Abstracts

To develop the following abstracts, the editorial staff searches more than 100 scientific journals, professional and organizational newsletters, conference proceedings, and other resources for information relevant to ecological restoration practice and research. Please send suggested abstract sources to the editorial staff (ERjournal@aesop.rutgers.edu).

Climate Change

Retention and Restoration Priorities for Climate Adaptation in a Multi-Use Landscape. 2019. Maxwell, S.L. (Centre for Biodiversity and Conservation Science, School of Earth and Environmental Sciences, University of Queensland, St. Lucia, QLD, AUS, smaxwell@uq.edu.au), A. Reside, J. Trezise, C.A. McAlpine and J.E.M. Watson. **Global Ecology and Conservation** 18: e00649. doi: 10.1016/j.gecco.2019.e00649

Climate change is altering species distributions on a global scale. These shifts will likely outpace natural adaptation and result in extinctions. Restoration projects must account for these changes. Maxwell et al. devised two climate-change planning scenarios to identify restoration priorities for Australia's Great Dividing Range, a large, multi-use landscape that may serve as a climate change refugium for over a thousand vertebrate species. The "balanced" scenario combines high quality habitat conservation with restoration of forestry and agricultural lands, in contrast with the "retention-focused" scenario which prioritizes retaining high quality habitat over restoration. Retention-focused efforts benefitted the most species, but many species also relied on habitat created in restored agricultural lands, which would favor the balanced restoration scenario. Though intact ecosystems provide the best defense against climate change, restoration practitioners must develop strategies to mitigate climate-driven extinction.

Coastal and Marine Communities

Landscape Context Modifies the Rate and Distribution of Predation around Habitat Restoration Sites. 2019. Duncan, C.K., B.L. Gilby (School of Science and Engineering, University of the Sunshine Coast, Maroochydore DC 4558, Queensland, Australia, bgilby@usc.edu.au), A.D. Olds, R.M. Connolly, N.L. Ortodossi, C.J. Henderson and T.A. Schlacher. **Biological Conservation** 237:97–104. doi: 10.1016/j.biocon.2019.06.028

Landscape restoration is an important factor in returning ecological function to degraded systems. Because habitats are spatially connected, the actual location of restored habitats is critical to successful restoration outcomes. Landscape context can alter source-sink dynamics especially when target species are highly vagile. Duncan and colleagues studied the effects of oyster reef restoration on predation by fish in the Noosa River, Australia. Here, oyster reef restoration has been implemented to enhance habitat complexity for fish. Sites represented a variety of seascape contexts and the authors used underwater cameras to record predation rates by different fish species. Reef restoration sites demonstrated a dramatic increase of predation. Predation probability decreased with increasing distance from the reef, particularly in sites adjacent to mangroves and seagrasses. Newly-restored oyster reef sites likely act as the center of a fish's home range but in the presence of high-quality habitats next to a restored reef, fish populations are unlikely to move to another complex habitat. These results highlight the need to make strategic decisions to place restored habitats in heterogeneous landscapes in order to maximize ecological function.

Restoring Subtidal Marine Macrophytes in the Anthropocene: Trajectories and Future-Proofing. 2019. Wood, G. (Centre for Marine Bio-Innovation, School of Biological Earth and Environmental Sciences, The University of New South Wales, Sydney, Australia. georgina.wood@unsw.edu.au), E.M. Marzinelli, M.A. Coleman, A.H. Campbell, N.S. Santini, L. Kajlich, J. Verdura, J. Wodak, P.D. Steinberg and A. Vergés. **Marine and Freshwater Research** 70:936–951. doi:10.1071/MF18226

In this perspective article, Wood and colleagues review different restoration efforts and techniques aimed specifically at seaweed and seagrasses in coastal habitats. They highlight the need to be mindful of the timescale at which different species may reach a fully functional state, because this will not only affect logistics, in terms of securing funding sources, but also the fact that restored populations should be "future-proofed" by considering projected changes in temperature or other conditions. In the same context, understanding "what" to restore is also critical, as certain species may be of interest but may not cope well with future conditions. In such cases it becomes

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more relevant to consider restoring an ecological function rather than a particular target species. The authors emphasize the need to include genetics and consider changes in species interactions when designing a future-resistant ecosystem. Finally, they address the important link between restoration and community engagement for the success of restoration, including challenges and opportunities presented by restoring a subtidal habitat where it is difficult to foster community participation due to logistical constraints.

Ecological Design

Overview and Trends of Ecological and Socioeconomic Research on Artificial Reefs. 2019. Lima, J.S., I.R. Zalmon (Centre of Bioscience and Biotechnology, University of North Rio de Janeiro, Campos dos Goytacazes, Rio de Janeiro, Brazil, Ilana@uenf.br) and M. Love. **Marine Environmental Research** 145:81–96. doi: 10.1016/j.marenvres.2019.01.010

Artificial reefs can attract fish and augment natural communities and fisheries, though some argue that construction of these structure displaces natural reef communities and does not increase productivity. Lima et al. present a literature review of 620 studies examining socioeconomic and ecological aspects of artificial reefs. Most studies focused on marine community structures as well as evaluating materials and designs of artificial reef structures. Research on socioeconomics was lacking and the authors felt that more attention should also be directed toward assessing environmental impacts and alternative materials. Developing effective management strategies for artificial environments also deserves more research focus.

Ecological Literacy

Untangling Perceptions around Indicators for Biodiversity Conservation and Ecosystem Services. 2019. Martínez-Jauregui, M. (National Institute for Agriculture and Food Research and Technology Forest Research Centre, Madrid, Spain, martinez.maria@inia.es) P.C.L. White, J. Touza and M. Soliño. **Ecosystem Services** 38:100952. doi: 10.1016/j.ecoser.2019.100952

Maintaining public support for conservation projects is essential to achieving management goals. Indicator species are commonly used to monitor conservation outcomes but there must be a clear link between a given indicator and the ecosystem or service it is intended to represent. Increasingly, socioeconomic factors play into conservation outcomes, so indicators must also align with the values of local stakeholders. Martínez-Jauregui et al. used a choice experiment to compare public perceptions of the roles of within-species, between-species, and ecosystem level biodiversity indicators for ecosystem services of Spanish pine forests. Genetic variation, invasive species, and keystone species were frequently chosen as high importance factors while population structure and land area ranked lower among public stakeholders. Understanding public preferences is essential to maintaining conservation support as these programs are frequently funded by local stakeholders.

Grasslands

Suppressive Plants as Weed Management Tool: Managing *Parthenium hysterophorus* Under Simulated Grazing in Australian Grasslands. 2019. Khan, N. (School of Agriculture and Food Sciences, The University of Queensland, Brisbane, Australia, nkhan@aup.edu.pk), D. George, A. Shabbir and S.W. Adkins. **Journal of Environmental Management** 247:224–233. doi: 10.1016/j.jenvman.2019.06.051

Parthenium hysterophorus (parthenium) is an invasive weed of agricultural systems in Australia. The best management strategy is an integrated approach combining biocontrol with suppressive plantings but this approach must be functional under a heavy grazing regime. Khan et al. examined the fodder capacity of six pasture species under no, low, moderate and heavy simulated grazing. Under low to moderate grazing pressure, *Setaria incrassata* (purple pigeon grass), *Cenchrus ciliaris* (buffel grass) and *Clitoria ternatea* (butterfly pea) successfully suppressed over 50% of *P. hysterophorus* growth while providing moderate to high fodder biomass making these species viable options for both control of the invasive and providing grazing forage. Multi-purpose invasion control tools are valuable cost-savers for land managers.

Invasive and Pest Species

Invasive Plant Removal Increases Insect Herbivory Pressure on a Native Tree Due to an Increase in Resource Quality. 2019. Maoela, M.A. (Department of Conservation Ecology and Entomology, Stellenbosch University, Matieland, South Africa, malebajoam@gmail.com), K.J. Esler, S.M. Jacobs and F. Roets. **Plant Ecology** 220:649–661. doi: 10.1007/s11258-019-00942-z

Insect herbivores structure plant communities in a variety of ways and evidence indicates that herbivore densities may be regulated by both predation and plant nutritional status. Maoela *et al.* examined the relative influence of these two factors by examining the effects of altering predatory arthropod abundance and altering leaf nutrient levels on herbivory of the native tree, *Brabejum stellatifolium* (wild almond). Their sites differed in invasion status, with sites ranging from restored to heavily invaded

by *Acacia mearnsii* (black wattle). Invasion status significantly impacted herbivore and predator abundance, richness, and community. High leaf nitrogen in restored sites was positively correlated to increased herbivory, indicating that bottom-up control plays a stronger role in herbivory pressure on *B. stellatifolium* in invaded areas. Herbivory control methods on native trees may be more effective when bottom-up strategies are employed.

Facilitating Natural Succession in a Heavily Invaded Ecosystem. 2019. Miller-Adamany, A., D. Baumann and M. Thomsen (University of Wisconsin–La Crosse Biology Department, La Crosse, WI, mthomsen@uwlax.edu). **Forest Ecology and Management** 444:235–243. doi: 10.1016/j.foreco.2019.04.043

Invasion can alter successional processes, thereby forcing ecosystems into alternate stable states and ultimately decreasing ecosystem function. *Phalaris arundinacea* (reed canarygrass) is a fast-growing invasive that outcompetes native wetland flora. The authors examined the effects of late-season mulching plus an herbicide (Oust®) vs. late-season application of a second herbicide (Rodeo®) on *P. arundinacea* reduction in a backwater Mississippi River channel near LaCrosse, Wisconsin. They also planted native species at three densities to facilitate succession. After two years, the Rodeo treatment was more successful in decreasing *P. arundinacea* performance and allowing for native plant establishment. Promoting succession in sites invaded by *P. arundinacea* is best achieved by reducing performance of the grass over several years rather than immediate removal. Designing restoration projects that facilitate natural succession processes can speed the accomplishment of restoration goals.

Lakes, Rivers and Streams

Macroinvertebrate Assemblages of the Post-Mining Calcareous Stream Habitats: Are They Similar to Those Inhabiting the Natural Calcareous Springs? 2019. Bartošová, M. (Department of Botany and Zoology, Masaryk University, Czech Republic m.bartosova@mail.muni.cz), J. Schenková, V. Polášková, J. Bojková, V. Šorfová and M. Horsák. **Ecological Engineering** 136:38–45. doi: 10.1016/j.ecoleng.2019.05.023

Freshwater habitats that form on the surface of former mines are often limited in biodiversity due to harsh chemical profiles. However, these areas often afford habitat heterogeneity in otherwise unvaried agricultural landscapes. The authors examined macroinvertebrate communities in post-mining calcareous streams in Czechia's Sokolov coal basin. Though richness was significantly lower than in natural waterways, post-mining streams were species rich and housed several specialist species and threatened species despite the seemingly contaminated water conditions. Community composition between the site types was distinct, suggesting that the harsh water conditions in post-mining streams do act as a filter to stream biodiversity. This study indicates that while post-mining streams are not ideal, they can serve as important macroinvertebrate habitat.

A Method for the Reintroduction of Entire Benthic Invertebrate Communities in Formerly Degraded Streams. 2019. Haase, P. (Senckenberg Research Institute and Natural History Museum Frankfurt, Gelnhausen, Germany, peter.haase@senckenberg.de) and F. Pilotto. **Limnologica** 77:125689. doi: 10.1016/j.limno.2019.125689

Freshwater ecosystem health has been severely degraded worldwide leading to rapid declines in biodiversity. Ecosystem services provided by riparian systems are essential, so with over 60% of riparian systems in poor condition in the EU, restoration of these habitats is becoming a priority. Though re-introduction is a common practice in wildlife conservation, this strategy has never been reported for benthic invertebrates. Haase and Pilotto developed a method for re-introducing intact benthic invertebrate communities to degraded streams, including selecting donor communities, specimen transfer, and monitoring that meet EU water quality framework standards. They tested transfer of over 400,000 specimens from three donor streams to one recipient stream and one recipient river in central Germany. The specimens experienced mortality rates of less than one percent. Monitoring was based on environmental DNA sequencing to determine community persistence. The methods presented in this paper are easily modified for use in other countries and the use of large numbers of individuals increases re-establishment probability for communities. Given the likelihood of re-establishment, these methods are cost-effective, which can improve public support of riparian restoration efforts.

Monitoring & Adaptive Management

A Decision Framework for Hemlock Woolly Adelgid Management: Review of the Most Suitable Strategies and Tactics for Eastern Canada. 2019. Emilson, C.E. (Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, Canada, caroline.emilson@canada.ca) and M. Stastny. **Forest Ecology and Management** 444:327–343. doi: 10.1016/j.foreco.2019.04.056

Adelges tsugae (hemlock wooly adelgid) has decimated *Tsuga* sp. (hemlock) forests in eastern North America. Recently, *A. tsugae* has been detected in southwest Nova

Scotia, concerning forest managers as many adelgid management strategies have proven insufficient. Emilson and Stastny present a decision framework for preventing, detecting, and controlling the pest. They also review restoration techniques and evaluate management strategies to enable forest managers to deal with inevitable future *A. tsugae* outbreaks, and prevent widespread ecosystem consequences.

Long-Term Vegetation Responses to Pinyon-Juniper Woodland Reduction Treatments in Nevada, USA. 2019. Ernst-Brock, E. (Department of Natural Resources and Environmental Science, University of Nevada, Reno, NV, cody_ernst_brock@nevada.unr.edu), L. Turner, R.J. Tausch and E.A. Leger. **Journal of Environmental Management** 242:315–326. doi: 10.1016/j.jenvman.2019.04.053

In the western United States, *Pinus monophylla* (singleleaf pinyon pine) and *Juniperus osteosperma* (Utah juniper) have been expanding their ranges due to a variety of factors including fire regime changes, increases in suitable habitat, and indirect grazing effects. This expansion reduces habitat suitability for sagebrush-dependent wildlife such as *Centrocercus urophasianus* (greater sage-grouse). Thinning is a frequently used management technique to mitigate habitat alteration but monitoring reveals disparate plant community responses to this strategy. The authors sampled a Western Nevada sagebrush steppe habitat 32 years post-thinning and seeding treatment. In thinned plots, *P. monophylla* cover was significantly reduced but many seedlings were detected in all plots. Native grass and shrub cover increased in treated plots, but the invasive *Bromus tectorum* (cheatgrass) also increased. Long-term, recolonization by *P. monophylla* is inevitable, and without further management will likely re-dominate previously thinned areas.

Propagation and Introduction

Using Naturally Occurring Climate Resilient Corals to Construct Bleaching-Resistant Nurseries. 2019. Morikawa, M.K. and S.R. Palumbi (Department of Biology, Hopkins Marine Station, Stanford University, Pacific Grove, CA, spalumbi@stanford.edu). **PNAS** 21:10586–10591. doi: 10.1073/pnas.1721415116

Assisting corals in adapting to climate change is essential to the future of these ecosystems. Heat tolerance varies by species, symbiont identity, and geographic area. In the genus *Acropora*, research indicates that heat tolerance is a function of symbiont genus as well as being under the control of several genes. Morikawa and Palumbi examined whether parent corals can retain heat tolerance in a nursery, tradeoffs between heat tolerance and growth and survival, and how to predict success after the 2015 bleaching event in American Samoa. Offspring of heat-tolerant parents were more bleach-resistant and retained higher genetic diversity than those from intolerant parents. Symbiont identity also played a strong role in predicting bleach tolerance. Identifying and selecting corals that are well-adapted to potential future climate stress may prove to be a key aspect of reef restoration success.

Reclamation, Rehabilitation, and Remediation

Succession After Reclamation: Identifying and Assessing Ecological Indicators of Forest Recovery on Reclaimed Oil and Natural Gas Well Pads. 2019. Lupardus, R.C. (University of Alberta, Camrose, Canada, lupardus@ualberta.ca), A.C.S. McIntosh, A. Janz and D. Farr. **Ecological Indicators** 106:105515. doi: 10.1016/j.ecolind.2019.105515

Drilling for oil and natural gas represents a major threat to Canada's boreal forests as site preparation consists of clearcutting and full removal of surface soil, stripping native seedbanks and drastically impacting potential site recovery via natural succession. This study examined community recovery of vegetation and soil on reclaimed well pads compared to reference forests in various successional stages. The study also identified above- and below-ground indicators for forest regeneration in 30 sites located in Alberta. Only two of the reclaimed well pads demonstrated similarity to reference sites, and a significant proportion resembled grasslands, indicating arrested recovery. Only one third of the pads showed a successional trajectory toward boreal forest. Well pads have long-lasting impacts on forest recovery and represent a significant source of boreal forest degradation.

Initial Stages of Recovery of Soil Macrofauna Communities after Reduction of Emissions from a Copper Smelter. 2019. Vorobeichik, E.L. (Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences, Yekaterinburg, Russia, ev@ipae.uran.ru). A.I. Ermakov and M.E. Grebennikov. **Russian Journal of Ecology** 50:146–160. doi: 10.1134/S1067413619020115

Heavy metal pollutants are hazardous to soil biota including the macroinvertebrate communities that facilitate organic matter decomposition and contribute to soil formation, structure, and nutrient availability. Vorobeichik et al. examined recovery of soil macroinvertebrate communities in spruce-fir forests that had been exposed to Russia's Middle Ural Copper Smelter (MUCS) over three periods of heavy metal emission (high, reduced, almost-terminated). Under all three emissions levels,

macroinvertebrate abundance decreased and community composition shifted with increasing proximity to the MUCS. Under the almost-terminated emission period, communities demonstrated increased abundance, even pollution-sensitive taxa. Analyzing the recovery of post-industrial soil communities is essential to gain insight into the long-term stability and function of these systems.

Traditional and Local Knowledge

Community Values and Traditional Knowledge for Coastal Ecosystem Services Management in the "Satoumi" Seascape of Himeshima island, Japan. 2019. Chakraborty, S. (Faculty of Sustainability Studies, Hosei University, Fujimi, Japan, shamik.chakraborty.76@hosei.ac.jp) and A Gasparatos. **Ecosystem Services** 37:100940 doi: 10.1016/j.ecoser.2019.100940

Coupled social-ecological systems (SES) occur where human settlements and ecosystems interact closely. Coastal areas are one such SES that contribute to local communities via ecosystem services such as food security. Sustainable management of SES should be ecosystem-based but a variety of cultural factors affect management decisions. Chakraborty and Gasparatos examined resource management practices informed by generations of traditional knowledge of local communities on Himeshima Island, Japan. These practices are generally a source of pride for communities but surveys also indicated that several ecosystem services have been degraded by habitat loss and overexploitation. Revitalization efforts have focused on shrimp culture and tourism but these practices may not be sustainable. Careful consideration of local cultural management practices is essential when restoring ecosystem services to coupled SES.

Urban Restoration

Large Terrestrial Bird Adapting Behavior in an Urbanized Zone. 2019. Alexandrino, E.R. (University of São Paulo, Luiz de Queiroz College of Agriculture, Forest Sciences Department, Piracicaba Brazil, eduardoalexandrino@hotmail.com), J.A. Bogoni, A.B. Navarro, A.A.A. Bovo, R.M. Gonçalves, J.D. Charters, J.A. Domini and K.M.P.M.B. Ferraz. **Animals** 9:351. doi: 10.3390/ani9060351

Cariama cristata (red-legged seriema) is a large terrestrial bird that has adapted to life in Brazil's semi-urban areas, particularly on the University of Sao Paulo campus. The birds are not a threatened species, however they do not occur in highly urbanized areas. Alexandrino et al. investigated how they are able co-exist in anthropogenic habitats, particularly in areas where domestic cats are common. *C. cristata* uses human structures to avoid cat encounters and for foraging on human-provided food resources. However, the birds seemed unaware of the dangers posed by cars. Urbanization may cause complex changes in wildlife behavior as animals adapt to anthropogenic environments. Understanding these changes is essential to developing effective management and conservation policies to protect species.

Biodiversity Conservation in Urban Parks: A Study of Ground-Dwelling Ants (Hymenoptera: Formicidae) in Rio de Janeiro City. 2019 Santos, N.M. (Instituto de Pesquisas, Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brazil, santosnm1@yahoo.cm.br), J.H.C. Delabie and J.M. Queiroz. **Urban Ecosystems.** doi: 10.1007/s11252-019-00872-8

Ant community structure can be a useful indicator for determining the quality of urban habitats. Urban parks in particular can house diverse native ant fauna and provided canopy cover, which increases available food resources and creates favorable microclimate for ants. The authors compared ground-dwelling ant communities in urban parks versus ant communities in continuous forests in and around Rio de Janeiro, Brazil. One hundred and sixteen native ant species occurred in the study sites but diversity was higher in continuous forests. Soil compaction and canopy cover were the primary drivers of diversity and community composition. As urbanization increases globally, understanding the role of urban greenspaces in providing habitats for a wide array of species is essential to conservation and restoration efforts.

Wetlands

Revegetation on Abandoned Salt Ponds Relieves the Seasonal Fluctuation of Soil Microbiomes. 2019. Tran, H.-T., H.-C. Wang, T.-W. Hsu, R. Sarkar, C.-L. Huang, and T.-Y. Chiang (Department of Life Sciences, National Cheng Kung University, Tainan, Taiwan, tychiang@ncku.edu.tw). **BMC Genomics** 20:478. doi: 10.1186/s12864-019-5875-y

The salt industry has degraded many coastal wetlands, leaving abandoned ponds in a disturbed landscape. Restoration strategies for salt ponds include mangrove establishment to improve soil properties by increasing nutrient content, reducing salt, increasing water permeability and recruiting communities of soil microbes. The authors compared seasonal bacterial community change between restored and unrestored salt ponds in Sicao, Taiwan. Restored wetlands housed increased soil microbial diversity. In unrestored ponds, communities fluctuated seasonally, indicating that revegetation stabilizes communities.

Restoring damaged wetlands is an essential strategy for the recovery of coastal environments damaged by the salt production industry.

Bird Diversity and Waterbird Habitat Preferences in Relation to Wetland Restoration at Dianchi Lake, South-West China. 2019. Luo, K., Z. Wu (Institute of Ecology and Geobotany, Yunnan University, Kunming, China, ziwu@nyu.edu.cn), H. Bai and Z. Wang. **Avian Research** 10:21. doi: 10.1186/s40657-019-0162-9

Wetlands are essential habitat for waterbirds but face global degradation. In China, urbanization is a major threat to wetlands and, by extension, to wildlife. Dianchi Lake is an urban lake in Yunnan Province that is currently undergoing a large-scale restoration. Luo et al. used canonical correspondence analysis (CCA) to examine bird community responses to restoration, habitat preferences, and historical data at Dianchi lake pre- and post-restoration. The authors recorded 182 bird species using the lake, 42 of which were new records for the province, but 10 species from historical data no longer occurred. CCA results indicated four habitat preference types: synanthropic, semi-natural, disturbance-tolerant, and special, indicating that management should account for each distinctive preference to ensure usage by the greatest diversity of species.

Wildlife Habitat Restoration

The Effects of Mountain Pine Beetle Outbreaks on Avian Communities in Lodgepole Pine Forests across the Greater Rocky Mountain Region. 2019. Janousek, W.M. (Avian Science Center and Wildlife Biology Program, Department of Ecosystem and Conservation Sciences, W.A. Franke College of Forestry and Conservation, University of Montana, Missoula, MT, william.janousek@umontana.edu), J.A. Hicke, A.J.H. Meddens and V.J. Dreitz. **Forest Ecology and Management** 444:374–381. doi: 10.1016/j.foreco.2019.04.047

In the western United States, *Dendroctonus ponderosae* (mountain pine beetle) outbreaks can decimate *Pinus contorta* (lodgepole pine) forests, causing up to 80% tree mortality. However, less is known about the effects of these outbreaks on other forest wildlife. Bird fauna are frequently used as bioindicators and can be used to examine broader forest impacts. However, the variety of indices used to evaluate effects make generalizing outbreak effects difficult. The authors used five years of monitoring data from the Integrated Monitoring in Bird Conservation Regions program to develop an occupancy model for forest bird communities, post-beetle outbreaks. According to the model, species richness did not differ between sites with and without outbreaks but community composition turnover did differ. These results indicate that species richness itself may not be sufficient to detect bird community changes. As climate change increases the frequency and severity of pest outbreaks, understanding community responses is essential to implementing effective management strategies.

Modelling White-Tailed Deer Impacts on Forest Regeneration to Inform Deer Management Options at Landscape Scales. 2019. Lesser, M.R. (State University of New York Plattsburgh. Center for Earth and Environmental Science. Plattsburgh, NY, mless004@plattsburgh.edu), M. Dovciak, R. Wheat, P. Curtis, P. Smallidge, J. Hurst, D. Kramer, M. Roberts and J. Frair. **Forest Ecology and Management** 448:395–408. doi: 10.1016/j.foreco.2019.06.013

Intense browsing pressure from *Odocoileus virginianus* (white-tailed deer) exerts major impacts on forest regeneration, plant population dynamics, and community structure in the Northeastern United States and often facilitates species invasions. Using forest regeneration models with variables for fine-scale plant competition, stand-scale seed dispersal and regional climate, land use and deer abundance patterns, the authors examined the effects of *O. virginianus* on regeneration of ten tree species. Unsurprisingly, increased deer abundance correlated to declining or changing seedling abundance for all ten tree species, and increases in seedling abundance may not be attainable by simply reducing deer abundance. In some modelled areas deer reduction may improve regeneration, indicating that these areas should be considered a management priority. Regeneration prediction is complex, but models like the one presented here may assist managers in defining goals, prioritizing areas that show regeneration potential, and ultimately improving degraded forests.

Woodlands

Effectiveness and Impacts of Girdling Treatments in a Conifer-Encroached Oregon White Oak Woodland. 2019. Kane, J.M. (Department of Forestry & Wildland Resources, Humboldt State University, Arcata, CA, jkane@humboldt.edu), E.A. Engber and J.E. McClelland. **Forest Ecology and Management** 447:77–86. doi: 10.1016/j.foreco.2019.05.059

Quercus garryana (Oregon white oak) woodland ecosystems are unique in the Pacific Northwest. These communities depend on frequent fires to maintain oak dominance but current fire suppression regimes that have been in place for many decades have allowed the encroachment of *Pseudotsuga menziesii* (Douglas fir). Prescribed burning has failed to control fir trees so managers are using girdling to restore *Q. garryana* woodlands. Kane et al. examined the efficacy of this treatment in Redwood National

Park over a seventeen-year period. Girdling killed 91% of *P. menziesii* with wide girdle width-to-tree ratios being the most effective treatment with both axes and chainsaws. Snags created via girdling showed bird activity. Fine woody debris that can serve as fuel did not persist through the study period and regeneration of both oaks and firs were variable. Effective management techniques are essential to maintaining unique *Q. garryana* communities.

Invasive Shrub Removal Benefits Native Plants in an Eastern Deciduous Forest of North America. 2019. Maynard-Bean, E. (Intercollege Graduate Degree Program in Ecology, Pennsylvania State University, University Park, PA, eem212@psu.edu) and M. Kaye. **Invasive Plant Science and Management** 12:3–10. doi: 10.1017/inp.2018.35

Eastern deciduous forests host a variety of invasive shrubs which are causing declines in many native taxa. Invasive shrub removal is believed to reverse negative impacts but outcome data are largely lacking in published literature. The authors examined the effects of removing 18 invasive shrub species over a seven-year period in a woodlot of the Penn State Arboretum in State College, PA. Plant diversity, understory abundance, and overstory regeneration increased for plants under one meter. For larger plants, there was no change in regenerating overstory species, likely due to the short time frame, canopy conditions, and perhaps browsing by *Odocoileus virginianus* (white-tailed deer). In general, invasive shrub removal yields positive results for native plant recovery and can be an effective management tool.

Seaweeds. Finley, J.H. 1917. *Nelson's Perpetual Loose-Leaf Encyclopedia.* New York, NY: Thomas Nelson and Sons. The Florida Center for Instructional Technology, fcit.usf.edu.