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Response to Willette *et al.* (2015)

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Response

We agree with the authors (WSV) that the environment in Cook Inlet changes in complicated ways. However, WSV's listing of several unresolved questions (chiefly, in our view, whether the results apply to smaller fish or to very shallow inshore environments and whether the bottom depth of fish nets can be predicted with sufficient accuracy) is insufficient rationale for discounting the large potential benefits to both commercial and sport fishery sectors of using shallower nets.

Our paper included an example that illustrated the likely relative harvest rates of using nets fishing at two specific depths (3.5 and 5.5 m). As we specifically noted in the caption to figure nine, we assumed net depths '*…to be directly proportional to the number of meshes; if the effective maximum depth of the net is different (because mesh size varies or nets billow under strong tidal currents), this would amount to a lateral shift of the curves along the x-axis*'. The analysis remains valid if we were to replace an assumed fixed-depth net with a variable net depth that oscillates over the tidal cycle; in this case, we would integrate the relative harvest rates of the nets as their effective depth changes over time. In practical terms, we would substitute the average effective depth of the net during that part of the tidal cycle chosen for a fishery opening and read off the relative harvest rates from the existing figure nine.

It is important to remember that the current management regime in Cook Inlet is neither the result of a carefully tailored biological analysis nor one based on a careful economic analysis of what management system will provide the best economic value to the state. Rather, the current system is a set of inherited rules now nearly 50 years old that managed harvest levels adequately in an earlier time when severe conservation concerns for Chinook did not exist and which more or less satisfied the competing interests of the stakeholders. As a result, all fishing sectors could obtain satisfactory livelihoods and co-exist. Because the regulations allowed 'co-existence,' no one really questioned whether they were economically and biologically optimal, and there was thus little pressure to change. In our view, the advent of new information derived from telemetry technologies should allow managers to fill in key knowledge gaps and re-assess management regulations in this light.

As WSV note, fisheries management in Cook Inlet has become 'highly contentious;' we agree, but do not agree that maintaining status quo management in the face of recent major environmental change is the best option, because major social, economic, and (possibly) biological loss is occurring. The key questions are as follows: (*a*) *Is the existing management structure close to the best possible?* and (*b*) *If not, what steps could be taken to improve the management?* Our results suggest that improvements to the management structure are indeed possible, because technological developments in acoustic telemetry provide an unprecedented ability to measure the movements of fish. The ability of properly implemented telemetry systems to identify radical alternatives to the status quo is widely underappreciated in our view, not just in Alaska but worldwide. In broad terms, our past inability to know where and how fish move has blinded us to opportunities to improve our management. In the current case, telemetry data allows us to identify a possible new regulatory solution that should improve the economic utility of *both* fishing sectors, a previously unrecognized possibility.

Major restrictions have been imposed on the Eastside Setnet (ESSN) Fishery relative to earlier periods. These resulted in huge declines in fishing effort and revenue, which also occur at a time when the target species (sockeye) is at high levels of abundance, exacerbating

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political pressures. The goal in implementing ESSN harvest restrictions is to reduce harvest rates on Chinook, but the results from our telemetry study show that it may not be necessary to restrict fishing effort on sockeye as much as originally thought, because appropriately modifying the shape of the gillnets could both protect the Chinook population and increase sockeye harvest. Given that an overescapement of sockeye could reduce future returns (through density-dependent mechanisms), and is a stated concern of management biologists, it seems sensible to us to consider a gear modification that could achieve both improved Chinook conservation and enhanced sockeye harvest.

WSV's remaining list of uncertainties are not logical reasons for discounting the use of shallower nets (that the time of maximum tidal height changes across the ESSN, that nets fished in shallow water close to shore will touch the bottom, or that small Atlantic salmon are positioned higher in the water column than larger individuals when held at extremely high densities in net pens). Fishery openings are already specified for explicit time periods, so choosing openings around the time of high tide will keep surface gillnets as far above the bottom as possible. Management authorities could also choose the time of openings for specific subareas closer to the time of maximal local tides if further fine-tuning was necessary. Finally, the relevance of the quoted [1] size-dependence of depth for Atlantic salmon in aquaculture net pens is questionable: (i) the species is different, (ii) salmon forced into very close contact (as occurs in net pen culture) are known to form dominance hierarchies with the smaller individuals forced out of the best territory [2], and (iii) at the stocking densities (4 salmon m^{-3}) reported in the cited study [1], the nearest neighbor spacing of caged Atlantic salmon was 1.4 m; because most salmon in that study were concentrated in the 3- to 9-m depth strata and cages were 15 m deep, effective spacing would be about 0.6 m. In contrast, assuming that the entire Kenai River Chinook run was simultaneously present and evenly distributed in the ESSN, the nearest neighbor spacing works out to >125 m.

Previous ADFG investigations of the vertical distribution of catch of sockeye and Chinook also provide at least partial corroboration of our hypothesis regarding the benefits of shallower nets. As noted in WSV, Bethe and Hansen [3] found that the vertical distribution of Chinook caught in setnets was essentially uniform (the authors compared the measured catch in the top two thirds of the net and the bottom one third). What WSV did not mention was that the same study also found that catches of sockeye salmon tended to occur disproportionately in the upper two thirds of setnets in '*nearly all areas, weeks, and distances from shore*' (p. 26), so even if Chinook were uniformly distributed (an assumption that our telemetry data does not support), then a benefit would still be obtained by reducing the maximum depth of the nets.

Finally, we do agree that a better understanding how net depth varies with the stage of the tide, net construction, and catch could be useful for fine-tuning the development of regulations on allowable net dimensions. We started this work in 2014, placing time-depth recorders on shallow and 'regular depth' nets of supportive ESSN fishermen to evaluate how nets of various depths change over the tidal cycle in Cook Inlet. The initial results are very promising and suggest that modifying regulations to reduce net depth has great promise to reduce Chinook mortality while allowing sockeye harvests consistent with (and possibly even greater than) historical levels, for the reasons we outline in our paper.

In summary, the science of biotelemetry offers new information that can contribute to simultaneously increase the economic value of Cook Inlet fisheries while meeting conservation objectives. These are important goals that all sides should be able to support, particularly because the results identified a previously unsuspected opportunity for politically opposed sectors to accept mutually beneficial regulatory changes. This is the most important and unexpected conclusion derived from the telemetry study and illustrates the potential power of modern technology to address 'wicked' management problems. As we noted in our paper, the results could help turn a politically contentious 'zero sum game' into an opportunity to align the objectives of different interest groups. We recognize that more study will always be beneficial, but in our view, the uncertainties WSV raise do not demonstrate that the current regulations concerning net depth are optimal, and several buttress our claim that strategically modifying net depth could pay potentially large dividends.

Competing interests
The authors received a financial benefit in the course of preparing this response. Their future salaries also depend on their continued technical and scientific performance, which includes the publication of this Response.

Authors' contributions
DWW and ADP co-wrote the Response. All authors read and approved the final version.

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References

1. Folkedal O, Stien LH, Nilsson J, Torgersen T, Fosseidengen JE, Oppedal F. Sea caged Atlantic salmon display size-dependent swimming depth. Aquat Living Resour. 2012;25:143–9. doi:10.1051/alr/2012007.
2. Akbaripasand A, Krkosek M, Lokman PM, Closs G. Does social status within a dominance hierarchy mediate individual growth, residency and relocation? Oecologia. 2014;176:771–9. doi:10.1007/s00442-014-3038-z.
3. Bethe ML, Hansen P. Investigation of methods and means to minimize Chinook salmon harvest in the East Side Set Net Fishery of Upper Cook Inlet, 1996. Special Publication 98–3. Anchorage, Alaska: Alaska Dept. of Fish and Game; 1998:84 pp. Available at: http://www.adfg.alaska.gov/FedAidPDFs/sp98-03.pdf