocactus*, Blom and Clark 1980; Ruffner and Clark 1986; Ness et al. 2006, 2009; Chamberlain and Holland 2008; Ludka 2009; *Cylindropuntia* [= syn. *Opuntia*], Pickett and Clark 1979; *Lophocereus* [= syn. *Pachycereus*] *schottii*, Holland et al. 2009)
- Protection mutualisms in desert cotton (*Gossypium thurberi*, e.g., Rudgers et al. 2003, Rudgers 2004; Rudgers and Gardener 2004)
- Protection mutualisms at the community scale (Chamberlain et al. 2010)
- Protection mutualisms from the ant's perspective (Lanan and Bronstein 2013)

(vi) Plant-Plant Interactions

- Ability to form resource islands (e.g., Carrillo-Garcia et al. 1999; Suzan et al. 1996)
- Cacti and their nurse plants: saguaro (McAuliffe 1984; Medeiros and Drezner 2012; see Drezner 2014 and literature therein), other cacti (giant cardon, *Pachycereus pringlei*, Suzan-Azpiri and Sosa 2006; senita cactus, *Lophocereus* [= syn. *Pachycereus*] *schottii*,

Holland and Molina-Freaner 2013; barrel cactus, *Ferocactus acanthodes*, Franco and Nobel 1989; Sonoran night-blooming cereus, *Peniocereus striatus*, Suzan et al. 1994)

(vii) Plant-Microbe Interactions

- Endo- and ectomycorrhizal and dark septate fungi (Allen et al. 1981; Barrow et al. 1997a,b; Carrillo-Garcia et al. 1999; Stutz et al. 2000; Bashan et al. 2007; Bills and Stutz 2009)
- Rhizobial bacteria in legume plant roots (Shearer et al. 1983; Shoushtari and Pepper 1985; Jenkins et al. 1987, 1988, 1989; Jenkins 2003)
- Endophytic bacteria (Puente and Bashan 1994; Puente et al. 2009a,b; Lopez et al. 2012)
- Endophytic fungi (Suryanarayanan et al. 2005; Hoffman and Arnold 2008, 2010; Riddle and Arnold 2011; Lau et al. 2013; Massimo et al. 2015)
- Other beneficial rhizosphere and rhizoplane microorganisms (Puente et al. 2004a,b; Andrew et al. 2012)
- Biological soil crusts (Bates et al. 2011; Strauss et al. 2012)

Supplemental Bibliography

- Addicott, J. F. (1986) Variation in the costs and benefits of mutualism: The interaction between yuccas and yucca moths. *Ecology* 70:486–494.
- Alcock, J. (1980) Natural selection and the mating systems of solitary bees. *American Scientist* 68:146–153.
- Alcock, J., and Smith, A. P. (1987) Hilltopping, leks and female choice in the carpenter bee *Xylocopa (Neoxylocopa) varipuncta*. *Journal of Zoology* 211:1–10.
- Allen, M. F., Smith, W. K., Moore, T. S., and Christensen, M. (1981) Comparative water relations and photosynthesis of mycorrhizal and nonmycorrhizal *Bouteloua gracilis* H.B.K. Lag ex Steud. *New Phytologist* 88:683–693.
- Althoff, D. M., Svensson, G. P., and Pellmyr, O. (2007) The influence of interaction type and feeding location on the phylogeographic structure of the yucca moth community associated with *Hesperoyucca whipplei*. *Molecular Phylogenetics and Evolution* 43:398–406.
- Andrew, D. R., Fitak, R. R., Munguia-Vega, A., Racolta, A., Martinson, V. G., and Dontsova, K. (2012) Abiotic factors shape microbial diversity in Sonoran Desert soils. *Applied and Environmental Biology* 78:7527–7537.
- Aukema, J. E. (2003) Vectors, viscin, and Viscaceae: Mistletoes as parasites, mutualists, and resources. *Frontiers in Ecology and the Environment* 1:212–219.
- Aukema, J. E. (2004) Distribution and dispersal of desert mistletoe is scale-dependent, hierarchically nested. *Ecography* 27:137–144.
- Aukema, J. E., and Martínez del Rio, C. (2002) Where does a fruit-eating bird deposit mistletoe seeds? Seed deposition patterns and an experiment. *Ecology* 83:3489–3496.

- Barrow, J. R., Havstad, K. M., and McCaslin, B. D. (1997a) Fungal root endophytes in fourwing saltbush, *Atriplex canescens*, on arid rangelands of Southwestern USA. *Arid Soil Research and Rehabilitation* 11:177–185.
- Barrow, J. R., Havstad K. M., Hubstenberger J., and McCaslin B. D. (1997b) Seed-borne fungal endophytes on fourwing saltbush, *Atriplex canescens*. *Arid Soil Research and Rehabilitation* 11:307–314.
- Bashan, Y., Khaosaad, T., Salazar, B. G., Ocampo, J. A., Wiemken, A., Oehl, F., and Vierheilig, H. (2007) Mycorrhizal characterization of the boojum tree, *Fouquieria columnaris*, an endemic ancient tree from the Baja California Peninsula, Mexico. *Trees Structure and Function* 21:329–335.
- Bates, S. T., Nash, T. H., and Garcia-Pichel, F. (2011) Patterns of diversity for fungal assemblages of biological soil crusts from the southwestern United States. *Mycologia* 104:353–361.
- Bills, R. J., and Stutz, J. C. (2009) AMF associated with indigenous and non-indigenous plants at urban and desert sites in Arizona. In *Mycorrhizas: Functional Processes and Ecological Impact*. Springer, Berlin. Pp. 207–220.
- Blom, P. E., and Clark, W. H. (1980) Observations of ants (Hymenoptera: Formicidae) visiting extrafloral nectaries of the barrel cactus, *Ferocactus gracilis* Gates (Cactaceae), in Baja California, Mexico. *Southwestern Naturalist* 25:181–195.
- Bronstein, J. L., Izhaki, I., Nathan, R., Tewksbury, J. J., Spiegel, O., Lotan, A., Altstein, O., Dennis, A. J., Schupp, E. W., and Green R. J. (2007) Fleshy-fruited plants and frugivores desert ecosystems. In Dennis, A.J., Schupp, E.W., Green, R.A., and Westcott, D. A.

- (eds.), *Seed Dispersal: Theory and Its Application in a Changing World*. CAB International, Wallingford, U.K. Pp. 148–177.
- Brown, J. H. (1998) The desert granivory experiments at Portal. In Resetarits, W. L., Jr., and Bernardo, J. (eds.), *Issues and Perspectives in Experimental Ecology*. Oxford University Press, Oxford. Pp. 71–95.
- Brown, J. H., and Davidson, D. W. (1977) Competition between seed-eating rodents and ants in desert ecosystems. *Science* 196(4292):880–882.
- Brown, J. H., Lieberman, G. A., and Dengler, W. F. (1972) Woodrats and cholla: Dependence of a small mammal population on the density of cacti. *Ecology* 53:310–313.
- Brown, J. H., Reichman, O. J., and Davidson D. W. (1979) Granivory in desert ecosystems. *Annual Review of Ecology and Systematics* 10:201–227.
- Buchmann, S. L., Matheson, A., O'Toole, C., Westrich, P., and Williams, I. H. (1996) Competition between honey bees and native bees in the Sonoran Desert and global bee conservation issues. In *The Conservation of Bees*. The Linnean Society of London and the International Bee Research Association. Academic Press, London. Pp. 125–142.
- Bustamante, E., Casas, A., and Burquez, A. (2010) Geographic variation in reproductive success of *Stenocereus thurberi* (Cactaceae): Effects of pollination timing and pollinator guild. *American Journal of Botany* 97:2020–2030.
- Cane, J. H., Kervin, L. J., and McKinley, R. (2013) Sensitivity of systematic net sampling for detecting shifting patterns of incidence and abundance in a floral guild of bees at *Larrea tridentata*. *Journal of the Kansas Entomological Society* 86:171–180.
- Carlo, T. A., and Tewksbury, J. J. (2014) Directness and tempo of avian seed dispersal increases emergence of wild chiltepins in desert grasslands. *Journal of Ecology* 102:248–255.

- Carrillo-Garcia, A., Leon de la Luz, J.-L., Bashan, Y., and Bethlenfalvay, G. J. (1999) Nurse plants, mycorrhizae, and plant establishment in a disturbed area of the Sonoran Desert. *Restoration Ecology* 7:321–335.
- Chamberlain, S. A., and Holland, J. N. (2008) Density-mediated, context-dependent consumer-resource interactions between ants and extrafloral nectar plants. *Ecology* 89:1364–1374.
- Chamberlain, S. A., Kilpatrick, J. R., and Holland, J. N. (2010) Do extrafloral nectar resources, species abundances, and body sizes contribute to the structure of ant-plant mutualistic networks? *Oecologia* 164:741–750.
- Chambers, N., Gray, Y., and Buchmann, S. L. (2004) *Pollinators of the Sonoran Desert: A Field Guide*. Arizona-Sonora Desert Museum, Tucson.
- Chappell, M. A. (1982) Temperature regulation of carpenter bees (*Xylocopa californica*) foraging in the Colorado Desert of southern California. *Physiological Zoology* 55:267–280.
- Clark-Tapia, R., and Molina-Freaner, F. (2003) The genetic structure of a columnar cactus with a disjunct distribution: *Stenocereus gummosus* in the Sonoran Desert. *Heredity* 90:443–450.
- Clark-Tapia, R., and Molina-Freaner, F. (2004) Reproductive ecology of the rare clonal cactus, *Stenocereus eruca*, in the Sonoran Desert. *Plant Systematics and Evolution* 247:155–164.
- Cooper, P. D., Schaffer, W. M., and Buchmann, S. L. (1985) Temperature regulation of honey bees (*Apis mellifera*) foraging in the Sonoran Desert. *Journal of Experimental Biology* 114:1–15.
- Davidson, D. W. (1977) Species diversity and community organization in desert seed-eating ants. *Ecology* 58:712–724.

- Davidson, D. W., Inouye, R. S., and Brown, J. H. (1984) Granivory in a desert ecosystem: Experimental evidence for indirect facilitation of ants by rodents. *Ecology* 65:1780–1786.
- Drezner, T. D. (2014) The keystone saguaro (*Carnegiea gigantea*, Cactaceae): A review of its ecology, associations, reproduction, limits, and demographics. *Plant Ecology* 215:581–595.
- Duval, B. D., and Whitford, W. G. (2008) Resource regulation by a twig girdling beetle has implications for desertification. *Ecological Entomology* 33:161–166.
- Fernandes, G. W., and Price, P. W. (1988) Biogeographical gradients in galling species richness. *Oecologia* 76:161–167.
- Fleming, T. H., and Kress, W. J. (2011) A brief history of fruits and frugivores. *Acta Oecologica* 37:521–530.
- Fleming, T. H., and Sosa, V. J. (1994) Effects of nectarivorous and frugivorous mammals on reproductive success of plants. *Journal of Mammalogy* 75:845–851.
- Fleming, T. H., Sahley, C. T., Holland, J. N., Nason, J. D., and Hamrick, J. L. (2001) Sonoran Desert columnar cacti and the evolution of generalized pollination systems. *Ecological Monographs* 71:511–530.
- Franco, A. C., and Nobel, P. S. (1989) Effect of nurse plants on the microhabitat and growth of cacti. *Journal of Ecology* 77:870–886.
- Gates, D. J., and Nason, J. D. (2012) Flowering asynchrony and mating system effects on reproductive assurance and mutualism persistence in fragmented fig-fig wasp populations. *American Journal of Botany* 99:757–768.

- Glazner, J. T., Devlin, B., and Ellstrand, N. C. (1988) Biochemical and morphological evidence for host race evolution in desert mistletoe, *Phoradendron californicum* (Viscaceae). *Plant Systematics and Evolution* 161:13–21.
- Good-Avila, S. V., Souza, V., Gaut, B. S., and Eguiarte, L. E. (2006) Timing and rate of speciation in *Agave* (Agavaceae). *Proceedings of the National Academy of Sciences* 103:9124–9129.
- Hayes, C. L., Talbot, W. A., and Wolf, B. O. (2013) Woodrat herbivory influences saguaro (*Carnegiea gigantea*) reproductive output. *Journal of Arid Environments* 89:110–115.
- Hoffman, M. T., and Arnold, A. E. (2008) Geographic locality and host identity shape fungal endophyte communities in cupressaceous trees. *Mycological Research* 112:331–344.
- Hoffman, M. T., and Arnold, A. E. (2010) Diverse bacteria inhabit living hyphae of phylogenetically diverse fungal endophytes. *Applied and Environmental Microbiology* 76:4063–4075.
- Holland, J. N., and Fleming, T. H. (1999) Mutualistic interactions between *Upiga virescens* (Pyralidae), a pollinating seed-consumer, and *Lophocereus schottii* (Cactaceae). *Ecology* 80:2074–2084.
- Holland, J. N., and Molina-Freaner, F. (2013) Hierarchical effects of rainfall, nurse plants, granivory and seed banks on cactus recruitment. *Journal of Vegetation Science* 24:1053–1061.
- Holland, J. N., Chamberlain, S. A., and Horn, K. C. (2009) Optimal defence theory predicts investment in extrafloral nectar resources in an ant-plant mutualism. *Journal of Ecology* 97:89–96.

- Holland, J. N., Chamberlain, S. A., and Miller, T. E. (2011) Consequences of ants and extrafloral nectar for a pollinating seed-consuming mutualism: Ant satiation, floral distraction or plant defense? *Oikos* 120:381–388.
- Inouye, R. S., Byers, G. S., and Brown, J. H. (1980) Effects of predation and competition on survivorship, fecundity, and community structure of desert annuals. *Ecology* 61:1344–1351
- Jenkins, M. B. (2003) Rhizobial and bradyrhizobial symbionts of mesquite from the Sonoran Desert: Salt tolerance, facultative halophily and nitrate respiration. *Soil Biology and Biochemistry* 35:1675–1682.
- Jenkins, M. B., Virginia, R. A., and Jarrell, W. M. (1987) Rhizobial ecology of the woody legume mesquite (*Prosopis glandulosa*) in the Sonoran Desert. *Applied and Environmental Microbiology* 53:36–40.
- Jenkins, M. B., Virginia, R. A., and Jarrell, W. M. (1988) Depth distribution and seasonal populations of mesquite-nodulating rhizobia in warm desert ecosystems. *Soil Science Society of America Journal* 52:1644–1650.
- Jenkins, M. B., Virginia, R. A., and Jarrell, W. M. (1989) Ecology of fast-growing and slow-growing mesquite-nodulating rhizobia in Chihuahuan and Sonoran Desert ecosystems. *Soil Science Society of America Journal* 53:543–549.
- Johnsgard, P. A. (1983) *The Hummingbirds of North America*. Smithsonian Institution Press, Washington, D.C.
- Karban, R. (1993) Costs and benefits of induced resistance and plant density for a native shrub, *Gossypium thurberi*. *Ecology* 74:9–19.

- Keeley, J. E., Keeley, S. C., Swiff, C. C., and Lee, J. (1984) Seed predation due to the yucca-moth symbiosis. *American Midland Naturalist* 112:187–191.
- Kiester, A. R., Lande, R., and Schemske, D. W. (1984) Models of coevolution and speciation in plants and their pollinators. *American Naturalist* 124:220–243.
- Lanan, M. C., and Bronstein, J. L. (2013) An ant’s-eye view of an ant-plant protection mutualism. *Oecologia* 172:779–790.
- Larson, D. L. (1996) Seed dispersal by specialist versus generalist foragers: The plant’s perspective. *Oikos* 76:113–120.
- Lau, M. K., Arnold, A. E., and Johnson, C. N. (2013) Factors influencing communities of foliar fungal endophytes in riparian woody plants. *Fungal Ecology* 6:365–378.
- Lightfoot, D. C., and Whitford, W. G. (1989) Interplant variation in creosote foliage characteristics and canopy arthropods. *Oecologia* 81:166–175.
- Lightfoot, D. C., and Whitford, W. G. (1990) Phytophagous insects enhance nitrogen flux in a desert creosotebush community. *Oecologia* 82:18–25.
- Lightfoot, D. C., and Whitford, W. G. (1991) Productivity of creosotebush foliage and associated canopy arthropods along a desert roadside. *American Midland Naturalist* 125:310–322.
- Lopez, B. R., Tinoco-Ojanguren, C., Bacilio, M., Mendoza, A., and Bashan, Y. (2012) Endophytic bacteria of the rock-dwelling cactus *Mammillaria fraileana* affect plant growth and mobilization of elements from rocks. *Environmental and Experimental Botany* 81:26–36.
- Ludka, J. T. (2009) “Protection and Reliability: An Examination of the Quality and Quantity of Ant Protection in the Food-for-Protection Mutualism between *Ferocactus viridescens*,

- Crematogaster californica* and the Invasive *Linepithema humile*.” Master of science thesis, University of California, San Diego.
- Marchosky, R. J., and Craig, T. P. (2004) Gall size-dependent survival for *Asphondylia atriplicis* (Diptera: Cecidomyiidae) on *Atriplex canescens*. *Environmental Entomology* 33:709–719.
- Mares, M. A., and Rosenzweig, M. L. (1978) Granivory in North and South American deserts: Rodents, birds, and ants. *Ecology* 59:235–241.
- Massimo, N. C., Nandi Devan, M. M., Arendt, K. R., Wilch, M. H., Riddle, J. M., Furr, S. H., Steen, C., U’Ren, J. M., Sandberg, D. C., and Arnold, A. E. (2015) Fungal endophytes in above-ground tissues of desert plants: Infrequent in culture, but highly diverse and distinctive symbionts. *Microbial Ecology* 70:61–76.
- McAuliffe, J. R. (1984) Sahuaro-nurse tree associations in the Sonoran Desert: competitive effects of sahuaros. *Oecologia* 64:319–321.
- McAuliffe, J. R. (1986) Herbivore-limited establishment of a Sonoran Desert tree, *Cercidium microphyllum*. *Ecology* 67:276–280.
- McAuliffe, J. R. (1990) Paloverdes, pocket mice, and bruchid beetles: interrelationships of seeds, dispersers, and seed predators. *The Southwestern Naturalist* 35:329–337.
- McGregor, S. E., Alcorn, S. M., and Olin, G. (1962) Pollination and pollinating agents of the saguaro. *Ecology* 43:259–267.
- McIntosh, M. E. (2002) Plant size, breeding system, and limits to reproductive success in two sister species of *Ferocactus* (Cactaceae). *Plant Ecology* 162:273–288.
- McIntosh, M. E. (2005) Pollination of two species of *Ferocactus*: Interactions between cactus-specialist bees and their host plants. *Functional Ecology* 19:727–734.

- Medeiros, A. S., and Drezner, T. D. (2012) Vegetation, climate, and soil relationships across the Sonoran Desert. *Ecoscience* 19:148–160.
- Miller, T. E. X., Louda, S. V., Rose, K. A., and Eckberg, J. O. (2009) Impacts of insect herbivory on cactus population dynamics: Experimental demography across an environmental gradient. *Ecological Monographs* 79:155–172.
- Minckley, R. L., Cane, J. H., Kervin, L., and Yanega, D. (2003) Biological impediments to measures of competition among introduced honey bees and desert bees (Hymenoptera: Apiformes). *Journal of the Kansas Entomological Society* 76:306–319.
- Mintzer, A. (1979) Foraging activity of the Mexican leaf-cutting ant *Atta mexicana* (F. Smith) in a Sonoran Desert habitat (Hymenoptera: Formicidae). *Insectes Sociaux* 26:364–372.
- Muscarella, R., and Fleming, T. H. (2007) The role of frugivorous bats in tropical forest succession. *Biological Reviews* 82:573–590
- Musselman, L. J. (1980) The biology of *Striga*, *Orobanche*, and other root-parasitic weeds. *Annual Review of Phytopathology* 18:463–489.
- Nabhan, G. (1980) *Ammobroma sonorae*, an endangered parasitic plant in extremely arid North America. *Desert Plants* 2:188–196.
- Ness, J. H. (2006) A mutualism's indirect costs: The most aggressive plant bodyguards also deter pollinators. *Oikos* 113:506–514.
- Ness, J. H., and Bressmer, K. (2005) Abiotic influences on the behaviour of rodents, ants, and plants affect an ant-seed mutualism. *Ecoscience* 12:76–81.
- Ness, J. H., Morris, W. F., and Bronstein, J. L. (2006) Integrating quality and quantity of mutualistic service to contrast ant species visiting *Ferocactus wislizeni*, a plant with extrafloral nectaries. *Ecology* 87:912–921.

- Ness, J. H., Morris, W. F., and Bronstein, J. L. (2009) For ant-protected plants, the best defense is a hungry offense. *Ecology* 90:2823–2831.
- Pellmyr, O. (1999) A systematic revision of the yucca moths in the *Tegeticula yuccasella* complex north of Mexico. *Systematic Entomology* 24:243–271.
- Pellmyr, O. (2003) Yuccas, yucca moths, and coevolution: A review. *Annals of the Missouri Botanical Garden* 90:35–55.
- Pickett, C. H., and Clark, W. D. (1979) The function of extrafloral nectaries in *Opuntia acanthocarpa* (Cactaceae). *American Journal of Botany* 66:618–625.
- Price, M. V., and Joyner, J. W. (1997) What resources are available to desert granivores: Seed rain or soil seed bank? *Ecology* 78:764–773.
- Price, P. W., Clancy, K. M., and Roininen, H. (1994) Comparative population dynamics of the galling sawflies. In Price, P. W., Mattson, W. J., and Baranchikov, Y.N. (eds.), *Ecology and Evolution of Gall-Forming Insects*. United States Department of Agriculture, St. Paul, Minnesota. Pp. 1–11.
- Puente, M. E., and Bashan, Y. (1994) The desert epiphyte *Tillandsia recurvata* harbors the nitrogen-fixing bacterium *Pseudomonas stutzeri*. *Canadian Journal of Botany* 72:406–408.
- Puente, M. E., Bashan, Y., Li, C. Y., and Lebsky, V. K. (2004a) Microbial populations and activities in the rhizoplane of rock-weathering desert plants. I. Root colonization and weathering of igneous rocks. *Plant Biology* 6:629–642.
- Puente, M. E., Li, C. Y., and Bashan, Y. (2004b) Microbial populations and activities in the rhizoplane of rock-weathering desert plants. II. Growth promotion of cactus seedling. *Plant Biology* 6:643–650.

- Puente, M. E., Li, C. Y., and Bashan, Y. (2009a) Rock-degrading endophytic bacteria in cacti. *Environmental and Experimental Botany* 66:389–401.
- Puente, M. E., Li, C. Y., and Bashan, Y. (2009b) Endophytic bacteria in cacti seeds can improve the development of cactus seedlings. *Environmental and Experimental Botany* 66:402–408.
- Raguso, R. A., and Willis, M. A. (2003) Hawkmoth pollination in Arizona's Sonoran Desert: Behavioral responses to floral traits. In Boggs, C. L., Watt, W.B., and Ehrlich, P. R. (eds.), *Evolution and Ecology Taking Flight: Butterflies as Model Systems*. University of Chicago Press, Chicago. Pp. 43–65.
- Raguso, R. A., and Willis, M. A. (2005) Synergy between visual and olfactory cues in nectar feeding by wild hawkmoths, *Manduca sexta*. *Animal Behaviour* 69:407–418.
- Raguso, R. A., Henzel, C., Buchmann, S. L., and Nabhan, G. P. (2003) Trumpet flowers of the Sonoran Desert: Floral biology of *Peniocereus* cacti and sacred *Datura*. *International Journal of Plant Sciences* 164:877–892.
- Reichman, O. J. (1979) Desert granivore foraging and its impact on seed densities and distributions. *Ecology* 60:1086–1092.
- Richardson, S. C. (2004a) Are nectar-robbers mutualists or antagonists? *Oecologia* 139:246–254.
- Richardson, S. C. (2004b) Benefits and costs of floral visitors to *Chilopsis linearis*: Pollen deposition and stigma closure. *Oikos* 107:363–375.
- Riddle, J. M., and Arnold, A. E. (2011) Diversity and phylogenetic affinities of endohyphal bacteria associated with foliar fungal endophytes of the Sonoran Desert. *Inoculum* 62:38.
- Rojas-Aréchiga, M., and Vázquez-Yanes, C. (2000) Cactus seed germination: A review. *Journal of Arid Environments* 44:85–104.

- Rudgers, J. A. (2004) Enemies of herbivores can shape plant traits: Selection in a facultative ant-plant mutualism. *Ecology* 85:192–205.
- Rudgers, J. A., and Gardener, M. C. (2004) Extrafloral nectar as a resource mediating multispecies interactions. *Ecology* 85:1495–1502.
- Rudgers, J. A., Hodgen, J. G., and White, J.W., III. (2003) Behavioral mechanisms underlie an ant-plant mutualism. *Oecologia* 135:51–59.
- Ruffner, G. A., and Clark, W. D. (1986) Extrafloral nectar of *Ferocactus acanthodes* (Cactaceae): Composition and its importance to ants. *American Journal of Botany* 73:185–189.
- Shearer, G., Kohl, D. H., Virginia, R. A., Bryan, B. A., Skeeters, J. L., Nilsen, E. T., Sharifi, M. R., and Rundel, P. W. (1983) Estimates of N₂-fixation from variation in the natural abundance of ¹⁵N in Sonoran desert ecosystems. *Oecologia* 56:365–373.
- Sherbrooke, W. C. (1976) Differential acceptance of toxic jojoba seed (*Simmondsia chinensis*) by four Sonoran Desert heteromyid rodents. *Ecology* 57:596–602.
- Shoushtari, N. H., and Pepper, I. L. (1985) Mesquite rhizobia isolated from the Sonoran Desert: Physiology and effectiveness. *Soil Biology and Biochemistry* 6:797–802.
- Simmons, N. B., and Wetterer, A. L. (2002) Phylogeny and convergence in cactophilic bats. In Fleming, T. H., and Valiente-Banuet, A. (ed.), *Columnar Cacti and Their Mutualists: Evolution, Ecology, and Conservation*. University of Arizona Press, Tucson. Pp. 87–121.
- Smith, C. I., Pellmyr, O., Althoff, D. M., Balcázar-Lara, M., Leebens-Mack, J., and Segraves, K. A. (2008) Pattern and timing of diversification in *Yucca* (Agavaceae): Specialized pollination does not escalate rates of diversification. *Proceedings of the Royal Society B* 275:249–258.

- Smith, C. M., and Bronstein, J. L. (1996) Site variation in reproductive synchrony in three neotropical figs. *Journal of Biogeography* 23:477–486.
- Sosa-Fernandez, V. D. (1997) “Dispersal and Recruitment Ecology of Columnar Cacti in the Sonoran Desert.” PhD dissertation, University of Miami, Coral Gables, Florida.
- Steenbergh, W. F., and Lowe, C. H. (1977) *Ecology of the Saguaro. II. Reproduction, Germination, Establishment, Growth, and Survival of the Young Plant*. National Park Service Scientific Monograph No. 8. National Park Service, Washington, D.C.
- Strauss, S. L., Day, T. A., and Garcia-Pichel, F. (2012) Nitrogen cycling in desert biological crusts across biogeographic regions in the southwestern United States. *Biogeochemistry* 108:171–182.
- Stutz, J. C., Copeman, R., Martin, C. A., and Morton, J. B. (2000) Patterns of species composition and distribution of arbuscular mycorrhizal fungi in arid regions of southwestern North America and Namibia, Africa. *Canadian Journal of Botany* 78:237–245.
- Suryanarayanan, T. S., Wittlinger, S.K., and Faeth, S. H. (2005) Endophytic fungi associated with cacti in Arizona. *Mycological Research* 109:635–639.
- Suzan, H., Nabhan, G. P., and Patten, D. T. (1994) Nurse plant and floral biology of a rare night-blooming cactus, *Peniocereus striatus* (Brandege) F. Buxbaum. *Conservation Biology* 8:461–470.
- Suzan, H., Nabhan, G. P., and Patten, D. T. (1996) The importance of *Olneya tesota* as a nurse plant in the Sonoran Desert. *Journal of Vegetation Science* 7:635–644.

- Suzan-Azpíri, H., and Sosa, V. J. (2006) Comparative performance of the giant cardon cactus (*Pachycereus pringlei*) seedlings under two leguminous nurse plant species. *Journal of Arid Environments* 65:351–362.
- Turner, R. M., Bowers, J. E., and Burgess, T. L. (1995) *Sonoran Desert Plants*. University of Arizona Press, Tucson.
- Turner, R. M., Bowers, J. E., and Burgess, T. L. (2005) *Sonoran Desert Plants: An Ecological Atlas*. University of Arizona Press, Tucson.
- Waser, N. M. (1979) Pollinator availability as a determinant of flowering time in ocotillo (*Fouquieria splendens*). *Oecologia* 39:107–121.
- Wetterer, J. K., Himler, A. G., and Yospin, M. M. (2001) Foraging ecology of the desert leaf-cutting ant, *Acromyrmex versicolor* (Hymenoptera: Formicidae). *Sociobiology* 37:633–649.