Priority	Research Topic	Genus/Species and comments
1	Climate Change: Assisted Colonization (mitigating threat)	Research on the potential for assisted colonization is required for the >100 species identified as having no overlap between current and future distributions (Fortini et al 2013 and 2016).
1		Climate change overall would be my highest area of priority. It affects everything - native species ranges, invasive species ranges, those interactions, etc, etc, etc. Modeling ranges to the best extent possible and assessing how both species ranges and those range overlaps that govern interactions (invasive species, pollinators, predation, etc) will change.
1		You want me to pick a single species? I think all the ecosystems as a whole need to be studied, that includes arthropods, plants, birds etc.
1		sesbania tormentosa, Capparis san, Chamaesyce sp. We need to mitigate the loss of the current strand habitat . Restore current inland coastal areas and take measures to build or raise/expand current coastal dunes
2	Climate Change: Assisted Colonization (mitigating threat)	genera that likely had a wider distribution but their former habitat is so altered that virtually nothing exists today. Where could you or would you put these? And how would all this play out in the Natural Area Reserves System, where there are varying philosophies on how or if these areas should be used for introductions; particularly if it is outside their former known range, even if it appears to be the only safe place to plant them.
2		Assisted colonization methodology for species first to be impacted. (Alpine?)
2		Acacia koa & Met pol. without our native forest "backbone"???
2		Brighamia rockii, Pittosporum halophilum, Scaevola coriacea, Cyanea solanacea, Cyanea procera, Phyllostegia hispida, Lysimachia maxima, Platanthera holochila, Schiedea laui, Clermontia oblongifolia ssp. brevipes, Hibiscus arnottianus immaculatus, Schiedea diffusa diffusa, Cyrtandra hematos, Peucedanum sandwicense
2		All species located at the top of the mountain.
2		Put Climate Change Assisted migration as number two, but think there really is not much real estate that the mid- and higher elevational plants can move to. In these cases, in order for the saving of these species through assisted migration to occur, I think it has to go hand in hand with restoration strategic planning and design.

Priority	Research Topic	Genus/Species and comments
2		All narrow range endemics, particularly species found in unique ecological niches (such as alpine or bog habitats).
3	Climate Change: Assisted Colonization (mitigating threat)	Combining population variation studies with climate change models will enhance assisted colonization (or simply prioritized conservation of tolerant populations).
3		Much of the vulnerability has been assessed, at least from a modeling perspective, so I would like to see studies on threat mitigation, especially for taxa with narrow ranges and/or from habitats threatened by sea level rise, high elevations, or other threatened habitats.
3		Endangered coastal species, i.e., Scaevola coriacea, Sesbania tomentosa, Brighamia rockii, and many others are our interest for protection because they are appropriate for our location and because wild populations will likely be under water in the future. Both identifying and mitigating threats to these species are equally important.
3		knowing what plants/animals will be most likely impacted by climate change and starting to plan restoration projects to incorporate vulnerability of certain plants/animals
4	Climate Change: Assisted Colonization (mitigating threat)	In general, creating maps to help land managers anticipate climate change and where future habitats will be for certain species/ecosystems.
4		for rare and listed species, and keystone species
4		Help determining how to overcome effects of changing climate for taxa that rank high in vulnerability assessment. Many taxa, eg. Sanicula mariversa
5	Climate Change: Assisted Colonization (mitigating threat)	Research on restoration/outplanting outside current ranges of species - especially for T&E species, rare species and single island endemics
5	Climate Change: Assisted Colonization (mitigating threat)	Target spp: All PEP species and other rare taxa. I think the vulnerability assessments are also critical. We need to start planning now so we can start taking corrective actions in the methodologies we choose to implement today, to the extent that we are able.
5		How far is reasonable to move a species in anticipation of change? Minimum population size to start with in a marginally new environment? Are there groups of appropriate species to move to higher elevation or wetter climate together?

Priority	Research Topic	Genus/Species and comments
5		See number 9
1	Climate Change: Vulnerability Assessment (identifying threat)	Aweo'weo, Milo, kou, lonomea, wiliwili, koai'a
1		Sakai and Weller; and also Robichaux and others with the Silversword alliance: a overall approach needs to be done: former distribution, current, and then what happens with all the factors and vulnerabilities and what exactly can be done to pull them back from the brink.
1		Brighamia rockii, Pittosporum halophilum, Scaevola coriacea, Cyanea solanacea, Cyanea procera, Phyllostegia hispida, Lysimachia maxima, Platanthera holochila, Schiedea laui, Clermontia oblongifolia ssp. brevipes, Hibiscus arnottianus immaculatus, Schiedea diffusa diffusa, Cyrtandra hematos, Peucedanum sandwicense
1		I am looking at this from the perspective of a professional in ex situ conservation, in other words, would defer decision to the field biologists who work closely with the species in the field. But would give more priority to the ones that are difficult to store or propagate for some reason or other and/or have very little or no information on.
1		All narrow range endemics, particularly species found in unique ecological niches.
2	Climate Change: Vulnerability Assessment (identifying threat)	Needed for all T&E species and for single island endemics as priorities. All species eventually.
2		Sub-alpine & alpine plants (similar to Krushelnycky, P. D., Loope, L. L., Giambelluca, T. W., Starr, F., Starr, K., Drake, D. R., ... & Robichaux, R. H. (2013). Climate-associated population declines reverse recovery and threaten future of an iconic high-elevation plant. Global change biology, 19(3), 911-922.
2		All species, but starting with canopy-dominant species seems a reasonable place to start.
3	Climate Change: Vulnerability Assessment (identifying threat)	All native flowering plants
4	Climate Change: Vulnerability Assessment (identifying threat)	Leptecophylla tameiameiae, Vaccinium reticulatum, Geranium cuneatum ssp. tridens, Dubautia spp.
5	Climate Change: Vulnerability Assessment (identifying threat)	Cyanea, Clermontia, Delissea, Brighamia, Lobelia, Trematolobelia

Priority	Research Topic	Genus/Species and comments
5		Habitat conditions and distributions are definitely being modified as a result of climate change and long-term stability of communities and ecosystems will be impacted even if the proximal threats (ungulates, land use, rodents, slugs, etc.) are controlled locally. Understanding the direction and magnitude of climate change factors will be critical to develop dynamic and, hopefully, successful conservation strategies from this point on.
1		Hibiscus
1		Geranium arboreum, Schiedea haleakalensis, Clermontia samuelii subsp. samuelii, Cyrtandra ferripilosa, Cyanea asplenifolia
1		Metrosideros spp. to determine if there is any natural resistance to Ceratocystis Sp. A & B (and other pathogens)
1	Inter/Intra-Population Variation (molecular study)	Hibbrabra, Abumen (not PEPP), Phyllostegia spp., Cyrtandra spp. From a management standpoint, identifying true "Big Island stock" of certain interisland species may be beneficial to ensure funds allocated to these species are being utilized for these species. Fortunately, work is underway for the Malvaceae species above. For Phyllostegias and Cyrtandras, greater understanding and perhaps revisiting published keys could help on the ground efforts in positively identifying species of concern. It seems there is a lot of misinformation and taxonomic overlap, which may be difficult to discern. One instance is disagreement over Phyllostegia parviflora var. glabriuscula.
1		Wide variety of genera and species
1	Inter/Intra-Population Variation (molecular study)	Phyllostegia spp., Cyrtandra spp. Developing restoration plants for the genera above is difficult because there is so much variation in phenotype between individuals at different sites. Hybridization is also an issue, especially in the Cyrtandras. Identifying individuals to species can be very difficult and so there is often uncertainty in how to proceed with genetically appropriate restoration efforts.

Priority	Research Topic	Genus/Species and comments
2	Inter/Intra-Population Variation (molecular study)	I think population variation is a poorly considered factor in conservation in Hawaii. This doesn't necessarily need to be molecular, although molecular studies enhance this topic a lot. What we need to link population variation to conservation is evidence for ecotypic variation, and so phenotypic and ecological studies that integrate population structure are important and fairly scarce in Hawaii.
2		When is it deemed ok to mix populations? On Hawaii Island this would be a question for Cyanea hamatiflora ssp. carlsonii as we have lots of potential outplants of Hualalai stock but few South Kona representatives.
3	Inter/Intra-Population Variation (molecular study)	Metrosideros; this approach yields rapid insight into the strength of isolation among closely related taxa within a lineage, which can be useful for conservation applications.
4	Inter/Intra-Population Variation (molecular study)	Acacia
4		Phyllostegia species- genectic test could be helpful to I.d. unknown species of mints, where overlapping characteristics appear.
4		Cyrtandra
5	Inter/Intra-Population Variation (molecular study)	Cyrtandra- genetic work identifying the relatedness or hybridization. If true species occur.
5		Schiedea
1	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	How is the loss of native pollinators and seed dispersers affecting montane plant communities? I don't have a particular species in mind - many plants may be susceptible
1		The idea of researching and identifying microbial symbiotic mutualisms with native plants and native microorganisms.
1		Common and rare fruiting species of plants. Native (Puaiohi) and non-native dispersers (Japanese White Eye, Shama, rats)
1		for rare and listed species-
1		Any taxa that are likely bird dispersed or pollinated. Campanulaceae. Also any taxa with low survivorship that could benefit from symbiotic fungal inoculation.
1		Peristylus (Platanthera) holochila, Liparis hawaiensis, and Anoectochilus sandvicensis and their obligate mycorrhizal fungal symbionts.

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1	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	Cyanea hamatiflora ssp. carlsonii. We have had difficulties getting good seed from this species in its South Kona Range. In the Hualalai population this is not as much of a problem. Wondering what is going on in South Kona - too few founders left? No or limited genetic transfer amongst individuals?
1		Hibiscus waimeae subsp. hannerae, Capparis sandwichiana, Schiedea apokremnos, Brighamia insignis, Cyanea leptostegia, Hesperomannia lydgatei, Kadua fluviatilis, Phyllostegia electra, Phyllostegia renovans, Platydesma spathulata, Strongylodon ruber, Gardenia remyi
2	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	Phyllostegia spp.,Geranium arboreum, Schiedea haleakalensis, Clermontia samuelii subsp. samuelii, Cyrtandra ferripilosa, Cyanea asplenifolia, Hillebrandia sandwicensis
2		Vicia menziesii (pollinator)
2		Joinvillea ascendens- tried to germinate in peat mix. Germinated but died shortly after. Assumed it used up nutrients from seed. Sowed seeds in live soil and seedlings grew to outplatable size. Assuming symbolic microorganism association needed to provide nutrients?
2		Exocarpus luteolus, Joinvillea ascendens var. ascendens
2		Cyrtandra
2		Priority to most endangered and species that have been most challenging in cultivation.
3	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	this goes back to Sakai and Weller, looking at arthropods and other pollinators/dispersers and their own current conservation standing (i.d. a specific arthropod is no longer extant and the dependent plant is also then in trouble. What are the missing holes or links, and can they be successfully filled or linked; even if it is a novel or radical approach never before contemplated.
3		-Species with seeds larger than those that can be dispersed by introduced birds or by rats. -Species for which seedset seems to be low (pollinators)

Priority	Research Topic	Genus/Species and comments
3		Pockets of rare plants seem to coexist. Identifying the microclimatic conditions present, along with the mutualisms would be greatly beneficial equally interesting.
3		Understanding certain mutualism issues is critical for assessing if individual species and communities to be able to survive, and particularly when your monitoring shows that plants are not able to get established and maintain their populations after the immediate threats (ungulates) are controlled.
3		Lobeliads
4	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	Schiedea.: This topic goes along with understand how mating system and pollination system impact the genetic diversity, reproductive isolation, etc. of native species in the wild and in restored plots. If you put plants where they do not have a needed pollinator, reproduction may be very low.
4		It's all about interactions. We need so much more knowledge about the various organisms that enable plants to disperse, establish, reproduce, and survive - and this research would inform conservation and management of the mutualists too. The majority of the flora needs more study in this respect.
4		Need a better understanding of what goes on under the soil i.e.soil biota and how it relates to our conservation efforts and identify the threats to our soils/substates
4	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	We could learn a lot more about pollination of native plants that might help with recover. Visiting OANRP and seeing Stenogyne kanehoana in large numbers and looking incredibly healthy was a pretty amazing experience after seeing one unhappy plant sticking out of a Lantana patch in 1987. What was almost as remarkable was to learn that despite all sorts of effort to pollinate and obtain seeds from the plants in cultivation, very few have been produced. I have trouble imagining that this plant is self incompatible (I don't think many mints are), but it would be great to know more about why seed production is so low. I think the broader impacts of research programs on these plants ought to include these kinds of questions. Although I am obviously influenced by our work on Schiedea, I think that we might expect academic researchers to consider theses issues.

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5	Mutualisms (identifying pollinator, disperser, mycorrhizal symbionts)	Little is known about soil mycorrhizal associations. ie Platanthera holochila.
5		Species with no or poor seed set for no apparent reason. Populations in declining health and/or in environments that have seen significant ecological change.
5		Understanding how these species interact with pollinators, mycorrhizal symbionts, and dispersers helps determine why they may or may not be declining and potentially how to reverse those trends. Uhiuhi (Mez kav) may be one species that is dependent on mycorrhizae and knowing that could help with management.: Argyroxiphium kauense, Asplenium peruvianum var. insulare, Bonamia menzisii, Chrysodracon hawaiiensis, Colubrina oppositifolia, Delissea undulata, Haplostachys haplostachya, Hibiscadelphus hualalaiensis, Hibiscus brackenridgei ssp. brackenridgei, Kokia drynarioides, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Silene lanceolata, Solanum incompletum, Stenogyne augustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiensis.
5		All native flowering plants
3	Phenology	Basic phenology info and pollinator info for species like Nothocestrum peltatum that never produce viable seed. So far, limited attempts at hand pollination in the field have not worked. Other species that could use work in this area are Xylosma crenatum and Melicopes. Lysimachia has Tim Kroesig working on them. Psychotria has Kenta Watanabe working on them.
3		Gouvit: Finally got our eyes on the Manuka population yesterday! Tried to see if OANRP had a rare plant plan online to help steer our collection efforts on the Big Island. Very few individuals have worked with this species here and there haven't been observations of fruiting times. For a lot of the inter island species, greater information dissemination between agencies is needed rather than reinventing the wheel.
4	Phenology	No species of preference, but phenology, reproductive biology, and mutualisms research will be essential to make seed storage possible for some species.
4		All native taxa (common & rare). Should establish something in Hawaii similar to USA National Phenology Network (https://www.usanpn.org/home)

Priority	Research Topic	Genus/Species and comments
4	Phenology	Asplenium peruvianum, Erythrina sandwicensis, Colubrina oppositifolia, Chrysodracon hawaiiensis Delissea undulata, Haplostachys haplostachya, Hibiscus brackenridgei, Hibiscadelphus hualalaiensis Kokia drynarioides, Melicope hawaiiensis, Meterosideros polymorpha var incana, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Reynoldsia sandwicensis, Silene lanceolata, Solanum incompletum, Stenogyne angustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiense.
4		Wide variety of genera and species
5	Phenology	This is basic, but a better understanding of phenology in many species would greatly benefit the effort to make collections. Our understanding of phenology patterns in many species is incomplete because routine monitoring is not usually possible for each species. Regular monitoring could provide more information on these patterns and the variation that can be expected across spatial and temporal scales.
1	Population Distribution (models)	Abutilon sandwicense, Alectryon macrococcus var. macrococcus, Erythrina sandwicensis, Eugenia koolauensis, Euphorbia celastroides kaenana, Euphorbia herbstii, Flueggea neowawraea, Hibiscus brackenridgei mokuleianas, Pleomele forbesii, Pritachardia kaalae, Pteralyxia macrocarpa
3	Population Distribution (models)	N/A, as many species as possible
4	Population Distribution (models)	can be used for rare and invasives?
5	Population Distribution (models)	Common Hawaiian fern species. It seems Restoration Strategy and Design would include Population Distribution and Population Survey studies.

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1	Population Size (surveys)	Many species are presumed extinct-or are down to very low numbers of individuals- but suitable habitat still exists. These areas need to be surveyed before they are totally obliterated by ungulates, weeds, rats, slugs, fire, or erosion. Cyanea spp., Delissea undulata, Tetramolopium capilare, Tetramolopium remyi, Deparia kaalaana, Phyllostegia spp., Stenogyne viridis, Argyroxiphium virescens, Diellia leucostegioidea, Gouania vitifolia (Maui), Mezoneuron kavaiensis (Maui), Isodendrion pyrifolia (Maui)
1		all endangered taxa
1		Alectryon macrococcus var. macrococcus, Bonamia menziesii (Makaleha), Cyanea sp. nov., Cryptocarya mannii, Hesperomannia lydgatei, Isodendrion longifolium, Lobelia sp. nov (Haupu), Myrsine linearifolia, Polyscias bisattenuata, Pteralyxia kauaiensis, Wilkesia hobdyi

Priority	Research Topic	Genus/Species and comments
1	Population Size (surveys)	Info gathered in 2010 from Recovery plans, 5-year reviews, and Maui nui task force held in 2010. Some information may have already been collected or completed. I didn't have time to check the references. Abutilon sandwicense - around Puu Pane in Waianae Mtns (source Oahu RecPlan [RP]), Acaena exigua - complete search of former habitat (Maui RP), Bonamia menziesii - need to resurvey outside exclosure at Puu o Kali, 1 in exclosure, Canavalia molokaiensis - unknown numbers since fire, need to resurvey all historic locations on Molokai (Maui Nui Task Force meeting - Bakutis), Cenchrus agrimonioides var. laysanensis - Historical locations (no individuals currently known in the wild), Clermontia lindseyana - look similar to CleKak, could be more, need survey Kahikinui - state side, Wailaulau drainage (Maui Nui Task Force - Oppenheimer), Clermontia oblongifolia ssp. mauiensis - Search for East Maui individuals (Huelo to eastern Kaupo at 750-1,110 meters elevation) (Maui RP), Cyanea lobata - Search its former habitat; start in but not limited to, Waikapu Valley, where the species was last seen in 1992; upper Kauaula Valley (western West Maui), Cyanea mceldowneyi - Determine status of Honomanu popln and manage appropriately, Cyanea pinnatifida - Appropriate habitat in historical locations Cyanea profuga - needs survey further east of Kumueli (Maui Nui Task Force - Bakutis & Perlman), Cyanea superba var. regina - Appropriate habitat in historical locations (last seen in 1932), Cyanea truncata - Appropriate habitat in historical locations (no extant wild individuals known), Cyrtandra crenata - Appropriate habitat in historical locations (no extant wild individuals known), Cyrtandra filipes - needs resurvey of Kapuna gulch, Molokai & Kauaula, Maui (Maui nui task force meeting - Oppenheimer & Perlman), Cyrtandra limahuliensis - Detailed surveys to assess the current status of the species, Cyrtandra lydgatei - needs resurvey of Lanaihale & Kauula, north fork (Maui nui task force meeting - Perlman & Oppenheimer), Cyrtandra polyantha - Appropriate habitat in historical locations (Hahaione Valley should also be revisited to determine if the popln still exists, Kadua degeneri var. coprosmifolia - In areas where it is found, Hibiscus waimae spp. hannerae - resurvey Hanakapiai for an accurate count of indivs, Huperzia mannii - At 900-1,525 meters elevation in the Manawainui area, between Kaupo Gap & Kipahulu Valley of HALE, Kokia kauiensis - survey Koaie & Kawaiiki area for

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		additional indivs, Melanthera fauriei - Historic locations for current status Cyperus pennatiformis ssp. pennatiformis - Historical locations on Kauai, Oahu and Maui (not observed for several years), Melicope balloui - Northwest Haleakala, where it was first discovered (middle elevation forests), Melicope linearifolia - Survey to determine current status of species Melicope mucronulata - Determine whether three known individuals on Molokai are still there, Melicope ovalis - windward Haleakala, in area where it was first found (mountains above Hana), Panicum niihauense - Historical locations on Niihau and Kauai, Phyllostegia parviflora var. glabriuscula - Historical locations on the island of Hawaii (not observed for several yrs), Portulaca molokiniensis - needs survey, no large plants seen in last 2 yrs on Molokini.

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1	Population Size (surveys)	Solanum nelsonii, Sesbania tomentosum, Portulaca sclerocarpa, Bidens hillebrandiana and other coastal plants. Need more collections and surveys of populations as well as more protection of coastal sites. More emphasis on coastal restoration.
1	Population Size (surveys)	238 PEPP species all need more surveys to locate more
2		Cyanea, Clermontia, Delissea, Brighamia, Lobelia, Trematolobelia
2		All potentially extinct species (i.e. taxon not seen for over 20 years, habitat remains, some hope of discovery remains). PEPP EXTINCT: Argyroxiphium virescens (Maui), Euphorbia remyi var. hanaleiensis (Kauai), Cyanea dolichopoda (Kauai), Cyanea eleeleensis (Kauai), Cyanea kolekoleensis (Kauai), Cyanea kuhihewa (Kauai), Cyperus neokunthianus (Maui), Dubautia kenwoodii (Kauai), Hibiscadelphus woodii (Kauai)., Lobelia dunbariae subsp. dunbariae (Molokai), Melanthera populifolia (Lanai), Melicope quadrangularis (Kauai), Melicope wailauensis (Molokai), Peperomia degeneri (Molokai), Phyllostegia knudsenii (Kauai), Scaevola hobdyi (Maui), Tetramolopium capillare (Maui), Cyanea copelandii subsp. copelandii (Hawaii), Cyanea pycnocarpa (Hawaii), Eragrostis fosbergii (Oahu), Kadua degeneri subsp. coprosmifolia (Oahu), Trematolobelia rockii (Molokai). It would be important to discovery any new founders of species thought to be extinct in the wild: Cyanea grimesiana subsp. grimesiana (Oahu), Cyanea pinnatifida (Oahu), Delissea rhytidosperma (Kauai), Delissea argutidentata (Hawaii), Hibiscadelphus giffardianus (Hawaii), Hibiscadelphus hualalaiensis (Hawaii), Kokia cookei (Molokai), Phyllostegia kaalaensis (Oahu), Phyllostegia parviflora var. lydgatei (Oahu), Schiedea jacobii (Maui), Stenogyne bifida (Molokai), Stenogyne kaalae subsp. sherffii (Oahu), Cyanea superba subsp. superba (Oahu), Silene perlmanii (Oahu), Kadua haupuensis (Kauai). Determining the population sizes is a task that PEPP takes on and has historically been considered by higher education as a management topic ... but if there were other parties conducting surveys as well, we would have a much better idea of the total number of plants within a given species. This will better inform conservation actions.

Priority	Research Topic	Genus/Species and comments
2	Population Size (surveys)	Understanding current population size is what is needed with long-term trends in populations in order to make management decisions and to prioritize species. We now potentially have a tool (LiDAR) to detect all individuals of some rare species and this should be done so we know where they are and how many of them are left.: Argyroxiphium kauense, Asplenium peruvianum var. insulare, Bonamia menzisii, Chrysodracon hawaiiensis, Colubrina oppositifolia, Delissea undulata, Haplostachys haplostachya, Hibiscadelphus hualalaiensis, Hibiscus brackenridgei ssp. brackenridgei, Kokia drynarioides, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Silene lanceolata, Solanum incompletum, Stenogyne augustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiensis
2		Too many to list
2		For our species the discovery of a single new founder can drastically increase the known population size and available pool of genetic material available for restoration efforts. As we are finding, many areas of our island are very poorly surveyed. Most, or all of our species would benefit from more survey time and access to new, poorly surveyed sites.
3		It is difficult to manage what you don't monitor but for many organizations we just don't have the capacity to monitor rare plant populations regularly. Understanding when species are doing well or when they are crashing and why is very important to craft strategic management plans.
3	Population Size (surveys)	Botanical survey usually results in identifying new populations of listed species. Additional surveys in suitable habitat can help to prioritize which species to work with, some plants may not be as rare as we think they are as additional populations may be out there.
3		Flueggea neowawraea : we still are turning up new locations and more potential habitat can be surveyed. Have had a hard time getting permission from a certain landowner to visit a known tree, thus this tree is unrepresented in collections.
4	Population Size (surveys)	abutilon

Priority	Research Topic	Genus/Species and comments
4	Population Size (surveys)	What is the tipping point: what causes, if it is possible to determine, what is that point at which a species starts to decline in an unrecoverable slide downhill (i.e. species that are nearly gone form the wild like gardenia, but do 'ok' in cultivation but are not forming the associations they need. How do we re-create places where they might thrive again in the face of wholesale destruction of lowland and dry land habitats in particular, with the rise of threat by alteration due to changing fire regimes and increased alien species introductions further complicating the matter.
4		Rare plant management is often based on assumptions of numbers of populations and individuals, and work is based on these numbers. Surveys are needed to confirm that these taxa are in fact as rare as is thought, since there are many areas that have not been explored by botanists.
4		N/A, all species
4		In regard to Clepelpel, which is only found in Hilo Forest Reserve, founder discoveries is in need. With 5 founders known, exploration is needed to augment the gene pool! However, access to parts of this vast reserve is difficult and access by helicopter seems the most viable. This is also the same case with Adeper, which is historically known from the Kahaualea NAR, Wao Kele o Puna, and HAVO east rift. This area is alive with active lava flows and therefore access by helicopter is the most viable option to explore the mosaic of kipuka.Clepelpel, Adeper, Cyaspp., All species!
4		Knowing the population size and trend is the basis and rationale for all work on rare and threatened species.
5	Population Size (surveys)	Cyanea maritas, Cyanea copelandii ssp. haleakalae, Phyllostegia brevidens, Phyllostegia bracteata, Sanicula sandwicensis, Hillebrandia sandwicensis, Sicyos cucumerinus

Priority	Research Topic	Genus/Species and comments
1	Population Trends (monitoring of life stages & longevity)	I would retitle this topic to gaining knowledge of basic biology of Hawaiian plants - this information is not know for the majority of Hawaiian plants, the list of species would be several hundred taxa; reserach is needed on basic population biology - age classes, reproduction, pollinators, disperser, recruitment rates,life span, what is a viable population (size and structure) and how much area of habitat does a species need to maintain a viable population
1		T&E species in restored dryland forests (mao hau hele, hau hele ula, aiea, kauila (Colubrina),halapepe, uhiuhi and others): to determine how well is restoration working? What are major threats still? Non T&E longlived species for which little regeneration is observed even in restored areas of dry forests: (lama, olopua, iliahi and others) and mesic or other forests (manono,ahakea, hame others) - which ones may be at risk of being threatened over the long-term, but we don't notice now since the adults are so long lived.
1		These are the endangered/threatened plant taxa in the state lands in North Kona, Hawaii - the ahupua'a of Pu'uwa'awa'a and Pu'uanahulu. Having info on population trends is critical to management efforts: Argyroxiphium kauense, Asplenium peruvianum var. insulare, Bonamia menzisii, Chrysodracon hawaiiensis, Colubrina oppositifolia, Delissea undulata, Haplostachys haplostachya, Hibiscadelphus hualalaiensis, Hibiscus brackenridgei ssp. brackenridgei, Kokia drynarioides, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Silene lanceolata, Solanum incompletum, Stenogyne augustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiensis.
2	Population Trends (monitoring of life stages & longevity)	Population trends for at risk and climate vulnerable species is needed, along with development of critical thresholds that if surpassed should trigger a decision framework aimed at identifying viable options: insitu vs seedbank vs exsitu propagation program vc assisted colonization, vs etc...
2		Basic population biology – # of populations and individuals, age classes, reproduction, pollinators, dispersers, recruitment rates, life span, etc
2		Restoration and management can only be realized if you know that your target species and communities are able to maintain a viable population structure.

Priority	Research Topic	Genus/Species and comments
3	Population Trends (monitoring of life stages & longevity)	all native taxa
3		Any Hawaiian plant species that lacks recruitment in the wild.
3		for rare and listed species-
3		Outplanting - population monitoring and weed control. Or should it be the other way around - weed control and then outplanting.
4	Population Trends (monitoring of life stages & longevity)	This is a lot of work, but it's really important for identifying the stages at which population stability are most dependent, and also the stages most threatened by global change factors. I don't think we do enough of this.
4		Especially in response to threats by climate change, introduced pathogens, and invasive species. Identification of focused areas to implement restoration strategies for species preservation.
5	Population Trends (monitoring of life stages & longevity)	lonomea, wiliwili, koai'a, nio
5		How long do species really live? Why do some lobeliads (in particular) appear to last longer than others; why do some like Delissea do well in cultivation, but there is no habitat left in the wild. Look at Kanaloa: once a very widespread plant, if you look at the pollen record: gone from the main islands, only on a a sea stack off Kaho`olawe where ungulates (and other predators including humans) could not reach it. it was discovered as an end game. Can anything be done to restore it to the wild or will it forever be only a rarity even in specialized cultivation.
5		Cyrtandra
5		all native species
5		Knowing the population size and trend is the basis and rationale for all work on rare and threatened species.
1	Propagation: Controlled Breeding	Solanum nelsonii-Was never able to get viable seed from field. Collected fruit with seeds, but no germination.Also collected fruit from greenhouse but no germination.

Priority	Research Topic	Genus/Species and comments
2	Propagation: Controlled Breeding	This information is not know for the majority of Hawaiian plants, the list of species would be several hundred taxa; very important for large scale restoration projects; questions to be answered would include - Are plants and seeds resulting from controlled propagtion genetically changed? If so, at what stage does this occur (F1, F2, etc.) and does it affect their ability to survive in the wild? Species that are a good candidates for wild vs. cultivated plants - Brighamia, Cyanea superba.
2		Common Hawaiian fern species, from spores.
3	Propagation: Controlled Breeding	Same as above. Also, developing breeding programs for fire resistant strains of native plants in fire prone area? Is this possible? Are there any candidates for this? Are there fire resistant native grasses that could be planted along the roadways that might slow the spread of human caused fire?
3		Developing propagation methods in general is a vital part of conservation. Being able to know when it is optimal to hand pollinate species is a critical part of this work. For example, Patty Moriyasu was able to pinpoint the exact moment a Clermontia peleana subsp. peleana pistil was receptive to pollen, which resulted in improved seed set, many times more productive than hand pollinations in the past, which ultimately vastly improved the prognosis of the sp. This is applicable for virtually any of the 600+ rare plant taxa. By virtue of rarity, PEP species would benefit the greatest by this research.

Priority	Research Topic	Genus/Species and comments
3	Propagation: Controlled Breeding	Please place this topic as the highest priority. This topic should lump all the different kinds of propagation together since different species require different methods. As a rare plant nursery we are doing the initial research on germination, vegetative propagation, best practices for cultivation, fertilization and pest control, as well as figuring out the phenology for doing hand pollinations. Our goal ultimately, is to produce plants for restoration out plantings. Stabilizing these species should be of the highest priority as extinction is final and precludes any other research that could be done in the future. Naturally, I think that priority should go to nurseries as we are a gene bank for rare plants. Since we produce thousands of plants each year and hold more than 90 species in our nursery we feel that funding should at least cover salaries for our staff of two for maintaining these endangered plants.
5	Propagation: Controlled Breeding	Any rare species that can be grown to maturity in nurseries (small trees, bushes, or herbaceous plants) would benefit from controlled crosses to generate lots of seed. I think priorities for this would be species that are only in cultivation or storage so that the chances of loosing the species is diminished. (NTBG did this with Kadua haupuensis and Steve Weller is doing it with Schiedea attenuata). Other instances where this has been of great benefit are for species in which individuals are so isolated that natural cross pollination rarely occurs. Example species: Euphorbia eleanoriae, Cyanea remyi, Kadua st. johnii, Kadua cookiana, Lysimachia.
5	Propagation: Controlled Breeding	Pteridophytes
1	Propagation: Tissue Culture	Propagation of rare ferns using tissue culture or any other means. Ruth Aguraiuja has done work with the Diellia group of Asplenium ferns, but several other genera have rare species for which little work has been done. Adenophorus, Ctenitus, Dryopteris and Doryopteris are genera with rare species.
3	Propagation: Tissue Culture	Micropropagation would be a vegetative way to obtain quantities of common Hawaiian ferns with creeping rhizomes, e.g.: Microlepia strigosa, Diplazium sandwichianum, perhaps others
3		Need to learn to propagate all 238 PEPP species in tissue culture

Priority	Research Topic	Genus/Species and comments
4	Propagation: Tissue Culture	Propagation of species invitro from vegetative samples. Nellie Sugii has lots of experience getting things to grow invitro through embryo rescue, but several species never get to the point of having embyros to rescue. It would be awesome to be able to grow some species from apical meristems or even leaves. Melicope knudsenii, Melicope haupuensis, Melicope degeneri, Psychotria grandiflora, Nothocestrum peltatum, Xylosma crenatum, Astelia waialealae (lots of propagation invitro for this genus in Australia), Myrsine mezii, Stenogyne campanulata, Sicyos lanceoloideus, Lysimachia, Labordia, Fluggea, Euphorbia eleanoriae, Cyanea, viola kauaiensis var wahiawaensis. This would also allow us to capture propagules from male founders in dioecious species that don't respond to cuttings, airlayers, etc. It would also be a way to get some kind of propagule from plants growing in very difficult to access areas when they aren't flowering and you won't have a chance to return or from immature plants that are unlikely to make it to maturity.
5	Propagation: Tissue Culture	And Propagation: Controlled Breeding - Ctenitis squamigera
5		Enhance production capabilities for all threatened species and possible commercial application for mass produced common species necessary for restoration projects.
5		I don't know much about this- but from what I know there has been remarkable progress in propagating some really rare plants using this approach- and the potential seems very exciting.
1	Propagation: Vegetative Techniques	Kanaloa kahoolawensis, Flueggea neowawraea, Platanthera holochila, Melicope adscendens, Melicope knudsenii, Deparia kaalaana, Diplazium molokaiense
1		Rare ferns/fern allies (Ctenitis, Pteris, Phlegmariurus, etc, etc.). Not having any tools to in propagation severely cripples our ability to do restoration, recovery, prevent extinction of these species.
1		Nothocestrum peltatum, Alectryon macrococcus ssp macrococcus, Xylosma crenatum, Melicope paniculata, Kokia kauaiensis
2	Propagation: Vegetative Techniques	Need to learn how to grow all PEPP species by cloning leaf material

Priority	Research Topic	Genus/Species and comments
2	Propagation: Vegetative Techniques	Asplenium peruvianum, Erythrina sandwicensis, Colubrina oppositifolia, Chrysodracon hawaiiensis, Delissea undulata, Haplostachys haplostachya, Hibiscus brackenridgei, Hibiscadelphus hualalaiensis, Kokia drynarioides, Melicope hawaiiensis, Meterosideros polymorpha var incana, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Reynoldsia sandwicensis, Silene lanceolata, Solanum incompletum, Stenogyne angustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiense.
3	Propagation: Vegetative Techniques	Many plants are either functionally male and there fore do not produce seeds, and/or are difficult to propagate via traditional methods such as cuttings or airlayers. This is also in addition to developing Tissue culture techniques.
3		A number of slow growing tree species, especially those that are dioecious, could drastically benefit from improved vegetative propagation methods and infrastructure. Getting these kinds of species represented in controlled breeding populations is critical for their conservation.: Flueggea neowawraea, Zanthoxylums, Melicopes, Gardenias, Bobeas, others.
4	Propagation: Vegetative Techniques	There are certain genera/species that have been difficult to cultivate, such as Huperzia spp., Adenophorus spp., Flueggea neowawraea, some Kauai Phyllostegia spp., etc. Without propagative techniques for these rare species that are not doing well in the wild (as they are responding to threats, low genetic diversity/numbers, widely dispersed populations, etc.), it will be difficult to conserve until these ex situ techniques are developed.
4		Vegetative techniques besides micropropagation, including division and harvesting of proliferations/buds/keiki, could be used to multiply Hawaiian fern species.
5	Propagation: Vegetative Techniques	Alectryon macrococcus var. macrococcus Bonamia menziesii (Makaleha) Polyscias bisattenuata

Priority	Research Topic	Genus/Species and comments
1	Reproductive Biology (mating systems: autogamy, outcrossing, apomixis)	Schiedea. This is the basic research topic that I work on, but it is not necessarily what I think is the most important aspect in conservation/restoration biology. It is one important piece of information to consider in conservation/restoration biology.
1		Schiedea haleakalensis - Wild populations continue to decline. Outplanting efforts lack quality results due to perhaps weakened genetics, a changing climate, lots of other factors. It's a challenging species to work with.
1		It could be argued that a set of related areas are all of roughly equal importance. Understanding reproductive biology--breeding and mating systems--in combination with identifying reproductive mutualists is critical for determining whether or not managed populations will be able to sustain themselves through natural reproduction. Other points in the life cycle are critical as well, especially seed germination and seedling establishment under natural conditions in the field. An experimental approach is best. Taken together, these steps should allow identification of the points at which regeneration is being limited, and direct conservation and management options to overcome them. In response to questions below: proceeding step-by-step through the reproductive life cycle, from flowering to well-established seedlings, needs to be completed for each species that is failing to regenerate naturally. Hence, seed dispersal, seed banks, germination, seedling establishment (and threats by granivores and herbivores) are all equally important--though it may make sense to start with flower biology and proceed one step at a time through the life cycle. I would advocate choosing a species and assessing all steps/processes, rather than choosing one process and examining a number of species.
1		I don't actually have a list of species just opinions on areas of research I think are most important for the conservation of native Hawaiian species - this would apply to all of the following questions

Priority	Research Topic	Genus/Species and comments
1	Reproductive Biology (mating systems: autogamy, outcrossing, apomixis)	Our work on Schiedea with the most relevance to conservation comes from an understanding of the reproductive biology and how that influences genetic variation within and between populations of species. We are concerned with making the most of what little genetic variation remains in species to produce the most highly fit offspring possible for use in restoration. Our information on reproductive biology also informs restoration plants- for example, when restoring a species with separate sexes and wind pollination, not only is it important to have the great genetic diversity possible, but female plants must have pollen-donating hermaphrodites in their immediate neighborhood at short enough distances for pollen to be transferred to females. For a facultatively or obligately autogamous species with a long history of self-fertilization, worrying about variation within populations might not be so important (because there won't be much variation to worry about), and you don't absolutely need pollinators. But even in Schiedea viscosa, which is largely selfing, we found evidence for heterosis in crosses between populations, indicating that occasional cross pollination (by now extinct birds?) might have been important. From Lauren's work on Schiedea kaalae, the importance of attracting moths to the population is to maintain outcrossing. Differences in the presence/absence of moths in restored populations of S. hookeri is very interesting. Will these moths eventually find these restored populations in sufficient numbers to maintain outcrossing (and seed production)?
2	Reproductive Biology (mating systems: autogamy, outcrossing, apomixis)	Wide variety of genera and species
2		Hibiscus waimeae subsp. hannerae, Capparis sandwichiana, Schiedea apokremnos, Brighamia insignis, Cyanea leptostegia, Hesperomannia lydgatei, Kadua fluviatilis, Phyllostegia electra, Phyllostegia renovans, Platydesma spathulata, Strongylodon ruber, Gardenia remyi
3		Phyllostegia spp.,Geranium arboreum, Schiedea haleakalensis, Schiedea diffusa

Priority	Research Topic	Genus/Species and comments
3	Reproductive Biology (mating systems: autogamy, outcrossing, apomixis)	Cyrtandra
4		Hesperomannia lydgatei
4		Asteraceae: on Kauai specifically Wilkesia spp., Dubautia spp., Keysseria spp., Melanthera/Lipochaeta spp.
4	Reproductive Biology (mating systems: autogamy, outcrossing, apomixis)	Understanding how these species reproduce is critical to recovering them.: Argyroxiphium kauense, Asplenium peruvianum var. insulare, Bonamia menzisii, Chrysodracon hawaiiensis, Colubrina oppositifolia, Delissea undulata, Haplostachys haplostachya, Hibiscadelphus hualalaiensis, Hibiscus brackenridgei ssp. brackenridgei, Kokia drynarioides, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Silene lanceolata, Solanum incompletum, Stenogyne augustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiensis.
5	Reproductive Biology (mating systems: autogamy, outcrossing, apomixis)	Need to study breeding systems of all 238 PEPP species to understand how to cross individuals and produce viable seed
5		Common and SCI native Hawaiian taxa with a focus on Kauai. I would include plant - pollinator interactions in this category.
3		Schiedea.: Consideration of the mating system and its impact on restoration and genetic diversity of the restoration population is critical to consider if a population is to be self-sustaining.
3		Wide variety of genera and species
3	Restoration: Inbreeding/Outbreeding Depression and Heterosis	Kokia, Erythrina, Gardenia
3		Hibiscus waimeae subsp. hannerae, Capparis sandwichiana, Schiedea apokremnos, Brighamia insignis, Cyanea leptostegia, Hesperomannia lydgatei, Kadua fluviatilis, Phyllostegia electra Phyllostegia renovans, Platydesma spathulata, Strongylodon ruber, Gardenia remyi
4	Restoration: Inbreeding/Outbreeding Depression and Heterosis	Cyanea, Clermontia, Delissea, Brighamia, Lobelia, Trematolobelia

Priority	Research Topic	Genus/Species and comments
4	Restoration: Inbreeding/Outbreeding Depression and Heterosis	Metrosideros; although this takes time, only through controlled crosses can we see the consequences of mating within highly genetically isolated species and mating between closely related taxa. Both can be important for conservation.
4		Lobeliads
1	Restoration: Outplanting Methods (seed sow, planting techniques)	Nothing in particular, but an increased emphasis on more common natives, instead of just PEP and ESA species would be a good thing for the long run.
1		Santalum Brighamia Hibiscus
2	Restoration: Outplanting Methods (seed sow, planting techniques)	lonomea, wiliwili, koai'a, naio
2		Sesbania tomentosa - Kauai ROI; low survivability when out planting. Large numbers of plants have been out planted with few survivors.
2		More research and experiments with outplanting methods to somehow enhance the competitiveness of native plants. Figuring out a way to help outplants establish quicker/easier with less follow-up management.
2		Polyscias bisattenuata
2		Determine ideal size (size of pot) or method (seeds, cuttings etc..) for reintroduction of species to the landscape
2		For many taxa that require restoration we are still determining the best techniques. I feel this is second priority.
2		All native plants
3	Restoration: Outplanting Methods (seed sow, planting techniques)	In line with assisted colonization research needs, we need to identify the proper outplanting techniques for species likely requiring assisted colonization so when the time comes, we have the techniques needed.
3		We should rethink our current paradigm of out planting and move toward direct seed sowing
3		Goes hand in hand with soil seed bank. Study of locations and previously employed techniques would be helpful.
4	Restoration: Outplanting Methods (seed sow, planting techniques)	information on improving outplant success is important: size of seedlings at planting, nurse/facilitator plants, invasive plant control, etc. We have done some work on seed broadcast but this is an area of interest and how greater seed establishment can be achieved.

Priority	Research Topic	Genus/Species and comments
5	Restoration: Outplanting Methods (seed sow, planting techniques)	No species of preference, but outplanting methods seems of higher importance than other restoration research, because it has practical utility compared to systems design or inbreeding depression research.
5		Many species
1	Restoration: Strategy and Design	Vicia menziesii - implementation of restoration in historic range. Multi-site planning to determine if limiting factors are the same or vary between sites
1		Short-lived as well as long-lived species. Concentration on Dry and Mesic species. Determine "outlook" in long-term for species with missing pollinators.
1		full scale restoration is not economically feasible so what approach do you take that best facilitates natural recovery? This includes species composition, density of planting, arrangement of vegetation islands. What type of restored forest has native recruitment and limited invasive species issues. As forest recovery is stimulated is there a strategy that is most beneficial to attract birds, bats insects etc. In addition, can climate ready forests be created? What I am thinking here is mostly for mesic forest that could be restored toward the drier end to be more resistant to drought. Or possibly how does seed source impact drought resistance.
1		Common Hawaiian fern species, including: Cibotium spp., Microlepia spp., Cyclosorus spp.
1		Identify methods which increase chances of success (recovery of listed species - natural regeneration). Identify species which are more likely to be successful in restoration projects with minimal follow up. Determine which species may be better for in situ vs ex situ conservation. Identify the amount of acres that need to be protected in order to recover species or suites of species.
1		Any appropriate native species, both common and threatened for each ecotone being addressed. Development of modified/updated plant communities for current and future conditions for each ecotone to allow for a more successful establishment of 100% native, diverse and multistoried system. Focus on ground cover and grasses for infilling tree and shrub plantings. Techniques and strategies for implementation in remote, rough, steep or difficult to access terrain.

Priority	Research Topic	Genus/Species and comments
1	Restoration: Strategy and Design	Asplenium peruvianum, Erythrina sandwicensis, Colubrina oppositifolia, Chrysodracon hawaiiensis, Delissea undulata, Haplostachys haplostachya, Hibiscus brackenridgei, Hibiscadelphus hualalaiensis, Kokia drynarioides, Melicope hawaiiensis, Meterosideros polymorpha var incana, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Reynoldsia sandwicensis, Silene lanceolata, Solanum incompletum, Stenogyne angustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiense, Stenogyne angustifolia
1		It is very important to develop ecological based restoration targets - i.e., what are the short-, mid-, and long-term goals of a restoration effort; what do you want this community to look like (population structure and composition) in 50 years?
1		Native Hawaiian ecosystems with a focus on Kauai. It seems like a whole lot of folks are doing stuff, but without the research needed to inform the actual actives.
2	Restoration: Strategy and Design	N/A, depends on site
2		Abutilon sandwicense, Alectryon macrococcus macrococcus, Erythrina sandwicensis, Eugenia koolauensis, Euphorbia celastroides kaenana, Euphorbia herbstii, Flueggea neowawraea, Hibiscus brackenridgei mokuleianas, Pleomele forbesii, Pritachardia kaalae, Pteralyxia macrocarpa
2		I would like to see less air conditioned room planning (meetings) and more on the ground actual testing of sites to identify more appropriate restoration sites. Please contact Dr Rob Robichaux and utilize his expertise on this subject as well as studying his successful projects. Ask for his recent paper on Silversword and Lobeliad restoration.

Priority	Research Topic	Genus/Species and comments
2	Restoration: Strategy and Design	All species! Although it's been said time and time again, landscape protection is the way to go! I understand that these kinds of mechanisms are often met with public scrutiny and misinformation, but thinking on an ecosystem level is beneficial to all organisms and relationships that we have yet to understand. In terms of design, RR and his dedication toward ArgSanSan and genetic bottleneck populations is a great example. We have begun to see recruitment in the augmented population, but with few founders flowering between 1976-2016, successes take time! He is also great in HAVO at the CCC unit in species densities per area, equal founder representation, etc.
2		Need research in development of weed control intervals for site (when to follow up/revisit for weed sweeps), how large an area should be native dominated in order to be considered a stable 'forest', what percent native dominance to be considered 'stable' native forest, also important to build off functional traits program (need research on more native plant species functional traits) in order for the program to be useful
2		Cheirodendron trigynum, Myrsine lessertiana, Coprosma rhynchocarpa, Rubus hawaiensis, Leptecophylla tameiameia, Vaccinium calycinum, Acacia koa, and Metrosideros polymorpha
2		mints
3	Restoration: Strategy and Design	Better techniques for building resiliency into restoration sites
3		Phyllostegia kaalensis
3		Anything that would affect the way we do rare plant restoration (i.e. inbreeding/outbreeding, genetic differences/similarities, breeding information, seed sowing trials of rare stuff, etc.) in ways to increase the fecundity, genetic diversity, plans for species withstand/survive climate change, etc. We need more tools to help us with rare species.
4	Restoration: Strategy and Design	Sesbania, Scaevola coriacea, Pittosporum halophylum, Brighamia rockii, Centarium, Canavalia molokaiensis, Santalum ellipticum, Tetramolopium
4		Hibiscus waimeae subsp. hannerae, Capparis sandwichiana, Schiedea apokremnos, Brighamia insignis, Cyanea leptostegia, Hesperomannia lydgatei, Kadua fluviatilis,

Priority	Research Topic	Genus/Species and comments
		Phyllostegia electra Phyllostegia renovans, Platydesma spathulata, Strongylodon ruber, Gardenia remyi.
5	Restoration: Strategy and Design	Much of restoration in Hawaii and worldwide has been triage or natural resource managers doing the best they can with the resources they have on the ground. A better, more informed approach would be scientifically designed experimental reintroductions with long term data collection (for rigorous statistical analysis) in addition to long term monitoring. This can only happen if researchers and land managers collaborate. Again, this needs to happen for much of the flora, including rare taxa, but certainly also ecosystem level restoration with suites of common natives.
5	Restoration: Strategy and Design	Figure out mixes or designs that will make for the best micro-habitats for outplantings and species and optimize conditions for large-scale success.
1	Seed Biology: Dormancy and Germination	Melicope anisata, Melicope degeneri and Melicope species in general - poor to no germination with these seeds. Melicope anisata aka Mokihana, favored for lei making and harvested a lot in forest; trying to cultivate in nursery has been mostly unsuccessful by seed, a little success with cuttings.
2	Seed Biology: Dormancy and Germination	See above
2		Melicope sp.
2		Melicope knudsenii, Melicope adscendens
3	Seed Biology: Dormancy and Germination	Haplostachys haplostachya-could not germinate seeds collected from wild or greenhouse. Sacrificed a few and located embryo in seed coat. Not sure what may be inhibiting germination.
3		Asplenium peruvianum, Erythrina sandwicensis, Colubrina oppositifolia, Chrysodracon hawaiiensis, Delissea undulata, Haplostachys haplostachya, Hibiscus brackenridgei Hibiscadelphus hualalaiensis, Kokia drynarioides, Melicope hawaiiensis, Meterosideros polymorpha var incana, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Reynoldsia sandwicensis, Silene

Priority	Research Topic	Genus/Species and comments
		lanceolata, Solanum incompletum, Stenogyne angustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiense
3	Seed Biology: Dormancy and Germination	Common and SCI native Hawaiian taxa with a focus on Kauai.
5	Seed Biology: Dormancy and Germination	Linked with seed biology is seedling biology. Over recent decades, it's clear that non-native plants are far surpassing native plants in establishment success. This means that there are dynamics at the seed and seedling stage that are largely driving turn-over in our forests (and other habitats) from native to invasive-dominated flora. I dont' think we know enough about these key stages in terms of species variation in tolerance, underlying strategies or traits, and the biotic and abiotic factors that apparently enhance invasive species establishment over that of native species.
4	Seed Biology: Soil Seed Bank	Determine species where this management option is important for population enhancement and recovery strategies
4		Primarily introduced taxa with a focus on the worst offenders. Secondarily native Hawaiian taxa - especially SCI taxa.
5	Seed Biology: Soil Seed Bank	common natives & invasive - would be a long list...
1	Seed Biology: Storage Conditions & Longevity	The ~1/3 of taxa that have not yet been studied/inferred. Will work with HSBP to provide a wish list of taxa for collections, and we can conduct the research!
2	Seed Biology: Storage Conditions & Longevity	Seed banking, tissue culture, and propagation research seems the first line of defense while threats are being managed, so is it crucial that apparently recalcitrant species such as Pritchardia, Chrysodracon (Pleomele), and Alyxia be researched to determine how to genetically bank populations either through seed or tissue storage.
2		General seed biology and storage should be a high priority, especially as more species may need to go into ex-situ storage if/when they go extinct in the wild until suitable restoration sites and strategies can be established. Storage, germination, longevity, conditions, are all important.

Priority	Research Topic	Genus/Species and comments
2	Seed Biology: Storage Conditions & Longevity	Common and SCI native Hawaiian taxa with a focus on Kauai. Even recalcitrant seeded species.
3		Araliaceae, Rutaceae, Rubiaceae
3		Any taxa for which this information is currently unknown or lacking
3	Seed Biology: Storage Conditions & Longevity	I am looking at this from the perspective of a professional in ex situ conservation. Do not have particular species in mind but think the at risk species (this may include non-listed species) that are not long term storage or germplasm storage information is not known (recalcitrant or unknown and ferns), and species that do not have collections or adequate collections represented in germplasm storage.
4	Seed Biology: Storage Conditions & Longevity	Need to learn to store seeds of as many as possible of 238 PEPP species
5		The work that Oahu Army, Drs. Baskins, Alivn, and Lyon (among others) have done to understand and share information regarding seed storage has been incredible. I would be interested in how these techniques can be improved, especially low tech/ low cost solutions.
5	Seed Biology: Storage Conditions & Longevity	Asplenium peruvianum, Erythrina sandwicensis, Colubrina oppositifolia, Chrysodracon hawaiiensis Delissea undulata, Haplostachys haplostachya, Hibiscus brackenridgei, Hibiscadelphus hualalaiensis, Kokia drynarioides, Melicope hawaiiensis, Meterosideros polymorpha var incana, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Reynoldsia sandwicensis, Silene lanceolata, Solanum incompletum, Stenogyne angustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiense.
5		Hibiscus waimeae subsp. hannerae, Capparis sandwichiana, Schiedea apokremnos, Brighamia insignis, Cyanea leptostegia, Hesperomannia lydgatei, Kadua fluviatilis, Phyllostegia electra Phyllostegia renovans, Platydesma spathulata, Strongylodon ruber, Gardenia remyi.
1	Taxonomy (phylogenetic relationships)	Cyanea, Clermontia, Delissea, Brighamia, Lobelia, Trematolobelia
1	Taxonomy (phylogenetic relationships)	Lobeliads. While my research is focused on using the Hawaiian lobeliads as a model system to study evolution and adaptive radiation. I will share any and all findings with those involved with conservation in any way that they say will be useful.

Priority	Research Topic	Genus/Species and comments
1	Taxonomy (phylogenetic relationships)	Clarification of the taxonomy for specific taxa will allow us to more accurately plan recovery of a particular species. Cloudy taxonomy can result in incorrect decision-making. Cyrtandra spp. (nature of hybrid swarms) Cyanea platyphylla, Cyanea fernaldii. Recently discovered or questionable spp.: Cyanea sp. nov. (Kauai), Melicope sp. nov. (East Maui), Melicope sp. nov. (West Maui), Pneumatopteris sp. nov. (Maui), Portulaca villosa subsp. nov. (Maui), Pritchardia sp. nov. (Oahu), Tetramolopium sp. nov. (Molokai, Maui), Tetramolopium sp. nov. (Molokai, Maui), Tetramolopium sp. var. nov. (Hawaii), Melicope sp. nov. (Kauai), Stenogyne sp. nov. (Maui), Sesbania sp. nov. (Molokai), Lysimachia sp. nov. (Pohakea, Kauai), Myrsine sp. nov. (Kauai)?, Melicope sp. nov. (aff. barbigera), Zanthoxylum dipetalum var. nov. (Maui), Eurya sp. nov. (Kauai), Lysimachia sp. nov. (Wainiha, Kauai).
1		Cyanea spp. on Kauai. Many poorly defined or confusing relationships.
1		Cyrtandra
2	Taxonomy (phylogenetic relationships)	Schiedea: This is a basic research topic that I work on, but it is not necessarily what I think is the most important aspect in conservation/restoration biology. It is one important piece of information to consider in conservation/restoration biology.
2		Hibiscus
2		all native taxa
3	Taxonomy (phylogenetic relationships)	Acacia
3		Cyanea sp. nov., Lobelia sp. nov (Haupu)

Priority	Research Topic	Genus/Species and comments
3	Taxonomy (phylogenetic relationships)	Hybridization: - confirm putative hybridization between Euphorbia deppeana and E. multiformis var. microphylla.- Cyrtandra subumbellata - with other Cyrtandra species, - Melanthera kamolensis - determine hybrid status of Alena pop (source 5-yr review), - Peperomia subpetiolata - Taxonomic issues (only hybrids available, Makawao FR) - no true indivs known, except those found by Joel Lau (source Maui Nui Task Force meeting - Oppenheimer) Taxon issues:- Cyrtandra filipes (sources Maui nui task force meeting - Oppenheimer & Perlman), - Eugenia koolauensis - relationship between Eugenia koolauensis and E. reinwardtiana, -Melicope mucronulata - On East Maui, there may be taxonomic confusion with "lower elevation, less pubescent forms of M. multiflora (=M. knudsenii)" (source 5-yr; Maui RecPlan), -Neraudia angulata - research taxonomic validity of varieties (source 5-yr review), - Phyllostegia mollis - Examine the genetic differences between the Oahu & Maui poplns. The Maui popln may be separated into its own species (source 5-yr; Oahu Rec Plan), - Tetramolopium filiforme - study the genetic & morphological variation within TetFil. Examine tax. validity of the 2 currently recognized varieties (T. f. var filiforme & T. f. var polyphyllum) (source 5-yr rev; Oahu Rec Plan), - Viola chamissoniana spp. chamissoniana - study VioChaCha & VioChaTra w/ respect to their tax. relationship, potential for hybridization, morphological diff, diff in ecological requirements (source 5-yr rev; Oahu Rec Plan) Genetic variability: -Melanthera fauriei - assess genetic variability of extant pops (source 5-yr review), -lysimachia filifolia - assess genetic variability w/in exant pops, especially diffs betw LysFil & LysRep, & whether they are both valid spp. (source 5-yr review)
5	Taxonomy (phylogenetic relationships)	Flueggea

<table>
<tr><th>Priority</th><th>Research Topic</th><th>Genus/Species and comments</th></tr>
<tr><td>5</td><td rowspan="2">Taxonomy (phylogenetic relationships)</td><td>o Pritchardia taxonomy and hybridization issues
o Taxonomy of Panicum fauriei var carteri
o Sesbania tomentosa – genetics between tree and shrubs
o Cyanea in Kipahulu, hybrid issues with C. copelandii and C. hamatiflora
o Phyllostegia bracteata and P. brevidens, taxonomy
o Clermontia oblongifolia var mauiensis – taxonomic issues
o Diversity within and between Marsilea villosa populations
o Confirm any true Peperomia subpetiolata remaining
o Brighamia wild vs cultivated
o Diellia Assess genetics of populations and level of hybridization
o Plantago princeps - Assess genetics of all varieties, may be more than 4, or additional species
o CleOblMau Determine whether this is a valid species or just a hybrid - if hybrid, no longer would require PEP attention
o SteKan Genetic assessment to determine number of clones in wild and cultivation
o Genetics and its link to demography
• Ochrosia species- differences on Oahu and Molokai; some key out to O. haleakalae
• Carex wahuensis ssp. herbstii – taxonomic problems
• DNA work on Delissea rhytidosperma to determine differences with D. kauaiensis
Hybridzation within Cyrtandra species - swamping rare species?

This area was kind of a catch-all</td></tr>
<tr><td>5</td><td>Genetic testing for sorting out species would help us to manage populations. There are many collections that are not definitively identified and it would be helpful to understand what their relationships are. For example work on Lobeliads placed Clermontia peleana singuliflora not as a subspecies of peleana but a separate species, and Clermontia pyrularia turned out to be more closely aligned with Cyanea. Genera which could use some work are Cyanea, Clermontia, Cyrtandra, and Phyllostegia.</td></tr>
</table>

Priority	Research Topic	Genus/Species and comments
1	Threat Control: Alien Invasive Plants	Too many to list easily here, but it seems to me that the most problematic invasive plants are: Psidium cattleyanum Clidemia hirta, Morella faya, invasive grasses, Casuarinaceae equisetifolia, Leucaena leucocephala
1		In my limited observations, most natural area managers are struggling most with threats (including all others listed), making outplanting and genetic banking attempts secondary until effective prevention and management methods are developed. Keystone species such as Meterosideros must be at a minimum protected to maintain genetic diversity.
1		Clidemia hirta, Psidium cattleianum, Hedychium gardnerianum, to name a few
1		More so developing techniques/tools for management in difficult terrain, researching invasive phenology & seed germination/dormancy and developing models that would aid in prioritization of target species within a management unit
2	Threat Control: Alien Invasive Plants	Clidemia, tibuchina, strawberry guava, christmas berry. These four species are the biggest hold up for restoration of mesic to wet mesic zones. Even after removal, they are capable of re-establishment in areas of 100% native cover.
2		We are seeing an explosion of alien plants. On East Maui pines have especially but we're also seeing Himalayan ginger populations in places we've never seen it before.
2		Biocontrol needed for Schinus terebinthifolius, promising biocontrol already being tested in Florida
3	Threat Control: Alien Invasive Plants	california grass, haole koa
3		Address control methods for field use; Biocontrol for widespread invasive plants; Do alien plants really compete with native plants for resources (water, nutrients, light, etc.)?

Priority	Research Topic	Genus/Species and comments
3	Threat Control: Alien Invasive Plants	We once had some really great native shrubland with Schiedea salicaria on W. Maui. A few years ago a fire, fueled by exotic grasses, swept through this area- we have not had the chance to go back to see how many Schiedea salicaria plants are still there. When we first visited these populations in the late 1980's the dry shrublands were full of native species, but I am not sure what they are like now. Even a few fire breaks might have made the difference. The effects of alien grasses on native dryland communities are devastating. Fountain grass is now spreading around to the side of Diamond Head with Schiedea adamantis- this species could still be controlled.
4	Threat Control: Alien Invasive Plants	various depending on habitat
4		Strawberry guava etc
4		Biocontrol for Clidemia hirta still needed
4		like more ways to control bigger areas of ubiquitous weed species next to or within intact forest- biological control or weed suppression techniques (i.e. HBT on drones or something) that will allow native forest regeneration in a big way. For instance if there was a way to get rid of understory clidemia in a native dominated canopy. Maybe this is too broad?
5	Threat Control: Alien Invasive Plants	Schiedea.: Alien invasive plants greatly impact where native populations can survive and how well plants in restoration areas will do.
5		Controlling invasive grasses in areas with rare plant species (Bidens ssp., Phyllostegia ssp., Clermontia and Cyanea ssp.)
5		List species in priority for those species with least - to most - invasive plant management importance. Helps to determine which species and where the most action is required (a triage for species locations)
1	Threat Control: Insects	Cyanea sp.
1	Threat Control: Insects	I have heard from managers that many outplants die from pests (insects and others such as mites) and diseases. While there is good work being done on many other threats, I do not see much work being done on pests and diseases of rare plants. I think this would be the area where most progress can be made.

Priority	Research Topic	Genus/Species and comments
2	Threat Control: Insects	It would be great to have a control method that can be used in the field for Coffee Twig Borer for Fluggea and other species that are harmed by it.
2		Species impacted by BTB! Flueggea neowawraea, Alectryon macrococcus. Also other insect effected taxa: Hibbramok seed predator?
2		Alectryon and Fluggea - we really have to try to do something about ambrosia beetles.
2		We need level 10 Bio security measures at our ports of entry.
3	Threat Control: Insects	Acacia koa, Sesbania tomentosa, Mezouna kavaiensis - all affected by twig borer. We experienced a lot of mortality with Koa and 'Ohai in low elevation nursery due to this insect.
3		Controlling insects, specifically ants, in lower elevation ecosystems.
3		Little fire ants
4	Threat Control: Insects	In general, species currently identified as being substantially impacted by current non-climatic threats should be prioritized for development of threat control or mitigation as a strategy to boost resilience of populations and species to current and anticipated habitat change.
4		In dry forest more research needed on insect interactions and especially in context of climate change
4		Control methods for ants, scales, white fly, cottony cushiony scale, other scales, red spider mites, boring beetles on Neraudia ovata, Mezonueron, Isodendrion, Nothocestrum. Kokia drynarioides - control of scale insects, aphid farming ants, Xylosandrus & other pests. Achyranthes splendens var. rotundata - scales and ants (5-yr rev). Two-spotted leaf hopper: - Hibiscadelphus giffardianus - more suitable control methods (Hawaii Island adden. Rec Plan), - Cyanea glabra (source Maui Island Rec Plan Adden). Black twig borer - Flueggea neowawraea, Abutilon sandwicense, Schiedea nuttallii.
4		Actually, all the threats should be lumped as they vary with site and species. I think that the threats have been identified and that funding should go to dealing with the threats and not studying them.

Priority	Research Topic	Genus/Species and comments
4	Threat Control: Insects	Threat Control in general. I know there is a lot of research in these areas already, but continuing on with this research seems so important for preventing the decline of natural populations and protecting and ensuring the future viability of maintaining restored populations.
4		Best practices and identification of insect pests in the nursery setting would be helpful. We had discussions at workshops but to consolidate the information would be ideal.
1	Threat Control: Mollusks	Campanulaceae, Caryophyllaceae and other mesic-wet species threatened by slugs.
2	Threat Control: Mollusks	Herbivory by alien molluscs is the limiting factor in establishment of seedlings whether from wild plants or outplanted nursery stock. Pesticides need to be developed.
3	Threat Control: Mollusks	Campanulaceae and snailicides use for conservation
4	Threat Control: Mollusks	Slugs and snails - impact on seedling survival of lobelioides, many other species • Slug experiments with Cyanea (if we have plenty of seeds)
4		Impact on recruitment of seedlings (Cyanea and Clermontia ssp., multi-species)
4		We have viable tools for ungulate control and a good potential for control of rodents (but we need to be able to apply this more broadly), we are currently stuck with limited and very localized tools for control of slugs in particular. This impact is likely much more widespread that we are currently aware of and can have very serious impacts on the survival potential for many plant species, both in management and restoration areas, as well as in the larger unmanaged native plant communities. Research is critically needed to identify slug control methods and how to implement their successful deployment at a landscape level.
5	Threat Control: Mollusks	Slugs and snails do so much damage to lobiliads (among others): 11. Recovery Studies: We need more concrete scientific analysis of recovery after management. For instance, removing pigs.

Priority	Research Topic	Genus/Species and comments
1	Threat Control: Pathogens	I cannot think of anything that is a bigger threat than the possibility of unwanted plant disease on these native species. Acacia koa & Met pol for forest conservation Specie of the mixed coastal strand for supporting seabird habit
1	Threat Control: Pathogens	Eugenia spp. - I think that the rust fungus can probably be controlled by antagonist fungi. In fact, I think that endophytes should be studied more.
1	Threat Control: Pathogens	Given that genus Metrosideros dominates Hawaii's native vegetation, study of the biology of the pathogen, Ceratocystis, natural resistance within Metrosideros (possible variation among taxa), and control of the pathogen's spread should be a high priority. Such studies are taking place.
1	Threat Control: Pathogens	Rapid Ohia Death
1	Threat Control: Pathogens	Myrtaceae
2	Threat Control: Pathogens	ROD and ohia
2	Threat Control: Pathogens	I have heard from managers that many outplants die from pests (insects and others such as mites) and diseases. While there is good work being done on many other threats, I do not see much work being done on pests and diseases of rare plants. I think this would be the area where most progress can be made.
2	Threat Control: Pathogens	Maybe there is a way to inoculate susceptible species (to whatever disease) prior to infection. Like the Phyllotegia kaalensis study (this study needs to be replicated on other species and broadened to include other pathogens)....but also for other stuff like ROD?
3	Threat Control: Pathogens	Rapid Ohia Death solution!
3	Threat Control: Pathogens	Threat control and understanding threats is very important. Large ungulates are well understood (fence to exclude them and then kill them), but the effects and control of pathogens, insects, mollusks, and other small mammals deserves more attention.
3	Threat Control: Pathogens	Plantago princeps
3	Threat Control: Pathogens	Ceratocystis

Priority	Research Topic	Genus/Species and comments
4	Threat Control: Pathogens	Accelerated rate of entry to Hawaii with increased rapid transit and lack of adequate inspection at port of entry. Rapid generational time, mutation and adaption capabilities. Ability to be generalists and/or jump from plant to plant. Can lie latent until something triggers it. ROD is a good example. Affects all life forms from land, air, sea.
4		Metrosideros and Eugenia- effective control or treatment methods to stop the spread of Ceratocystis fimbriata and Puccinia psidii.
4		All native flowering plants
5	Threat Control: Pathogens	ROD, and other potential pathogens on keystone native plants
5		Biosecurity programs for keystone species like Metrosideros
5		how do we counter Trump and his peoples
1	Threat Control: Small vertebrates	All native flowering plants
2	Threat Control: Small vertebrates	I am quite interested in how small mammals (mice and rats) predate or disperse seeds of native plants - and whether this could be a major limiting factor for recruitment. Many fruiting plants could be susceptible to this
2		for rare and listed species-
2		Pritchardia, Santalum,
3	Threat Control: Small vertebrates	Impact on seed production of PEPP species including Cyanea ssp., Pittosporum ssp.
3		Cyanea, Clermontia, Delissea, Brighamia, Lobelia, Trematolobelia
3		Rats, mice, mongoose
3		While we all know that pigs, goats, sheep, cattle, etc. destroy many native plants I am not sure that we know how much damage is done from rats and mice, especially to seeds. I know Don Drake hosted a rat symposium a few years ago and some work on rat control has been done but I think this is another area that deserves attention.

Priority	Research Topic	Genus/Species and comments
3	Threat Control: Small vertebrates	I have a sense that a large factor limiting recruitment is small vertebrates - small mammals especially. Other factors I think that may limit recruitment are slugs and snails, and insects. Understanding how these threats interact and influence demography I think will be crucial for reversing declines of rare plants.: Argyroxiphium kauense, Asplenium peruvianum var. insulare, Bonamia menzisii, Chrysodracon hawaiiensis, Colubrina oppositifolia, Delissea undulata, Haplostachys haplostachya, Hibiscadelphus hualalaiensis, Hibiscus brackenridgei ssp. brackenridgei, Kokia drynarioides, Mezoneuron kavaiense, Neraudia ovata, Nothocestrum breviflorum, Portulaca sclerocarpa, Silene lanceolata, Solanum incompletum, Stenogyne augustifolia, Zanthoxylum dipetalum var. tomentosum, Zanthoxylum hawaiiensis.
4	Threat Control: Small vertebrates	Rats, mongoose and cats, our biggest threats to endangered birds.
5	Threat Control: Small vertebrates	RATS!: Pritchardia kaalae, Cyanea's, Cyrtandra dentata, Cyrtandra polyantha, cyrtandra viridiflora, Delissea subcordata, Gardenia mannii, Labordia cyrtandrae, Labordia triflora, Lobelia monostachya, Lobelia oahuensis, Melicope ovalis, Trematolobelia singularis
5		More research into seed and fruit depredation by rodents and its affect on native plant recruitment.
1	Threat Control: Ungulates	pigs in high elevation wet forest
1		Sorry I do not have a particular taxa to list. I choose this topic, threat control (all threats) as I feel it is most important to preserve the existing wild populations. In my opinion these species and populations have the greatest chance of success if we can determine and control threats in existing sites.
2	Threat Control: Ungulates	Fencing is the foundation for conservation and also the most expensive. What types of material could be used to improve longevity especially in volcanic fume conditions. In addition, techniques to improve detection, baits, control of ingress animals. It is well established that ungulates are harmful to native species so not as interested in general ungulate impacts research.

Priority	Research Topic	Genus/Species and comments
2	Threat Control: Ungulates	I have have had my priorities backwards because without controlling ungulates there will be no native Schiedea species, and no reproductive biology to worry about. Even though it is listed separately, I would also add in control of insects/pathogens- as the effects of these seem to increase each year. Twenty years ago we saw abundant recruitment from seeds of dry site species, but not for any of the mesic/wet site species. Many of these species have become weedy in our greenhouse, despite their extreme rarity in nature. Given half a chance, many rare species of Schiedea could recover. But- sometimes it only takes one pig to ruin everything.
5	Threat Control: Ungulates	pigs, axis deer, goats
5		Any species under threat by ungulates - and/or invasive plant species (I would include here).