Northwest **Power** and **Conservation** Council

June 7, 2016

MEMORANDUM

TO: **Fish and Wildlife Committee members**

FROM: **Patty O'Toole, Program implementation manager**

SUBJECT: **Update on Council's Research Plan**

BACKGROUND:

Presenter: Patty O'Toole

Summary: Staff will update the Committee on two tasks associated with updating the research plan.

Relevance: Updating the Council's Research Plan is relevant to the Council's Fish and Wildlife Program priority #2: Implement adaptive management (including prioritized research on critical uncertainties).

Background: Council staff will review two tasks for updating the research plan: Task 3: Historical look at past investment for research, and Task 4: Identify list of Critical Uncertainties. The draft work plan for updating the research plan is attached for reference.

More Info: Task 3: The Council's Fish and Wildlife Program calls for, as one of the first steps in updating the research plan, an update of how previous research funds were allocated to particular categories and critical uncertainties. To accomplish this directive, staff is using the critical uncertainties report as a structure, and then using budget information from CBfish in order to get a sense of historical spending for categories and critical uncertainties. Pisces information is used for the identification of work element budgets, to account for research that may be nested in other

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types of projects. The goal of this task is to gain an understanding of what level of investment various program areas and uncertainties have received. At the June Committee meeting, staff will review some preliminary information from this effort.

Task 4: The Council's Fish and Wildlife Program directs the research plan to include critical uncertainties for the Program and requests that the ISAB and ISRP to assist with updating the list of critical uncertainties. This ISAB and ISRP review was completed under task 1. Public comments (task 2) identified additional uncertainties or modified uncertainties for the Council to consider. A categorized list of uncertainties for the research plan will be developed using these sources. The staff will review some preliminary work on developing a list of critical uncertainties and will seek input from Committee as to appropriate scope and scale of the uncertainties.

Attachment 1 *(for reference).*
Research Plan Update - *draft* work plan *(May 3, 2016)*

Objective: Update the Council's research plan consistent with the 2014 Fish and Wildlife Program. The purpose of the research plan is to help the Council, Bonneville, project proponents, and the independent science panels track and evaluate research projects, prioritize critical uncertainties for the program, and along with other considerations, guide funding recommendations. Research seeks to resolve critical uncertainties identified in the Council's Research Plan and assesses new methods and technologies to improve the program. The process will provide opportunities for public input.

Tasks	Estimated time frame	Status
Task 1. ISAB/ISRP Report	January 29, 2016	Complete
The Council requested on February 23, 2015 that the independent science panels begin a review of past research and the critical uncertainties relevant to the program. Specifically, the Council asked the ISAB and ISRP for 1) a revised set of critical uncertainties; 2) a detailed list of research themes or categories that fully encompasses past, current, and possible future research; 3) scientific input on identifying priorities among the critical uncertainties; and 4) a determination of whether ongoing research is making progress in answering critical uncertainties listed in the current research plan. The ISAB and ISRP's report, *Critical Uncertainties for the Columbia River Basin Fish and Wildlife Program* is now posted on the Council's website.		
Task 2. Public Comment	March 11, 2016	Complete
On February 1, 2016 the Council invited comments on the Critical Uncertainties report. Written comments were received from 16 entities. Some were short and programmatic in nature; many were extensive and detailed. In addition the Council held a public meeting on March 7, 2016 to discuss the report and updating the Council's research plan. Eighteen entities participated in the meeting, and meeting notes are posted on the Council's website.		
Task 3. Historical look at past investment for research	May – July, 2016	Underway
The Council's Fish and Wildlife Program calls for, as one of the first steps in updating the research plan, an update of how previous research funds were allocated to particular categories and critical uncertainties. To accomplish this directive, staff is using the critical uncertainties report as a structure, and then using budget information from CBfish in order to get a sense of historical spending for categories and critical uncertainties. Pisces information is used for the identification of work element budgets, to account for research that may be nested in other types of projects. The analysis will also account for the relationship of projects to Biological Opinion RPA's. This data was presented to central and state staff and will be reviewed with Bonneville staff in the near future. The goal of this task is to gain an understanding of what level of investment various program areas and uncertainties have received.		

Task 4. Identify list of Critical Uncertainties (Sources include: ISAB report, additions from public review)	June-July	Underway
The Council's Fish and Wildlife Program directs the research plan to include critical uncertainties for the Program and requests that the ISAB and ISRP to assist with updating the list of critical uncertainties. This ISAB and ISRP review was completed under task 1. Public comments (task 2) identified additional uncertainties or modified uncertainties for the Council to consider. A categorized list of critical uncertainties for the research plan will be developed using these sources.		
Task 5. Develop priorities/priority framework	July-August	Pending
The Council's Fish and Wildlife Program notes that the research plan should prioritize critical uncertainties for the program and guide funding recommendations. Priorities will be described in the research plan. Options to consider for a prioritization framework include: Program vision or goals/objectives, models, a decision focused framework, Program guidance-including the risk uncertainty matrix (described in the Program and elaborated upon in the Critical Uncertainties report); adaptive management principles, project categories, other program criteria.		
Task 6. Consider and describe any needed process elements	August	Pending
The comments on the Critical Uncertainties Report and general comments on the research plan update include process and implementation suggestions. These will be reviewed and considered for the research plan.		
Task 7. Committee, Council approval	September-October	Pending
Staff will work with the Fish and Wildlife Committee and periodically with the full Council to review a draft revised research plan. Staff will seek a decision from the full Council for the release of the draft plan for public review.		
Task 8. Public comment	October-November	Pending
Public comment will be collected for at least 45 days beginning with an email notification of the public comment opportunity.		
Task 9. Revise per comments	November	Pending
Staff will review the comments with the Fish and Wildlife Committee and will make recommendations for incorporating the comments into the draft plan.		
Task 10. Final review and approval Committee, Council	December-January	Pending
The Fish and Wildlife Committee will review the revised plan and recommend consideration to the full Council for approval. The full Council will approve the final updated research plan.		

Task 4. Research Plan

Theme	Organizing policy questions	Uncertainty	Sub uncertainty
A. Tributary Habitat	1. Do investments in tributary habitat restoration mitigate for degraded mainstem habitat and passage conditions?	1.1 To what extent do tributary habitat restoration actions improve the survival, productivity, distribution, and abundance of native fish populations?	1.1.1 How much does improving habitat and eliminating barriers (removing dams and culverts, or transporting migrating fish above dams) increase carrying capacity and contribute to recovering important fish populations? 1.1.2 To what extent is an increase in carrying capacity usurped by non-native invasive species, preventing recovery of native fish and wildlife populations? 1.1.3 How do fish adapt their behavior to mitigate for extreme water temperature?
	2.What additional habitat restoration projects should be implemented?	2.1 What combinations of protected and restored aquatic, riparian and upland habitat are most effective at meeting the life cycle needs and sustaining populations of fish and wildlife in tributaries? 2.2 Do some restoration efforts provide resilience to buffer against climate events and recover native species of interest?	2.2.1 How can habitat restoration activities or hydrosystem operations modify groundwater-surface water interactions and floodplain habitats to provide refuges during extreme events and improve overall survival, productivity, distribution, and abundance of anadromous and resident native fish populations?
B. Fish propagation	1. Are current propogation efforts successfully producing fish for harvest and conservation?	1.1 What is the relationship between basinwide hatchery production and the survival, fitness, and growth of naturally produced fish in freshwater, estuarine, and ocean habitats? 1.2 What is the magnitude of any demographic benefit to the production of natural origin juveniles and adults from natural spawning of hatchery origin supplementation adults? 1.3 What are the potential impacts on wild sturgeon from mixing of genetic stocks as part of broodstock and larval fish rearing mitigation efforts?	1.1.1 Can hatchery production programs meet adult production and harvest goals (integrated and segregated) while protecting naturally spawning populations? 1.1.2 What are the effects, by life stage, to natural populations from competition, predation (direct and indirect), and disease caused by interactions with hatchery-origin juveniles, from harvest in fisheries targeting hatchery-origin adults and from hatchery effluent? 1.2.1 What are the range, magnitude, and rates of change of natural spawning fitness of integrated (supplemented) populations, and how are these related to management rules, including the proportion of hatchery fish permitted on the spawning grounds, the broodstock mining rate, and the proportion of natural origin adults in the hatchery broodstock?
	2. Can hatcheries successfully support Pacific Lamprey?	2.1 What is the potential role of lamprey propagation and translocation as a way to mitigate for lost lamprey production when passage and habitat improvements alone are insufficient to restore lamprey populations? Specifically, can artificial propagation be used to supplement and restore depressed populations of Pacific lamprey?	

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C. Hydrosystem flow and passage operations	1. Do hydro operations dedicated to fish provide the expected benefits?	1.1 What is the relationship between levels of flow, ~~and~~ spill, disolved oxygen and survival of ~~juvenile~~ fish (including salmonids, eulachon, sturgeon, lamprey, and other focal species) through the Columbia Basin hydrosystem (including the Columbia, Snake and Willamette rivers) ? 1.2 What are the effects of spill operations on returning adults that subsequently affect adult fish migration behavior, straying, pre-spawning mortality, and smolt-to-adult return ratios (SARs)? 1.3 How does the existing hydrograph affect reproductive and recruitment success for sturgeon and burbot and thus conservation aquaculture operation decisions in the Kootenai River subbasin?	
		1.4 How does dam passage affect fish?	1.4.1 How does juvenile passage through multiple dams versus transportation affect adult fish migration behavior, straying, and pre-spawn mortality, and juvenile-to-adult survival rates? 1.4.2 Do juvenile bypass systems negatively affect smolts making them less fit or are less fit smolts more likely to end up in the bypass system? 1.4.3 Do dams prevent adult lamprey from migrating up and downstream to reach a preferred spawning location?
		1.5 How do hydrosystem reservoirs affect foodweb, predator-prey interactions, competition, survial and growth? 1.6 What is the flexibility of the hydrosytsem to be optimized for different species needs (flow, temperature, etc)?	
	2.What additional hydro operations or passage strategies could be considered to benefit fish?	2.1 What are the effects of water temperature at mainstem dams and reservoirs on fish passage (both juvenile and adults)?	
D. Mainstem habitat	1. Do hydro operations dedicated to improve mainstem habitat provide the expected benefits for fish?	1.1 What are the impacts of hydrosystem operations on mainstem habitats, including the freshwater tidal realm from Bonneville Dam to the salt wedge? How might hydrosystem operations be altered to recover mainstem habitats? 1.2 Did reductions in historical mainstem habitat, including dam construction, change the density-dependent responses of salmon, sturgeon, and other anadromous and resident species?	
	2.What additional hydro operations or passage strategies should be considered to improve mainstem habitat to benefit fish?	2.1What should be the magnitude and timing of restored flows, ramping rates, and temperature regimes for the free-flowing segments of the river?	

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		2.2 What would be the effects of operational changes for optimizing water temperatures and water quality for fish in shoreline and riparian habitats?	
		2.3 Where, when, and at what frequency under different conditions do salmonids and other native species use coldwater thermal refuges in the lower Columbia and Snake rivers?	2.3.1 To what extent can managed releases from high-head dams mitigate or mask the effects of climate change by regulating water temperatures and thereby optimizing endangered fish habitat downstream of such structures? 2.3.2 What would be the effects of operational changes for optimizing water temperatures and water quality for fish in shoreline and riparian habitats, as well as for wildlife in these habitats?
		2.4 How much spawning and rearing habitat is available to white sturgeon above and below Bonneville Dam under a range of actual operational conditions?	
		2.5 How do operational changes and habitat conditions, including temperature, differentially affect spawning success and juvenile growth and survival to the recruitment stage for white sturgeon?	2.5.1 What are the impacts of hydrosystem operations on mainstem habitats, including the freshwater tidal realm from Bonneville Dam to the salt wedge? How might hydrosystem operations be altered to recover mainstem habitats and enhance prey production and the carrying capacity of mainstem habitats?
E. Estuary, plume, and ocean	1. Are investments in the estuary having the expected beneficial effects?	1.1 What are the responses of focal species (anadromous salmonids, white sturgeon, Pacific lamprey, and eulachon), life history types, and populations to alternative restoration actions and locations in the estuary that best inform management decisions?	
		1.2 How can we efficiently and effectively manage and restore estuarine habitat to increase the carrying capacity of the estuary for salmonids and other focal species (anadromous salmonids, white sturgeon, Pacific lamprey, and eulachon)?	
	2. What should we know about the estuary, plume, and ocean that will improve lifecycle survival forecasts or inform management actions?	2.1 How much do specific factors impact growth, fish condition, residence time, age at maturation and survival of focal fish species (anadromous salmonids, white sturgeon, Pacific lamprey, eulachon) in the estuary, plume, and ocean?	2.1.1 How do upstream nutrient fluxes influence hypoxia below Bonneville dam?
		2.2 How do climate change, hypoxia, and ocean acidification affect survival of focal fish species (anadromous salmonids, white sturgeon, Pacific lamprey, eulachon) in the estuary, plume, and ocean?	
		2.3 How large are density dependence effects for salmonids in the estuary and ocean, including the influence of hatchery fish and/or invasive species (e.g., American shad juveniles)?	

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		2.4 To what extent can predictive models be used to evaluate the potential impacts of hydrosystem projects on estuary, plume, and coastal marine habitats and their biota? 2.5 What tidal freshwater, estuary, plume, and ocean habitats and their biota are most important to focal species (anadromous salmonids, white sturgeon, Pacific lamprey, eulachon)?	
F. Population structure and diversity	1. What is the abundance, distribution, and diversity of focal species?	1.1 What is the current range of biological diversity (life history and genetic) in focal fish and wildlife populations in Columbia River Basin ecosystems, and how is that diversity influenced by geographic location and changing environmental conditions?	1.1.1 What is the abundance, distribution and diversity of Pacific lamprey in the Columbia River Basin?What are mortality rates for lamprey by life-stage? 1.1.2 What is the status of white sturgeon populations in the Columbia River Basin?
	2. What level of population diversity is necessary to ensure population integrity?	2.1 What is the relationship between genetic diversity and ecological and evolutionary performance, and to what extent does the loss of stock diversity reduce the fitness, and hence survival rate and resilience, of remaining populations?	2.1.1 How effective is genetic assessment for determining trends in population status and population diversity?
	3. What is the potential for reintroducing anadromous fish above blocked areas?	3.1 What is the success rate of the current efforts at re-introducing anadromous fish into blocked areas throughout the Pacific Northwest? 3.2 What is the feasibility of reintroducing anadromous fish at each federal and non-federal project that currently blocks anadromous fish from historic habitat? Specifically, what is the feasibility of implementing adult and juvenile passage at dams that currently do not have passage?	3.2.1 Will the novel biotic communities that have assembled since barrier construction—with their predators—allow the reintroduction of productive native fish populations? 3.2.2 What is the feasibility of upstream and downstream passage options for salmon and steelhead in the upper Columbia (above Chief Joseph and Grand Coulee dams)? 3.2.3 Can extirpated populations be recolonized by relying on out-of-basin brood stock?
	4. What factors within and outside of the Columbia River Basin influence trends in recruitment, mortality, and abundance of Columbia River Basin fish and wildlife populations?	4.1 What are the contributions of habitat loss, harvest, predation and mainstem passage to reduced riverine survival and production of anadromous salmonids and other fishes targeted in the Fish and Wildlife Program?	4.1.1 How do fish move among rearing habitats, and what is the importance of habitat connectivity and spatial distribution? 4.1.2. How does changing hydro, harvest, hatchery and habitat actions affect salmon and steelhead status and trends given the influence of ocean conditions?

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			4.1.2 What factors are limiting recruitment of white sturgeon above and below Bonneville Dam? 4.1.3 Do the mainstem dams isolate sturgeon populations, and if so, what is the feasibility of restoring connectivity to maintain genetic diversity in the long-term?
		4.2 What life history strategies are utilized by Columbia River Basin fishes (e.g., Pacific salmon, lamprey, sturgeon, eulachon), and how do they influence survival and growth in tributaries, the mainstem above and below the dams, estuary, and ocean plume?	4.2.1 After anticipated restoration of tributary habitats and given the range in ocean conditions and spawner densities, what level of SARs is needed for each salmon ESU in order to (1) provide for a self-sustaining population, and (2) provide harvests that meet harvest goals?
		4.3 How can the abundance and diversity of fish in the Columbia River be increased and sustained over the long term given the multitude of biological, physical, and cultural constraints? In particular, what are the potential benefits and risks of re-introducing anadromous fish into blocked areas throughout the Pacific Northwest?	4.3.1 What are the levels of genetic diversity and degree of spatial genetic differentiation among populations or aggregations of Pacific lamprey from the Columbia River Basin and rivers along the west coast of North America? Specifically, what are the genetics of anadromous and resident lamprey populations (e.g., existence of genetically distinct population structure, rate of gene flow, population/subpopulation characteristic, etc.)? 4.2.2. What is the potential for and likelihood that reintroduced salmon will form adfluvial populations above barriers without volitional passage, and how will this impact population growth and persistence of the anadromous population? 4.2.3 What are the potential risks of reconnecting 2 groups of fish separated by a barrier (e.g. are the 2 groups still similar or have they adapted to their separate habitats resulting in negative effects if reconnected together).
G. Predation	1. How effectively are undesirable impacts of predation ameliorated by management actions including hydrosystem operations, habitat modifications and predator population control?	1.1 To what extent is the viability or abundance of native fish and wildlife populations in the Columbia River Basin jeopardized by predation?	1.1.1 What proportion of adult salmon and white sturgeon are killed by sea lions (and other marine mammals) during their upstream migration below Bonneville Dam?
		1.2 To what extent is the productivity or viability of salmon populations increased by management actions to reduce avian and fish predation on smolts during the downstream migration versus actions to reduce marine mammal predation during the upstream migration below Bonneville Dam?	1.2.1 How does the cost-effectiveness of actions to control predator populations compare to that for alternative actions (e.g., flow and habitat modifications, hatchery supplementation) to increase the productivity or viability of natural salmon populations? 1.2.2 How does the presence of alternative prey, such as eulachon, affect the rate of predation on adult salmon, steelhead, sturgeon and lamprey?
	2. Are there other actions that could reduce predation on listed species?	2.1 How does increasing the total density of prey through hatchery releases, and alternative prey species affect the rate of predation on natural-origin juvenile and adult salmon, including listed fish?	

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H. Non-native species	1. Are current efforts to prevent the introduction and reduce the populations of nonnative species effectively protecting native species?	1.1 What are the primary pathways of introduction of invasive and non-native species, and what management actions and limit them? 1.2 To what extent is the viability or abundance of native fish and wildlife species in the Columbia River Basin jeopardized by non-native species?	
I. Contaminants	1. Can toxic substances undermine fish and wildlife recovery efforts?	1.1 What are the distributions, uses, and concentrations of toxics, including emerging contaminants, in the Columbia River Basin, and what are their trends over time? 1.2 How do toxic substances, alone and in combination, affect fish and wildlife distribution and abundance, survival and fitness, and productivity in the Columbia River Basin?	1.1.1 What are the impacts of different hydrologic scenarios and management actions (e.g., dam operations and flow management) on contaminant distributions and transfer of contaminants to food webs? 1.2.1 What are the cumulative and/or synergistic effects of multiple toxic contaminants, particularly pesticides, on riparian insects and other organisms that impact the carrying capacity of the Columbia River ecosystem (including estuarine, coastal ocean and riverine habitats), as well as interactions between these chemicals and non-chemical stressors? 1.2.2 How do food web transfer, sediment transport, and biological effects of emerging and legacy organic contaminants under current management regimes affect key Columbia River species, the success of restoration projects within the Basin, and human health (i.e., the success of harvest mitigation)? 1.2.3 What levels of chemicals of emerging concern (CECs)7 impact the health of focal species including Pacific lamprey, white sturgeon, and salmonids?
J. Climate change	1. Are long-term climate trends expected to undermine recovery efforts for fish and wildlife in the region?	1.1 What food web effects are associated with long-term climate trends predicted for the Columbia River Basin? 1.2 Are the Program's habitat restoration actions and hatchery facilities able to effectively respond to rapid changes in water availability and quality? 1.3 What are the potential effects of climate change on river hydraulics, temperature, and sediment movement in tributaries and mainstem reaches of the Columbia River Basin? 1.4 How might climate change affect the success of salmonid reintroductions, supplementation or recovery efforts, particularly since warmer waters may favor other species, especially non-natives? 1.5 How can understanding future climate conditions help guide restoration actions and ensure their effectiveness over time?	1.2.1 How secure are surface and ground water sources as aquifers are being depleted because of multiple and competing uses?

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		1.6. How could integrated ecological monitoring be used to determine how climate change affects fish and wildlife and the freshwater, estuarine, ocean, and terrestrial habitats and ecosystems that sustain them; how can this information inform decisions?	
	2. What strategic actions could help ameliorate potential effects of climate change including increased water temperatures, decreased summer river flows, changes in upland plant communities, and other ecosystem changes?		
K. Human development	1. How are projected changes in society's use of land and other resources likely to affect environmental quality, habitats, and fish and wildlife populations?	1.1 What changes in human population levels and their distribution, per capita income, and economic activity are expected over the next 20 years?	
L. Harvest	1. How effective are current harvest and escapement strategies at supporting recovery efforts and providing harvest opportunities?	1.1 What is the biological goal for spawning escapement including consideration of nutrient return?	
	2. Are there new harvest and escapement strategies that would do a better job of supporting recovery efforts and providing harvest opportunities?	2.1 How can fishery interceptions and harvests of ESUs or populations, both hatchery and wild, best be managed to minimize the effects of harvest on the abundance, productivity, and viability of those ESUs and populations?	2.1.1 What is the catch-and-release mortality by species and stock, and in relation to environmental variables in the ocean, estuary and freshwater? 2.1.2 What are the impacts of directed (intentional) and incidental (unintentional) harvests on population-specific characteristics and productivity of Columbia River Basin fishes? 2.1.3 Are hatchery harvest rates a reasonable surrogate for wild salmon harvest rates in freshwater and the ocean?
M. Monitoring and evaluation methods	1. Are current methods to count fish and measure productivity accurate, reliable, and cost effective?	1.1 What are the acute and chronic effects of various tag types on fish survival, for example PIT-tag effects on juvenile salmonids? 1.2 Can survival of juvenile salmonids from spawning to estuary be best monitored using PIT tags, acoustic tags, genetic or other tags?	
	2. Are there better methods for counting fish and measuring their productivity?	2.1 Fish survival is currently estimated using capture-recapture methods. How can advances in genetic stock identification, reductions in sizes of tags, new tag technologies, and other emerging methods be used to improve estimates of survival (better precision and less bias) and/or reduce costs?	2.1.1 What methods can be used to estimate the survival and abundance of lamprey?

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	3. Are there better methods for determining the response of fish populations to habitat restoration?	3.1 What are the most effective methods for quantitative estimates of changes to abundance, survival, movement, and production in response to habitat restoration, and how can these estimates be integrated across a range of spatial scales from individual restoration treatments to whole watersheds, and temporal scales from individual seasons to entire life cycles?	3.1.1 Do the current methods for detecting effects of many small, incremental habitat improvements on fish populations provide answers with sufficient precision and accuracy to evaluate the success of these programs?
			3.1.2 Are models used to predict habitat benefits of actions prior to implementing actions accurate and useful in order to prioritize actions and assess cost/benefit ratios?
		3.2 Are there effective methods for fish-in and fish-out monitoring for measuring effects of habitat restoration and other changes?	3.2.1 What statistical methodologies are available for estimating the number of fish (1) entering and then leaving habitat areas or for (2) entering and the number of progeny leaving the habitat area? And how effective are the statistical methodologies for different habitat types?
	4. Are there better methods for determining the response of wildlife populations (other than fish) to habitat restoration?	4.1 Can impacts to transient wildlife populations (e.g., waterfowl) and small localized wildlife populations (e.g. bears) be effectively monitored at a lower cost?	
N. Public engagement	1. How well does the Fish and Wildlife Program communicate with and engage the public (and its diverse social groups) associated directly or indirectly with the landscape?	1.1 How well does the Fish and Wildlife Program communicate with and engage the public (and its diverse social groups) associated directly or indirectly with the landscape?	