

Table for Workshop

What are the main impacts / vulnerability in your sector / area / ecosystem?

Sector	Geographic Area	Ecosystem	Impacts	Ideas to manage	Adaptation Research	Impediment
Manderah	• Manderah	• Coastal • Estuarine	• Sea-level ➤ Inland salt encroachment	• Maintain riparian vegetation – salt tolerant species	• Which species to plant? • Mapping of impact • Mapping of where to plant • Planning Map	• Standard practices may not be suitable, but difficult to change • Money – LGA + developers • Political Will • Competing interests - developing • LGA overridden by higher authority • Lack of planning • Lack of power
National Park – Yunderup Lakes	• Lake Clifton	• Coastal • Lake	• Loss of whole lake community • TEC	• ?? Too Hard, Too Late ?? • Stop irrigation • Hydrology management	• Groundwater flows • Baseline info on rate of growth/decline	• High cost • Uncertainty of outcome

				• Stop development • Improving buffer zone	thrombolites	
Urban bush forest site	• Kensington Bushland	• Banksia • Woodland	• Water table dropping ➢ Banksia loss • Foxes, cats – Feral animals	• Very difficult!! • Decrease weed burden • Artificial recharge of aquifers • Mitigation ➢ Expand into parklands, gardens	• Monitoring losses • Thresholds – what is critical temp/water levels ➢ Drive management • What are the co-benefits? • What are the other costs of not adapting? ➢ Eg. Health, sustainability etc.	• Lack value urban bushland • Cost • Urban pressures
Natural areas	• Perth metro area	• Local bushlands	• Fragmentation	• Corridors • Local plants in gardens • Local council planning	• Physiological & sociological research • Learning to communicate effectively on	• Current bylaws • People's attitudes

			• Fire • Lack of rainfall • Weeds	• Working with FESA pick up fires quickly • Early detection & rapid response • Weed control • Reduce arson by education & physiological counselling • Sensible fire plans • Change garden designs & watering regimes • Change water consumption habits • Conscious decisions about using additional resources or sustainability education and awareness raising • Engineer for water recycling • Weed control	profound issues • Better mapping in particular species • Research on timing and	Governement and agency policy and attitudes Lack of mitigation • Lack of money
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					sprouting	• Lack of connection between damage
Natural Areas	• SWARF	• All	• Shrinkage, loss & change	• Refugia where? For how long? Under what circumstances? For what species/ECs? Which direction?	• Refugia?	• Money • Gov't attitudes re Climate Change & Science • Public attitudes to Climate Change and Science
Natural Areas	• SWARF (wet SW)	• Organic rich wetlands	• They burn and oxidise ➤ Lose habitat species	• Manage forests to minimise water use, keep as old growth. If regenerate – maybe necessary to thin	• Will thinning increase runoff to swamps?	• Continued extraction of ground water • Presence of ferals • High water consumption
Natural Areas	• Kimberleys	• Rainforest patches	• Fire, clearing, weeds, stock	• Fire management & Feral ➤ Burn early – hence mosaic	• Good vegetation map • Where are the vulnerable habitats?	• Money

Research	• Arid interior	• Rangelands	• Grazing	• Control Livestock access	• Appropriate species revegetation	• Distance to Perth • Commercial value culture
Research	• Arid interior	• Rangelands	• Increase drying • Increase temperature	• Species movement	• Forced translocation/ Protect refugia	• Change land use culture
Research	• Arid interior	• Rangelands	• Fire	• Decrease ignition • Indigenous engagement ➤ Traditional methods	• Include Indigenous knowledge	• Indigenous engagement
Research	• SW WA	• Jarrah Forest	• Soil/litter/plant desiccation	• Change groundwater management	• Identify environments least susceptible	• No obvious cause • Money • People/time
Research	• SW WA	• Jarrah Forest	• Wetland/ stream drying	• Revegetation • Translocation of species	• Identify priority areas	• Solid uptake for revegetation

Research	• SW WA	• Jarrah Forest	• Hotter, more frequent fire	• Control burning	• Appropriate regime identifying impacts	• Divergence of needs ➤ Practicality of doing it
Research	• NW WA	• Wet-dry tropics	• Sea level rise	• Prioritise restoration areas	• Identify least susceptible environments	• Logistics technical/logistical control
Research	• NW WA	• Wet-dry tropics	Weeds and ferals	Identify species and distribution	Monitoring, biological control	Logistics technical/logistics central
	• South West	• Forest	• Reduced stream flow • Loss of riparian vegetation	• Restore water use balance ➤ Thinning regrowth • Restoration of riparian vegetation	• Social research/ Education ➤ Acceptance of adaptive management	• Lack of knowledge across all areas • Lack of understanding & support from community • Short term funding cycles • Too hard syndrome

	• South West	• Agricultural landscape • Woodland & Heath	• Fragmentation • Small populations vulnerable • Reduced dispersal ➢ Barriers ➢ No where to go	• Restoration ➢ New populations ➢ Augmentation • Connectivity increased ➢ Small & large scale • Identify refugia • Assisted migration	• Restoration ➢ How big? ➢ Where? ➢ Multiple species (ecosystems) • Effectiveness of corridors ➢ Risk of corridors due to predators and weed • Where are the refugia (are they in conservation reserves?) ➢ What do they look like? ➢ How do they function? ➢ How to manage stresses, eg. fire, predation, disease, weeds? • Which species vulnerable?	• Lack of knowledge across all areas • Lack of understanding & support from community • Short term funding cycles • Too hard syndrome
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					➤ Which adapted/ wide tolerances?	
	• Rangelands	• Great Western Woodlands	• Reduced water availability • Increased fire frequency and intensity	• Assisted migration of key, common species across rainfall gradient • Mosaic controlled burning	• Is there genetic adaptation across rainfall gradient? • Frequency and size of mosaics	• Lack of knowledge across all areas • Lack of understanding & support from community • Short term funding cycles • Too hard syndrome
	• South West	• Forest	• Increased intensity and frequency of fire	• Strategic controlled burning ➤ Mosaic	• Frequency of fire & size of mosaics to reduce fire and increase persistence (eg. plants time to flower)	• Lack of knowledge across all areas • Lack of understanding & support from community • Short term funding cycles • Too hard

						syndrome
	• South West	• Perth Urban • Gnangara Mound	• Increased water abstraction	• Remove horticultural extraction away from intake areas to mound	• Social research/ Education ➤ Water use knowledge	• Lack of knowledge across all areas • Lack of understanding & support from community • Short term funding cycles • Too hard syndrome
	• Kimberley	• Tropical savannah	• Increased cyclonic intensity • Rising sea level ➤ Reducing habitat on islands - marine turtles nesting beaches	• Reduce emissions!!! • Secure populations on mainland ➤ Reduce stresses	• Increasing resilience of mainland populations eg. cane toad impacts, feral predators, grazing pressure	• Funding ➤ Isolated location with limited access
	• Swan Coastal Plain	• Complex wetland –	• Weed growth increases in a	• Research into effective grassy	• Keep all remaining	• Political resistance to stop

		upland system ➤ Multiple vegetation communities	stressed environment eg. wild grass increases fire risk	weed control in fragmented bushland on Swan Coastal Plain • Control weeds • No prescribed burns	bushland as refugia to allow natural adaptations	clearing • Failure to avoid urban sprawl into unsuitable habitats – eg. Palusplain wetlands
			• Groundwater drawdown • Acidification of watertable, soil acidification of acid sulphate soils • Good quality Agricultural Land Strategic	• Metres on all bores • Payment on volume extracted especially for production horticulture away from intake areas to Gnangara Mound • Drastically reduce abstraction ➤ as is grossly over allocated (as is Murray-Darling)		• Lack of knowledge and understanding of general public
	• Swan Coastal Plain	• Banksia woodlands	• Increased clearing	• Stop clearing • Reduce	• Groundwater barometers on	• Ignorance • Lack of funds to

				groundwater abstraction • Restore ecological linkages through urban semi-urban lands	freeway billboards	manage
			• Fire - arson	• Social research & programs to reduce arson		• Lack of rigorous policies
NRM	• Swan Coastal Plain	• Banksia woodlands • Groundwater bodies • Swan River	• Reduced water flow • Lowered groundwater • Water quality • Fire Risk (i.e. drought)	• Water use changes • Water recharges • Fire risk management & control	• Ground water monitoring (quantity, quality) • Water/nutrient soil amendment /retention techniques • Swan Canning quality ➤ Water release monitoring	• Social changes required (water use) ➤ Recycling ➤ Recharge ➤ Reduce ➤ Re-use • Economic usage changed (agricultural) • Political will due social resistance to change expectations

Local Government	• Coastal	• Estuarine/ coastal dunes	• Sea level ➤ Habitat inundation ➤ Salinity change in Biota ➤ Coastal fresh lakes	• Larger planning buffers to develop • Retreat	• How to save wetland/ dune habitat in an urban area • Boat house	• Desire for water front properties • Historical development • Decrease state/ federal policies
Research	• South-West	• Jarrah forest	• Resource availability • Range/distribution • Breeding/ reproduction • Feral species	• Translocation • Captive breeding/ release • Feral species management	• Improved practice for management • Species suitability	• Funding • Time • Logistic co-operation
Agricultural	• South-West Agriculture	• Managed and degraded	• Rainfall pattern change • crop stress and diseases	• Change pattern eg. perennial pastures • Minimum tillage • Drought resistance	• New crops	• Conservation, funding, markets
State Forest/Water Catchment	• SWWA	• Riparian vegetation	• Reduced stream flow, loss of riparian	• Thinning regrowth	• Adaptive management	• Cost • Acceptability

		within the Jarrah Forest	and stream biodiversity	• Jarrah • Reducing LAI ??	• Experiment in selected water catchment	
	• Swan Coastal Plain • SWWA	• Groundwater dependent ecosystems ➤ Banksia ➤ Woodlands ➤ Wetlands	• Transformation and loss	• Reduced reliance on groundwater through increased water use efficiency, behavioural change and water recycling	• Social science into impediments to behavioural change • engineering - water recycling	• Policy • Behaviours • Population density and growth
	• SWWA	• All (Nawan? Range endemic species)	• Reduced availability of habitat • Stress • Extreme events • Increased fire risk • Drought	• Assisted migration but limits because of lack of latitudinal extension (southern ocean)	• Where? • When?	• Lack of continent • Policy • Attitude • Money
	• SWWA	• All	• Changed fire regimes • Increased frequency and intensity of fire	• ?	• Fire Management	

	• SWWA	• All	• Habitat fragmentation interacting with climate change creating barriers for gene flow and species dispersal	• Increased connectivity	• Where? Most beneficial? • Key areas for restoration • Priorities for purchase/reservation • Covenanteeing of key remnants • Measuring dispersal • Shape	• Money • Land-use • Where?
Parks Protected Areas	• SRNP	• Low montane	• Increase fire • Decrease rainfall, decrease cloud cover • Increase temperature • Increase disease (pc)	• Prescribed burning • Disease control • Monitoring • Assisted migration	• Fire management plans • Disease plans • Transects/quadrats	• Decrease funding • Logistics • Interest • Where? No place to go
Protected Areas + Development + Pastoral + UCL	• Transitional vegetation zone ➤ Great Western	• Numerous	• Increase fire • Increase temperature • Decrease rain	• Prescribed burning • Feral control • Weed control	• Fire management ➤ Management trials	• Decrease funding • Large area

	Woodlands		• Landuse (mining) fragmentation	• Ecosystem adaptation	• Vulnerability of species	
All suburbia	• Local districts	• Development • Homes • Gardens • Yards • Shopping Centres	• Using water (over use) • Emissions with vehicles • Airconditioners & Heating etc.	• Some ??? active effective awareness to reach the general public	• Neon signs on freeways eg. “Dams full-empty etc.”	• People’s total ignorance • Greed and selfish • Willfulness – have what they want when they want it and how they want to
			• Change makes us ill who are not accustomed to change as huge as this requires of us!!	• Psychologically addressed • Socially addressed • Deal with the change at grass roots level (excuse the pun)	• The more emphasis that is put on saving the planet, environment, etc., I find more use, more water, use their vehicle, huge vehicle, high on fuel usage etc.	• People’s total ignorance • Greed and selfish • Willfulness – have what they want when they want it and how they want to - Social Issue Those who are well off

					• Using air flight for excess + any travel!!	make the choice to conserve the environment. It is already a way of life for the poor!!
	• Grangara Southwest • Pilbara Midwest	• Groundwater dependent ecosystems N.B. Terrestrial biodiversity in WA is largely dependent on groundwater which will be affected by climate change.	• Declining rainfall linked to declining groundwater levels and impacts to vegetation	• Understand links – response models • Allocation of water reflects rainfall		• Funding • Legislation
Community group	• WA	• All especially groundwater and salinity	• Vegetation clearing • Poor mining rehabilitation	• Community Engagement/ belief / Education	• Working with community apathy	• Apathy ➤ Community and State Gov't
WA NATS Club	• WA	• Water supply	• Desal plants	• Community	• More factual	• Lack of belief &

			• Groundwater	awareness	promotional community info	commitment by gov't itself
Department of Water	• WA	• GW & SW Water dependent ecosystems	• Loss of critical refugia	• Limit water use in these areas	• Mapping determine refugia likely to change or remain under changing climate	• Funding • Collaborations • Data access
National reserve system (DEC etc)	• WA	• All	• Adequacy • Representativeness • Comprehensiveness	• Purchase of land • Flexibility • Engage with private landholders	• Modelling of impacts of CC on current CAR criteria	• Money • People • No one is doing anything • Availability of land recognition as a priority
Research	• SW WA	• Granite outcrops	• Reduced rainfall • Reduced wet season • Increased fire risk	• Identify moisture refugia • Translocation ? ➤ usefulness • Physical intervention ➤ control burning ➤ buffer	• Usefulness of translocation • Location & adequacy of massive refugia • Burning – when, type, where, life histories, obligate	• Money • People

				burning	seeders (effect on species)	
Research (DEC)	• Swan Coastal Plains (e.g.)	• Banksia	• Inappropriate fire regimes • Increase in extreme fire weather events	• Ecological fire regime • Control burning	• Historic fire history data • Prediction of incidence of fire weather events	• Money • People • Altering people's perceptions of fire • Existing fire management policies
Local Gov't	• Bridawood reserve	• Largest remaining remnant of critically endangered community (<i>marri kingia</i>)	• Urban development (all around it) • Extinction debt • Feral/domestic animals • People pressure/ use groundwater regimes	• Shoot the developers • Return to natural hydrology • Cat exclusion zone • Development should be urban ____ not sprawl	• Which ones? • What was the natural hydrology	• Money • People • Gun licence • Contract killers • Development pressure
Agriculture	• Kimberley	• Blacksoil plains ➤ High rainfall	• Shift of agriculture from wheatbelt	• Reduce food wastage • Maximise sustainable	• Current biodiversity values • Reserve system	• Money • People • Lack of foresight

		arable lands		agriculture systems • Adequate reserve system		
DEC/ Research	• Wheatbelt reserves • SWWA	• Various	• Barriers to species migration (fragmentation)	• Connectivity • Assisted migration • Engage with private landholders	• Modelling of envelopes (species/ community distribution) • Research on assisted migration	• Lack of knowledge
Local Gov't	• Serpentine • Jarrahdale	• Palus plain	• Urban development pressure • Remnant veg on private land	• Stewardship program • Grants for management • Rate reductions for remnant veg • Land tax deductions for remnant veg	• What happens to the groundwater with 2m of sand fill on top of the natural soil level?	• Private land conservation is expensive for landholders • Money • People
Research	• All	• All	• Climate change migration affecting / altering spp-spp	• Species migration into new habitat		

			interactions			
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