Citizens of Ebey's Reserve (COER) October 2018 Comments on: Endangered Species Act

Final Environmental Impact Statement for EA-18G "Growler" Airfield Operations at Naval Air Station Whidbey Island

The following are Citizens of Ebey's Reserve (COER) comments on the application of the Endangered Species Act (ESA) in the Final Environmental Impact Statement (FEIS) for EA-18G "Growler" Airfield Operations at Naval Air Station Whidbey Island (NASWI). They are additional to comments we (COER) submitted on the draft EIS in February 2017.

Addendum E.1: ESA Compliance Issue

In evaluating the impacts, the U.S. Fish and Wildlife Service and National Marine Fisheries Service did what they could to fairly and objectively address impacts on marine mammals, fish, and sea birds based on the limited information available. They failed in many cases, however, to forthrightly apply extensive uncertainty and data shortcomings in reaching their conclusions. That is not a matter of trivial import, albeit under ESA guidelines it is a bit ambiguous.

If exposure of a listed species to a given activity is extremely unlikely to occur, the agency concludes that the effects on the species are *discountable*. If the agency is unable to conclude the effect was discountable, they assume exposure to occur and evaluate the consequence of that exposure.

Then, if they determine, based on the *best available information*, that they "*could not meaningfully measure, detect, or evaluate*" the effect of an action on the species, they may conclude the effect was "*insignificant*." If they are unable to reach either of those conclusions (i.e., insignificant or discountable), they then, per quote below, are to give that species the benefit of the doubt and considered the effect to be "*adverse,*" as this quote from the Navy's Northwest Training and Testing EIS:

> *In accordance with Service national policy (USFWS and NMFS 1998, p. 1-6) and congressional intent [H.R. Conf. Rep. No. 697, 96th Congress, 2nd Session 12 (1979)], the following analysis relies on best available information and provides the benefit of the doubt to the listed species in light of uncertainty or data gaps (see also p. 19952, middle column, of the preamble to the implementing regulations for section 7 of the ESA at 50 CFR 402; 51 FR 19926)*."

So, if a species was extremely unlikely to be exposed to a military activity, the agency concludes potential effects were discountable—i.e., ignored. Otherwise, if exposed but the impact "*could not be measured, detected, or evaluated,***"** then the effect was assigned as i*nsignificant*—i.e., no problem. So if the agency can't tell, they give the benefit of doubt to the project action (herein, the Navy). If the imnpacts *cannot be assessed in any way at all*, the agency gives the benefit of a doubt to the species—i.e., assumes an adverse effect.

That reveals a strange scientific conundrum. That is, the agency may not always be able to "*measure or detect*" a potential impact, but it should always be able to "*evaluate*"—i.e., attempt to unravel and understand, even though in the end no scientifically efficacious protocol could justify guesses as conclusions. There is no guidance about how efficacious the evaluation must be; in fact, absent guidelines, it may be very superficial or even capriciously subject to political pressure.

In spite of large and critical "data gaps" in the FEIS endangered species analyses, COER found no situation where the benefit of doubt was accorded to a listed species. Given the significant and extensive data gaps, if the agency was to truly err on the side of the resource, the resource should get the benefit of the doubt perhaps at least half the time, but none of the time?

It may be reasonable to treat a relatively stable and healthy resource with a measure of freedom when dealing with unknowns and uncertainties, but that cannot be said for Washington's endangered unstable, unhealthy, and declining marbled murrelets or for the nearly extinct southern resident killer whales. These precarious populations demand absolute protection and judicious caution, and therefore much more attention than has been demonstrated in exercising the benefit-of-doubt requirement.

Addendum E.2: ESA — Marbled Murrelet

The marbled murrelet is endangered by Washington State (and perhaps soon by Oregon) and is listed as threatened at the federal level. COER has reviewed the June 14, 2018, Biological Opinion (BiOp) for marbled murrelets as presented in NASWI expanded Growler FEIS Appendix C. We find the BiOp analysis (pages C-233 to C-240) of likely impacts of Growler noise on murrelets to be thorough, credible, and supportable.

However, we find the concluding "effects of the take" to be inconsistent with the projected impacts and noncompliant with national policy (USFWS and NMFS 1998, p. 1-6) and congressional intent [H.R. Conf. Rep. No. 697, 96th Congress, 2nd Session 12 (1979)], as we will examine in detail below. First, however, we underline some of the most salient points in the BiOp analysis of effects. The following are quotations from pages C-233 to C-240 (in purple font) by page number from the BiOp.

Quotations from the BiOp

C-233:

However, as Francis and Barber found in their review of literature on the impacts of noise on wildlife:
"…the presence of a species in a noisy area cannot be interpreted as an indication that it is not being impacted by elevated sound levels…."
(Francis and Barber 2013, p. 305)

When a species does not have an obvious response to a stressor (e.g., completely avoiding an area where stressors occur) it can be challenging to assess the consequences of

exposure. **There are no known research efforts on the response of marbled murrelets to military aircraft overflights**.

Also, studies that examine the effects of continuous, relatively low-level noise (Kleist et al. 2018 for example) are not as useful for analyzing this proposed action, which will present intermittent, higher-level noise of shorter duration.

> <COER Comment: As often noted in related documents on NASWI Growler noise, the Navy has asserted that presence of murrelets within jet noise contours indicates they are "habituated," meaning jet noise does not disturb their behavior. Francis and Barber (above) refute that ungrounded and naïve presumption i**n the absence of any study on marbled murrelet responses to jet noise.>**

C-234:

Ward and others (1999) observed the behavioral responses of Pacific brant (*Branta berniclanigricans*) and Canada geese (*Branta canadensis taverneri*) to aircraft overflights in southwestern Alaska. The researchers found that the majority (seventy-five percent) of brant fly in response to overflights and that brant respond to overflights as high as 1,219 m (about 4,000 ft) and as far away as 4.8 km (about 3 miles) away (Ward et al. 1999, p. 375). Canada geese responded less often than brant, but both species exhibited a greater response to loud aircraft and aircraft that were laterally closer (Ward et al. 1999, pp. 375-377). The researchers also observed that during some overflights, flocks of brant and Canada geese took flight before the aircraft were visible, suggesting that aircraft noise cued the escape behavior (Ward et al. 1999, p. 379).

One study found behavioral responses to actual and simulated military jet overflights in captive black and wood ducks (Conomy et al. 1998, pp. 1138-1140). Over consecutive days of exposure to overflights, the behavioral response rate for black ducks decreases [but] large proportions of black ducks respond to overflights after many several months of exposure (Conomy et al. 1998, p. 1139)... However, wood ducks' behavioral responses do not significantly decrease over several days of exposure to recordings of jet overflights.

Observations of harlequin ducks exposed to military jet overflights show that the ducks increase their alert, vigilant, and agitated behaviors as well as startle responses during overflights, and that responses to overflights were short (less than one minute), but duck behavior remained altered for up to two hours following the overflights (Goudie and Jones 2004, pp. 289, 293-294). There is also a correlation between the intensity of jet noise and the intensity of behavioral reactions – the strength of harlequin duck behavioral reactions increased with louder overflights (Goudie and Jones 2004, pp. 293-294). Further analysis of the data shows that harlequin ducks have a significantly stronger response to military jet overflights compared to overflights of other types of aircraft, which is probably at least partially due to military jets being the loudest aircraft observed (Goudie 2006, pp. 33-34).

C-235:

However, the proportion of birds reacting to overflights and whether/how reactions to overflights change over time appears to vary by species, even species that are part of the same family (Conomy et al. 1998, pp. 1140-1141; Ward et al. 1999, pp. 375-377). **We do not have data from a species that is closely related to the marbled murrelet. If marbled murrelet reactions to aircraft overflights fall somewhere on the continuum seen in the species discussed above, then between six (Conomy et al. 1998, p. 1140) and seventy-five percent (Ward et al. 1999, p. 375) of marbled murrelets can be expected to alter their behavior in response to Growler noise exposure.**

C-236:

These behavioral responses to aircraft overflights are energetically costly. Kittlitz's murrelets are an appropriate surrogate species to analyze in regards to marbled murrelets since the two species are closely related, are similar in size, and have similar life histories. The research with Kittlitz's murrelets indicated that increased energy expenditures associated with these behavioral responses result in decreased fitness (reduced reproduction, growth, or survival) (Agness et al. 2013, pp. 13, 19). Responding to boats increased the energy demands more in non-breeding birds, which are more likely to fly in response to vessels, than in breeding birds which tend to dive in response to disturbance (Agness et al. 2013, pp. 14, 17). Flight in response to vessels caused non-breeding Kittlitz's murrelets to expend up to fifty percent more energy than they would in the absence of exposure to vessels (Agness et al. 2013, p. 17). Breeding birds, which fly in response to disturbance less often expend up to thirty percent more energy than they would in the absence of exposure to vessels (Agness et al. 2013, pp. 14, 17). Even if breeding marbled murrelets can capture additional prey to offset the energy expense to themselves, the time and energy spent to catch that prey may impact prey deliveries to chicks and threaten nest success (Agness et al. 2013, p. 18). It is probably easier for non-breeding marbled murrelets to compensate for the energy lost to responding to disturbances, **but it is unclear if, or how long, they can cope with frequent (almost daily) additional energy needs** (Agness et al. 2013, pp. 18-19). A marbled murrelet's ability to compensate for additional energy needs is also dependent on the availability of prey.

> <COER Comment: The BiOp goes on to explain that the prey base in Puget Sound has been reduced, as has essential prey diversity, leaving sand lance as their primary prey, a lower energy source than herring. This exacerbates the impact of jet noise harassment on murrelet well being and reproduction success, including provisioning young. That is, harassment may affect feeding success in a variety of detrimental ways, but **actual effects are simply not known**.>

When energy expenditures are greater than average or when medium- to high-quality prey is unavailable, Kittlitz's murrelets may be unable to consume enough prey to meet their energy needs (Hatch 2011, pp. 87-88). Therefore we expect that when adult marbled murrelets respond to Growler overflights they will expend additional energy and increase the likelihood that they will be unable to catch enough prey to meet their energy needs. When birds cannot meet their energy needs they become malnourished; they may lose mass (Hatch 2011, pp. 87-88), be less likely to reproduce (Peery et al. 2004, pp. 1094-1095), and/or be more susceptible to infection (Beer 1968, p. 122; Smith 1975, p. 243).

C-237:

As discussed earlier, breeding marbled murrelets are more likely to dive than they are to fly in response to disturbance. We expect the energetic cost of diving to be significant, although less than that measured for Kittlitz's murrelets when responding by flight. In a study of another alcid species, thick-billed murres (*Uria lomvia*), researchers found that their metabolic rate when diving was triple the resting metabolic rate (Croll et al. 1992, p. 351).

Missed feedings can reduce the fitness of nestlings. During chick rearing, adults feed the young 1 to 8 times per day (mean = 3.2 ±1.3 SD) (Nelson and Hamer 1995a, p. 61). If we assume an average of 4 feedings per day, a single aborted feeding would constitute a loss of 25 percent of that day's food and water intake for the nestling. Such a loss is considered to be a significant disruption of normal behavior given that, "Murrelet chicks grow rapidly compared to most alcids, gaining 5 to 15 g/day during the first 9 days after hatching" (Nelson and Hamer 1995a, p. 60). With such a fast growth rate and a low average number of daily feedings, it is reasonable to assume missing a single feeding may disrupt normal growth and create the likelihood of injury by presenting a developmental risk to the chick. Young marbled murrelets that receive multiple daily feedings grow faster and fledge earlier than those with lower provisioning rates. Early fledging helps minimize nest mortality (Nelson and Hamer 1995a, p. 66).

C-239:

The findings from Bloxton and Raphael (2009, entire) indicate that marbled murrelets in Washington are not initiating nesting or are abandoning their nests during incubation or chick rearing, possibly in response to poor foraging conditions. For those marbled murrelets that do initiate nesting and begin chick rearing, the implications of missed feedings due to noise or visual disturbance are significant, because **each missed feeding represents a delay in the development of the chick, prolonging the time to fledging and increasing the risk of predation, accidental death from falling off the nest, or abandonment by the adults.** If the disturbance at a nest site is prolonged, each successive day of disturbance represents an increasing risk that multiple missed feedings will trigger a significant delay in their growth and development processes, cause permanent stunting, or result in the mortality of a nestling due to malnourishment.

> <COER Comment: All of the above well-documented and efficacious research findings speak to the reality that the impacts of Growler noise are highly likely, yet cannot be qualitatively or quantitatively resolved **because the data/information gaps are too great.** The following quotations (also in purple font) are from the Department of the Navy Informal Consultation (DONIC)[1] with the U.S. Fish and Wildlife Service (USFWS),

1 U.S. Department of the Navy. 2017 (April). Informal Consultation Package for EA-18G "Growler" Airfield Operations at the Naval Air Station Whidbey Island Complex, Oak Harbor, Washington.

which addresses the impacts of the expanded Growler operations on marbled murrelets.>

Quotations from the DON Informal Consultation (DONIC)

DONIC Page 27:

The proposed action area is within the Puget Sound encompassed by the marbled murrelet recovery zone (Conservation Zone 1), as designated and described in the *Recovery Plan for the Marbled Murrelet* (US Fish and Wildlife Service 1997)….

The marbled murrelets preferred habitat type, old-growth coniferous forests near coastal areas, only occurs in small patches with the action area. None of these small patches have been identified as supporting marbled murrelet nesting. As commented by the WDFW in email correspondence with the Navy in October 2016, **"No nesting birds have been found on Whidbey Island and no nests have been documented on any islands in the northern Puget Sound (Milner 2016, Appendix C)," although no surveys have been completed since the 1990s.** The WDFW also explained that old growth trees that would typically be considered suitable habitat in Deception Pass Park are impacted by prevailing winds that prevent moss coverage from developing on defective limbs to the extent that would be necessary for nesting platforms (Milner 2016, Appendix C). The Hamer Environmental (1995) effort supports this assessment, where by performing surveys of potential nest habitat it was found that the majority of marbled murrelet nests were located on moss and that moss presence may increase the number of platforms within a stand as it creates a multitude of nest platform choices by providing substrate on many locations throughout a single limb….

COER Comment: That statement is inaccurate. This is what Hamer and Nelson (1995, page 79)[2] actually found:

> For nests found throughout North America, moss formed 49 percent of the substrate, moss mixed with lichen or litter formed 30 percent of the nests, and litter 21 percent (n = 37). All nests found in Alaska had moss as a component of the nest substrate.

The 49% for all North America was an average that included nests in Alaska which were all (100%) on moss. Hence, the moss percentage for the Washington to California was actually less than 49%. This is further substantiated by the U.S. Fish and Wildlife Service examination of nests in Washington State in 2012, as below[3]:

> Platforms – The most important component of murrelet nest trees is the presence of platforms. Old-growth, mature, or younger coniferous forests with appropriate structure can provide these platforms…A platform may be a depression on a branch, an area where a limb

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[2] Hamer, T.E., and S.K. Nelson. 1995. Characteristics of Marbled Murrelet Nest Trees and Nesting Stands. USDA Forest Service Gen. Tech. Rep. PSW-152. (https://www.fs.fed.us/psw/publications/documents/wild/gtr152/chap6.pdf)

[3] http://www.wsdot.wa.gov/NR/rdonlyres/2D97D3D8-D448-43A7-8249-E2319095C8C2/0/MAMUhabitatFWS.pdf

> branches, a surface created by a deformity such as a dwarf mistletoe broom, a debris/moss platform or stick nest equal to or greater than 4 inches in diameter including associated moss, lichen, or duff if present (Bloxton and Raphael 2009, var.; Burger 2002, p. 41; Evans Mack et al. 2003, p. 2; Hamer and Nelson 1995, p. 79; Nelson 1997, p. 16). Any forested area with one observed platform is capable of supporting a nest (Evans Mack et al. 2003, p. 3). Platforms may be clumped in one area or dispersed throughout the forested area.

This means all the DONIC attention given to moss as a factor for murrelets not being found on Whidbey Island is disingenuous. **Consequently, the question remains unknown:** Why are there no nests in the Deception Pass area or elsewhere on Whidbey Island, or for that matter in the old-growth stands adjacent to the OLF? Could jet noise be part or all of the answer?

Murrelets are believed to be philopatric, meaning they return to their natal area to nest as adults. This strategy tends to ensure nesting success in the sense that the returning adult obviously fledged successfully from that area and survived to sexual maturity, and hence, returns to nest in a tried-and-proven location. Such a strategy boosts reproductive success.

The opposite is also true logically and hypothetically. That is, one nest failure sponsors a permanent loss because that chick becomes a ghost never return there as a parent, and that ghost produces no progeny, so its would-have-been progeny become ghosts, and generationally expands into more ghosts. The parents of the failed nest may prudently seek out another area in years following failure or try it once more, only to fail again. Either way, that amounts to multiples less nesting there, and bit-by-bit the attrition takes its toll until it becomes a ghost nesting area. This could be modeled from literature estimates on life expectancy, nesting frequency, eggs laid per nest, fledgling rate, recruitment age, and adult survival rate, using various input scenarios. Until that is done, the numeric impact of such nest failures **remain as a very important unknown**.

The Navy acknowledges dramatic increases in jet noise during the 1970s and 1980s. In the ensuing 20 to 30+ years could noise-based nesting failures have driven and eradicated the murrelet's nesting success and usage memory? Or if not yet fully extirpated, could low nest density coupled with sampling paucity explain why no recent murrelet nests have been documented there, and why murrelets in Washington, commute a greater sea-to-nest distances than elsewhere (Hamer 1995)? Could this be why there is no nesting on the islands of northern Puget Sound? **More unknowns**.

DONIC, Page 27 (continued):

The USFWS confirmed during the 2012 EA-6B Prowler Squadrons to EA-18G Growler at NAS Whidbey Island consultation that the project was more than 0.25 miles from suitable marbled murrelet nesting habitat. More recently, the Navy contacted the Washington

Department of Fish and Wildlife to ensure the most up-to-date information on marbled murrelet nesting occurrence in the action area. **They [USFWS] responded that small patches in the action area could be considered suitable nesting habitat,** but that none of these small patches have been identified as supporting marbled murrelet nesting and that no nesting birds have been found on Whidbey Island (Milner 2016, Appendix C).

Marbled murrelets are found year-round in marine waters adjacent to Whidbey Island (eBird 2017, Seattle Audubon Society 2017), and individuals make daily, year-round flights between different foraging areas (Nelson 1997, WDFW, 2013). Marbled murrelet **nesting areas have not been documented in Island County (Opperman *et al*. 2006, WDFW 2013), nor have marbled murrelets been documented in terrestrial areas of the proposed action area** (WDFW 2011 *as cited in* US Department of the Navy 2012a), **so it is assumed that potential impacts to marbled murrelets in the action area would be associated with foraging activities within marine waters.**

COER Comment: Given the absence of nests in the action area in spite of suitable nesting habitat and the presence of foraging murrelets in nearby marine waters, why no nesting? Instead of using those adjacent nesting areas, murrelets in Washington fly further to their nests than they do in Oregon or California (Hamer 1995, as stated in USFWS 2016[4, 5]), and as stated on DONIC page 29, in northeastern Washington they fly up to 145.5 km [90 mi], or a mean distance = 53.5 km [33 mi] (Lorenz *et al*. 2016). They likely don't go those extra miles because they love to fly. That is a substantiated and widely accepted principle: that animals minimize energy expenditure in order to preserve that energy for essential life functions and activities that promote survival and reproduction (note that BiOp discussion above supports that). Given that there are foraging murrelets just a just a few miles or so from the Ault Field and OLFC, why do they pass over the nearby nesting habitat and instead seek out more distant nesting sites requiring far more flying energy and more time subtracted from feeding activity needed to support both adult and nestling. Could that extra energy travel demand be part of the reason that nesting success for these birds is so low in Washington State?

USFWS (2016, Appendix D, p. 12) [6] expresses concern that the current estimates for murrelet juvenile ratios (**Ŕ)** *"…is generally insufficient to maintain stable population numbers ...*" and concludes the following in regard to Washington's murrelets:

> Considering the best available data on abundance, distribution, population trend, and the low reproductive success of the species, the Service concludes the murrelet population within the Washington portion of its listed range currently has little or no capability to self-regulate, as

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[4] Hamer, T.E., and S.K. Nelson. 1995. Characteristics of Marbled Murrelet Nest Trees and Nesting Stands. USDA Forest Service Gen. Tech. Rep. PSW-152. (https://www.fs.fed.us/psw/publications/documents/wild/gtr152/chap6.pdf)

[5] USFWS (U. S. Fish and Wildlife Service). 2016. Biological Opinion: Northwest Training and Testing Environmental Impact Statement. U.S. Fish and Wildlife Service Reference 01EWFW00-2015-F-0251.

[6] The juvenile ratio (**Ŕ**) is calculated from marine survey data of the total number of 1-year old murrelets enumerated divided by the tally of all murrelets older than age 1.

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> indicated by the significant, annual decline in abundance the species is currently undergoing in Conservation Zones 1 and 2 [i.e., Washington].

We do not dispute that the murrelet problems in Washington involve a complex mix of factors. However, the extensive presence and severity and amplitude of jet noise since the 1970s in and around Whidbey Island, cannot be dismissed as a potential cause of nesting displacement and the unusually high murrelet nest failure rate: 8 out of 10 nests in Washington fail to fledge, i.e. produce viable young (USFWS 2016). That failure rate is insufficient to maintain the population and compounds the recruitment insufficiencies each year, which is exactly what the population surveys are showing in Washington. Growler noise may or may not be a factor that has displaced adult nesting and impacted chick survival. This is **just another critical unknown**.

BiOp Conclusion and Effect of the Take

The BiOp conclusion and effect of the take are presented below in purple font with COER's explanation of support or disagreement inserted in black font.

Page C-240:

9.2.3 Aircraft Overflights Conclusion

Based on the above analysis, we conclude that both adult and sub-adult marbled murrelets will be exposed to noise from Growler operations in their marine habitat. When adult marbled murrelets are exposed during the nesting season they may drop or swallow fish intended for delivery to nestlings. As a result of that exposure of adults during the nesting season, nestlings may experience delayed or missed feedings…**we conclude that sub-adult and adult marbled murrelets will be exposed to noise from Growler overflights year round, during both the day and the night, over the thirty year term of the proposed action**.

Page C-251:

The Service anticipates incidental take of a subset of adult and juvenile marbled murrelets exposed to 1,981,560 incidents (created by 2,899,530 pattern maneuvers) over thirty years when marbled murrelet marine habitat will be exposed to aircraft overflights. The incidental take is expected to be in the form of harassment, because exposure to aircraft overflights will create a likelihood of injury by significantly disrupting normal behaviors such as foraging and reproduction. **Altered behavior will result in some adult and subadult marbled murrelets being more susceptible to injury or mortality from starvation or illness and will increase the likelihood that some chicks will die from starvation, falling, or predation.**

15 EFFECT OF THE TAKE

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the marbled murrelet or destruction.

COER Comment: We accept the USFW estimated number of incidents (1,981,560) over 30 years or 66,052 incidents per year in the action area. **We emphasize that there is no information to begin to allow a reasonably efficacious estimate of how many of such incidents would translate into a single mortality.** That said, it seems entirely likely that a very conservative estimate could be that every 1000 incidences would cause at least one immature or adult to become so stressed and weakened by jet nose harassment that it would die from malnutrition or disease, fall to a predator, or fail to reproduce, or if it did reproduce then fail to provision the chick, exacerbating the unsustainable 8 in 10 nests that currently fail in Washington. It's not necessary that the1000 incidents be the only factor effecting a loss in the murrelet population. If Growler noise harassment and stress becomes the proverbial back-breaking straw among other factors beyond our human control, then jet noise becomes an accomplice, **yet one within our control**.

One loss per 1000 incidents amounts to 66 resulting mortalities each year and each of such losses becomes one less murrelet to enter subsequent breeding populations in following years. At that rate, and not factoring in the losses in progeny dead birds would otherwise have created, there would be a simple loss of 600 to 700 murrelets every decade. That level of impact would surely add significant potential to put the Zone 1 murrelets in jeopardy.

Those metrics, however, are of course speculative. They could be far worse--there simply is no way of knowing. **It is just another critical data gap.** We underline that, among the others above, because we are going to revisit that further below.

Pages C-252-253:

Monitor implementation of the proposed action and report the annual number of Growler flight operations and their associated flight tracks to ensure that the level of take exempted by this Incidental Take Statement is not exceeded.

17 TERMS AND CONDITIONS
In order to be exempt from the prohibitions of section 9 of the Act, the Navy must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

To implement RPM 1:
1a. The Navy shall submit a monitoring report to the Service (Washington Fish and Wildlife Office, attn.: Federal Activities Branch) by February 1 of each year. The report shall describe the Growler flight operations of the previous year. At a minimum, this report shall include the number of flight operations by type (e.g. departures, FCLPs, ground-controlled arrivals, interfacility flights, etc.) and flight track. If any of these numbers cannot be recorded and reported directly, the report shall contain an estimate of the numbers and explain the method used to derive the estimate.

1b. The Navy shall request a meeting with the Service if the monitoring described in 1a shows that the Navy is on a trend to exceed the level of take exempted by this Incidental Take Statement. The purpose of this meeting will be for the Service and Navy to discuss implementation of additional conservation measures to ensure the proposed action does not exceed the level of take exempted by this Incidental Take Statement. The Service believes that no more than the extent of take described above will occur as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

COER Comment: We have no problems with the conditions other than they are really pretty trivial. Condition 1a just facilitates 1b, which attempts to seem as though there is a substantive "take" analysis occurring, which there is not. The take is merely a double-check on the number of various Growler operations, and that says nothing about the number of murrelets actually removed from the breeding population or not recruited to that population. It tacitly hides the fact that if the harassment take results in murrelet loses, the numbers will continue to be unknown and the conditions masqueraded as some sort of important way that USFWS and the Navy are on top of protecting the murrelet population. In fact, all 1b does is to hold the Navy to some operational level, for which there is no defendable conversion into even a weak prediction of the impact on the murrelet's future.

Pages C-252-253:

18 CONSERVATION RECOMMENDATIONS
Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations **are discretionary** agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.
1. Work with the Service to design and conduct a study that evaluates marbled murrelets response to military aircraft overflights and the consequences of those reactions.
2. Work through the Navy's Integrated Natural Resources Management Plans to restore and enhance forage fish habitat to increase productivity and prey available to marbled murrelets.
3. Continue to monitor incidents of aircraft/bird strikes, identify the species of bird struck, and report findings to the Service.
4. Limit the number of FCLPs performed at OLF Coupeville. Interfacility flights (which are only needed to perform FCLPs at OLF Coupeville) expose large areas of marine habitat along their flight tracks and limiting the number of FCLPs at OLF Coupeville will limit the number of interfacility flights.

5. Limit the use of flight tracks that expose a greater amount of marbled murrelet marine habitat to Growler overflights. Within each type of flight operation there are flight tracks that expose more or less marbled murrelet marine habitat. Limiting use of flight tracks that expose larger areas of marbled murrelet habitat will decrease exposure of marbled murrelets to stressors.
6. Facilitate surveys for streaked horned larks by trained biologists at Ault Field and OLF Coupeville. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

COER Comment: These are fine but only #4 and #5 would actually reduce harassment takes and hence reduce potential losses. Table 4 of the BiOp reveals that each interfacility flight (coming to + going coming from OLFC) exposes murrelets to noise above the 92-dBA disturbance level. Each such trip covers an area of 75.5 square miles. Hence, the more operations at OLFC, the greater becomes the frequency of murrelets exposed to disturbance level noise. As estimated in BiOp Table 5 those OLFC arrival or departure trips amount to nearly about 2000 disturbance exposures each year, not including about 7800 exposures/year due to FCLP activities at OLFC. Given the approximate 4-fold proposed increase in FCLP operations at OLFC those 10,000 annual exposures could be reduced by about three-fourths to 2500, if the operations at OLFC were held to the no-action level.

The critical importance of the Washington (zones 1 & 2) marbled murrelet subpopulations as related to the importance of the tristate distinct population segment and overall population is examined in Appendix E.2-A below. While that examination addressed the NWTT final EIS, it applies just as well to the result of impacts examined in the expanded Growler EIS.

COER Non-Concurence

We do not concur with the BiOp conclusion--that the “take” (harassment) is unlikely to be of detriment to the species.

Issue1: The BiOp has masked the impacts of Growler noise effects on marbled murrelets via the Navy’s reprehensible “segmentation” of its activities into pieces, which taken individually may not be found to be of detriment to a listed species but taken as a single aggregate project would cross over that significance line.

The impact of more Growlers at NASWI has been wrongfully segmented. Here is one such Northwest Training and Testing (NWTT) EIS example that exemplifies that:

> For each 8.5 hours of daily aircraft flight time, there will be an average of 4 minutes (less than one percent) of flight time per day that is likely to expose marbled murrelet nesting habitat to aircraft noise that exceeds 92 dBA SEL (page 215 from the NWTT Biological Opinion for the NWTT EIS).

We could argue about the details of that NWTT BiOp statement, but that would miss the point. An expanded Growler fleet means it will need a place to train. That includes not only the Whidbey Island action area (i.e., the expanded Growler EIS) but also the Olympic MOA as per the NWTT EIS. Instead of considering the 92-dBA impacts in those two areas as one project on the same marbled murrelet subpopulation, the Navy has inappropriately broken that impact into two discrete geographic considerations or pieces: Growler noise impacting murrelets in the expanded Growler EIS "*action area*" and Growler noise impacts to murrelets in the Olympic MOA (NWTT EIS). **Those two segmented activities impact affect the same marbled murrelet subpopulation**. Breaking the overall impact into two smaller impacts makes it easier to find no real impact on this or that (so no problem here folks, move along).

While to further hide and mix up the overall impact, the expanded Growler EIS examines numbers of incidents of exposure, while the NWTT examines minutes a day, obfuscating apples with oranges and visa versa.

More Growlers means more >92 dB threshold noise in both the Olympic MOA and the Whidbey Island *action area*. Hence, the Whidbey *action area* impacts were inappropriately segmented from the Olympic MOA impacts, hiding the full impact picture from public view, complicating legal challenges and magnifying costs for potential challengers. And, it violates the intent of the ESA—i.e., to examine the full impact of a project on the listed species (i.e., more jets = more noise = more impact). That is not acceptable, even though it sadly seems to have become the modus operandi to get around the ESA. Appendix E.2-B below is presented by COER's expert consultant who analyzed the NWTT impacts on marbled murrelets. Some additional findings presented in the NWTT BiOp are listed in Appendix E.2-C below.

Before the record of decision is rendered, the NWTT BiOp needs to be combined with the expanded Growler BiOp into a single comprehensive analysis of Navy impacts on marbled mureletts.

Issue 2: The BiOp failed to fully consider the data gaps, as required by national policy (USFWS and NMFS 1998, p. 1-6) and congressional intent [H.R. Conf. Rep. No. 697, 96th Congress, 2nd Session 12 (1979)], that the benefit of the doubt be given to the listed species **in light of uncertainty or data gaps** (see also p. 19952, middle column, of the preamble to the implementing regulations for section 7 of the ESA at 50 CFR 402; 51 FR 19926).

It may be reasonable to treat a relatively stable and healthy or even an improving and responsive listed species with a measure of freedom when dealing with unknowns and uncertainties, but that cannot be said for Washington's endangered unstable, unhealthy, and declining marbled murrelets, or for the nearly extinct southern resident killer whales. These precarious populations demand absolute protection and judicious caution, and therefore much more real attention than has been demonstrated in exercising the benefit-of-doubt requirement by USFWS and the Navy.

Jets can move and do so easily and very quickly. Marbled murrelets cannot move to other places to live and avoid harassment, and certainly not their chicks in the nest. The Navy's intransigent position that the Growlers must all be located at NASWI—that no other place would possibly work—is shallow and disingenuous. If NASWI were to experience a natural event that made it unusable, per Navy position, that would be "IT"—the Growlers simply would be doomed—no place to go. Fact is, a FOIA revealed that the NASWI Growlers conducted nearly 5500 to 8500 FCLP operations annually at various locations from Virginia to California in 2015 to 2017. Given the impetus of necessity, Growler FCLPs can be relocated, in spite of the Navy's not wanting to. Only Navy intransigence and simple convenience stand in the way.

The benefit of doubt in both the Growler EIS and the NWTT EIS has been given to the Navy, when, given the extraordinary data gaps, it should go to the resource. To do otherwise, is cavalier. We and the resource expect more from the USFWS than letting pressure warp their responsibility.

The Ninth Circuit has stated, "w*hen a district court balances the hardships of the public interest against a private interest, the public interest should receive greater weight.*" *F.T.C. v. World Wide Factors, Ltd.*, 882 F.2d 344, 347 (9th Cir. 1989)

COER respectfully suggests that the public interest in this Growler-murrelet debate is both; i.e., the necessity of preserving biodiversity (i.e., protecting our country's endangered species, like the murrelet), but also necessary, national defense. While those two objectives conflict somewhat with each other, fact is, they are far from mutually exclusive. There are solutions, that can accomplish both objectives, but they require thoughtful reasoning and a will to confront reality and do what is necessary. We have the capability and the capacity to redistribute Growlers and in so doing help to preserve the marbled murrelet chances into the future.

Addendum E3: ESA — Other Listed Species

Potentially affected threatened or endangered species discussed in the FEIS (Table 3.8-8) includes 8 marine fish species and two marine mammal species (the humpback whale and Southern Resident killerwhale), as well as 2 listed terrestrial species that occur in the action area.

Section 4.8.3 Biological Resource Conclusion lists eight reasons why the proposed Navy activities would not impact any of those 10 listed species. In the brief 30-day window following

release of the FEIS, COER has only had time to closely examine one of those species, the marbled murrelet, the only one for which a BiOp was prepared.

Given our time constraint, COER's review of the other species is generically based on what we learned from that detailed review on murrelet. What we found, as discussed above, was that the conclusions did not comport with the science presented in the BiOp. In fact, in places it was nearly antithetical to the literature, but most importantly, it overlooked the huge gaps in knowledge, inferring that when science does not have any information to bring to bear, there is no detriment to the species.

As a result of that scientifically dubious reassoning we have no confidence in the veracity of the "no detriment" conclusion on the other terrestrial and marine species.

For example, we found recently that fuel dumping is praticed by NASWI Growlers (NAS WHIDBEY INSTRUCTION 3710.1Y):

> 3.15 FUEL DUMPING. Fuel dumping is to be accomplished at or above 8,000 feet AGL and performed, except in an emergency, under radar control, over water adjacent to Smith Island.
>
> 7.6.5 Fuel Dumping. Fuel dumping shall not be conducted below 8,000 feet AGL. Fuel release in the Coupeville pattern is strictly prohibited unless an emergency situation exists. Whidbey Approach Control shall be advised prior to and upon completion of fuel release.

This Smith Island practice is presumed to occur at great enough elevation to enable evaporation before reaching the sea. However, neither that practice, nor the efficacy of that presumption, was addressed in FEIS. The potential for impact across many species is significant.

And in another recently discovered story, Whidbey News Times reported unexplained releas of firefigting foam and sewage into the marine waters adjacent to Ault Field.

http://www.whidbeynewstimes.com/news/routine-maintenance-reveals-toxic-firefighting-foam-in-base-stormwater/

Levels of PFAS were nearly 2.5 times the EPA safety guideline for humans. The effects on fish and marine mamals are unknown.

These and many other potential impacts related to adding Growlers at NASWI, need far more consideration and are cause for grave concern.

Appendices:
E.2-A to E.2-C

Appendix E.2-A

Washington's Marbled Murrelets:

Can They Withstand More Takings?

This analysis examines the California, Oregon, Washington distinct population segment (or tri-state DPS) for the marbled murrelet as it relates to the Navy's Northwest Training and Testing (NWTT) environmental impact statement and attendant U.S. Fish and Wildlife Service's (USFWS) biological opinion (BiOp). Because the expanded Growler EIS and its BiOp also address Washington (zone 1 and 2) marbled murrelets, the import of this examination applies to those two documents as well.

Two questions are the primary focus: (1) whether the murrelets composing this DPS can withstand any additional takings without risk of population collapse, and (2) whether the putative takings are credible or so speculative that it calls into question USFWS policy to err on the side of caution when confronted by major uncertainties.

The examination is broken into three parts. Part I examines the importance of the tri-state DPS and how the Washington sub-population may affect the viability of the entire DPS. In that regard, it is noteworthy that the State of Washington has listed the state's population, not as threatened, but as endangered. Part II examines the impacts of the NWTT activities on the marbled murrelets in Washington State and teases apart the reasonable knowns from the assumption-heavy speculations. Of additional interest is whether there the most current and applicable scientific literature has been satisfactorily recognized and applied. Finally, Part III examines whether the putative impacts are sufficiently developed to achieve or exceed a modest threshold of scientific credibility.

It is important to begin this examination with a clear understanding that the Service is very concerned about the status of the tri-state DPS status, as explained in the Synthesis of the 5-year review (USFWS 2009, p. 68):

> However, **we remain concerned about the apparent substantial downward trend of the population** and the species' continued vulnerability from a broad range of threats across its entire listed range. Although some threats have been reduced, most continue unabated and **new threats now strain the ability of the murrelet to successfully reproduce**. In summary, if reproductive success continues to be too low to sustain the population, the observed population trends continue to decline significantly and manmade and natural threats continue at current or increased levels, a change in listing status to endangered may be warranted in the future.

It is further important to understand that the status of Washington State's two subpopulations (Zones 1 & 2) is so fragile that Washington has already listed its marbled murrelet subpopulations as endangered. Basically, the DPS is being killed by duck bites, under the misguided logic of what real damage can this one duck bite do

DPS Analysis

Question 1.—*Is the tri-state distinct population segment essential to the survival and recovery of the coastwide species and would the demise of that DPS threaten the survival of the species?*

[Yes.]

In numerous places within the marbled murrelet recovery plan and its 5-year reviews, as well as in its USFWS Biological Opinion for the NWTT (BiOp) environmental impact statement (EIS), USFWS (or the Service) has stipulated that the marbled murrelets in California, Oregon and Washington compose a "distinct population segment" (DPS) that must be protected to assure the species long-term survival, as clearly established in the Service's 5-year review: *"The coterminus United States population of murrelets [i.e., the tri-state DPS] is also considered significant in accordance with the criteria of the DPS Policy, as the loss of this distinct population segment would result in a significant gap in the range of the taxon and the loss of unique genetic characteristics that are significant to the taxon."* (USFWS 2009, p. 12) This is further explained on pages 11 and 12:

> Loss of the DPS would result in a significant gap in the range of the murrelet. This gap is significant because the Washington, Oregon, and California area accounts for roughly 18 percent of the total coastal distribution of the species, encompassing 17 degrees of latitude. In addition, the Washington, Oregon, and California area is located at the southern-most extent of the range. This DPS contains an ecologically distinct forest system, the coastal redwood zone. Citing Noss 1994, Fraser (1999, p. 50), declares that in order to maintain opportunities for speciation and future biodiversity, the conservation of peripheral and disjunct populations is critical. **Recovery of species without the conservation of these peripheral populations may be impossible if these populations are eliminated or severely damaged** (Fraser 1999, p.50).

Question 2.—Are there sub-populations within the tri-state DPS?

[Yes.]

As examined in detail below, FWS clearly considers the six Conservation Zones (Figure 1) composing the tri-state DPS to be "subpopulations," as stated in the BiOp (USFWS 2016, Appendix D, p .6):

> The 1997 *Recovery Plan for the Marbled Murrelet* (USFWS 1997) identified six Conservation Zones…Recovery zones are the functional equivalent of **recovery units** as defined by Service policy (USFWS 1997, p. 115). …For the purposes of consultation, the Service treats each of the Conservation Zones as separate sub-populations of the listed murrelet population.

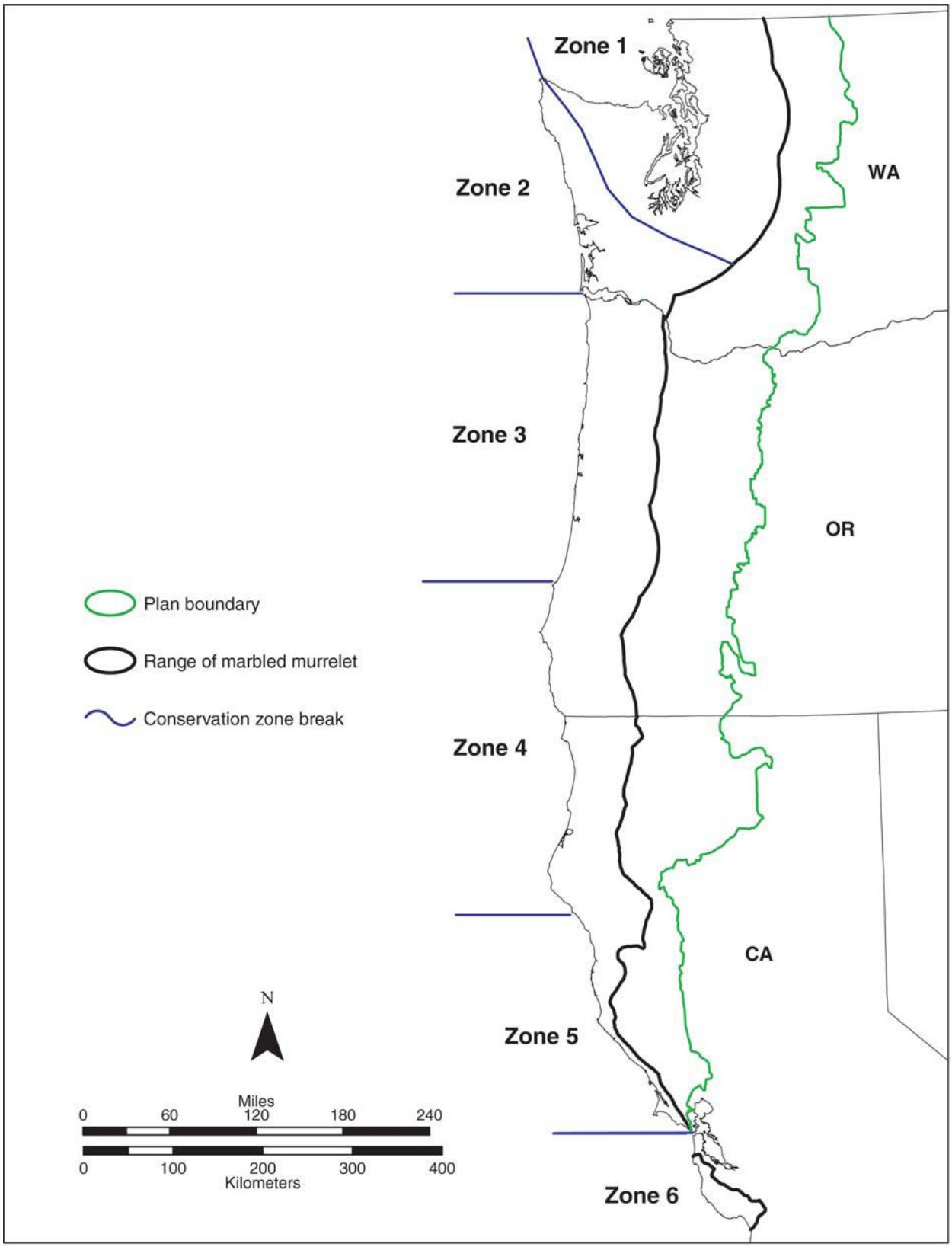

Figure1. Map of the six Conservation Zones (from the BiOp, Figure 6; USFWW 2016, p. 66)

The Endangered Species Act Consultation Handbook[7] (p. xvii) defines *"*recovery units" as *"management subsets of the listed species that need to be identified for recovery management purposes…*[and they] *will be called a 'recovery unit' instead of a 'population'."*

This definition tacitly implies biological importance to the subpopulation unit and a need for discrete monitoring and management. Murrelets in Washington State are split as two subpopulations occupying Zones 1 and 2 (Figure 1), listed by the State of Washington as "endangered" due to their very fragile status.

> **Question 3.—Are the subpopulations essential to the survival and recovery of the tri-state DPS; i.e., is it likely that the demise of one or more sub-populations (zones) would threaten the survival of the tri-state DPS?**

[*Yes*.]

Murrelets are believed to be philopatric, meaning they return to their natal nesting area to nest as adults. This strategy tends to ensure nesting success in the sense that the returning adult obviously fledged successfully from that area and survived to sexual maturity, and hence, it is returning to nest in a tried and proven location. Such a strategy helps reproductive success. It also allows localized adaptations to that particular habitat. Murrelets in Washington, for example, are adapted to commuting a greater sea-to-nest distances than elsewhere (Hamer 1995). So, localized adaptations are important to the overall breeding success.

The five-year review of the marbled murrelet recovery plan states (USFWS 2009, p. 25), *"The current information on murrelet genetics indicates that (1) there is clinal genetic variation in the species from the Aleutian Islands to central California."* That means there are graduated genetic differences between subpopulations north and south reflecting adaption to local north-south habitat differences. Gene flow from small levels of migration in and out across the clines preserves genetic variation. Were spatial gaps to develop (i.e., fragmentation of the distribution), it could thwart gene flow and lead to reproductive isolation and the loss of heterozygosity (genetic variation).

Recognizing these geo-genetic differences, USFWS (2009, p. vi) notes the importance of treating the subpopulations as separate units to provide necessary individualized attention to their unique differences. Under "Actions Needed" the plan lists, "*1. Establish six Marbled Murrelet Conservation Zones…and develop landscape-level management* ***strategies for each Zone****…"*

Population biology is based on the established understanding that healthy populations are not only adapted to their particular environment but that their gene pool contains the sufficient heterozygosity (genetic variation) needed to ensure the species ability to adapt to temporal changes in habitat and environment. As populations dwindle in size, and spatial gaps develop between subpopulations (reproductive isolation), forces such as genetic drift, inbreeding are exerted on the gene pool. Such forces reduce essential genetic variability, which can lead to fixation of alleles (i.e., suppression of heterozygosity).

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7 https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf

Distributional gaps are therefore a concern to species survival. As unequivocally concluded the 5-year review of the marbled murrelet recovery plan (USFWS 2009, p. 12), "*The coterminus United States population of murrelets is also considered significant in accordance with the criteria of the DPS Policy, as the loss of this distinct population segment would result in a significant gap in the range of the taxon and the loss of unique genetic characteristics that are significant to the taxon.*"

Conclusion: Accepting the USFWS concern that the gap created by loss of the tri-state DPS would put the coastal population at risk, it follows that a significant subpopulation gap within the tri-state DPS would similarly put the DPS at risk of collapse, and of course, that could create the domino effect putting the coastwide species at risk.

- The USFWS-recognized and accepted significant downward breeding population trend of Washington's two subpopulations, puts Washington's murrelets in a unique position of concern, not reflected in the Oregon and northern California subpopulations.
- Based largely on the downward population line in Washington, USFWS has expressed concerns that the entire species may need to be reclassified as "endangered" rather than "threatened."

Question 4.—Of the six subpopulations composing the DPS, are the two Washington State sub-populations (Zones 1 and 2) the most fragile and imperiled, and if so, do they need particular emphasis on protection?

[Yes.]

Fragmentation is already evident in the central California (Zone 6) murrelet subpopulation (USFWS 2009, p. 12), but the population there is too small to show a trend. Nevertheless, northern California (Zone 5) is showing a significant downward trend of –9.1% over the most current 10-year evaluation period ending 2013. Washington's marbled murrelets, however, are declining at a far more accelerated rate. Table 2 of Appendix D in the NWTT BiOp reveals that the breeding season densities of marbled murrelets (number/km^2 of sea waters) between 2001 and 2013 have decreased by –32.8% in Zone 1, and by –50.0% in Zone 2, while over the same period, densities increased by 6.2% in Zone 3 (Oregon) and by16.1% in Zone 4 (northern California/southern Oegon). Including the latest 2014 and 2015 survey data, FWS shows in Table 3 (Appendix D, BiOp) that the average rate of decline from 2001 to 2015 has been –5.3% per year in Zone 1 and –2.8% per year in Zone 2, whereas Zones 3 and 4 are stable.

Hence, while the marbled murrelets across the west coast of the U.S. are federally listed as "threatened," Washington State has appropriately listed the Washington's murrelets (zones 1 and 2) as "endangered."

The USFWS attributes much of the murrelet's problems to loss of breeding habitat. Table 4 in the BiOp (Appendix D, page 9) examines loss of that habitat from 1993 to 2012. Zones 1 and 2 lost about 27%, whereas Zones 3 and 4 lost about 25%. That is not a significant difference. Furthermore, Zones 1 and 2 combined have about twice the "*high quality nesting habitat*" of Zone 3 and about 12 times that of Zone 4 (2012 data, Table 1, Appendix D, BiOp). So while the nesting habitat statistics for Zones 1 and 2 are much better than for Zones 3 and 4, the breeding population sizes are the inverse. The most recent (2015) survey estimates are 7494

murrelets for Zones 1 and 2 combined versus 17,584 murrelets for zones 3 and 4 combined (Table 3 of the BiOp).

Nesting habitat, then, by acreage and by percent loss, does not explain the alarming downward trend in Zones 1 and 2, where clearly something(s) else is going on that gravely threatens the future of Washington's murrelets.

As stated in the 2004 and 2009 FWS 5-year reviews of the marbled murrelet, as well as in the NWTT BiOp (Appendix D, page 4-5), USFWS clearly believe that an 18% gap in the distribution of the marbled murrelet is "significant" and would put the species in jeopardy (USFWS 2009, page 12):

> Loss of the DPS would result in a **significant gap** in the range of the murrelet. This gap is significant because the Washington, Oregon, and California area accounts for roughly 18 percent of the total coastal distribution of the species, encompassing 17 degrees of latitude. In addition, the Washington, Oregon, and California area is located at the southern-most extent of the range.

Hence, as viewed by USFWS, loss of the tri-state DPS, representing18% of the total coastal distribution, would create a significant gap. By comparison, note that the Zones 1 and 2 compose 60% of the tri-state DPS total potential nesting habitat (i.e., 1343/2227 from Table 1 of Appendix D of the NWTT BiOp). It follows that loss of Zones 1 and 2, representing about 60% of the tri-state breeding area, would similarly create a major gap in the tri-state DPS, which would put the DPS at grave risk, especially given the existing fragmentation in the tri-state area. Continuing the above quote, USFWS (2009, page 12) goes on to state:

> This DPS contains an ecologically distinct forest system, the coastal redwood zone. Citing Noss 1994, Fraser (1999, p. 50), declares that in order to maintain opportunities for speciation and future biodiversity, the conservation of peripheral and disjunct populations is critical. Recovery of species without the conservation of these peripheral populations may be impossible if these populations are eliminated or severely damaged (Fraser 1999, p.50)…
>
> Conclusion: We consider the Washington, Oregon, and California population of murrelets to be a valid distinct population segment under the 1996 DPS Policy. This population of murrelets is discrete based on differences in conservation status, management of habitat, and regulatory mechanisms between the United States and Canada that would result without the Federal protective measures afforded by the Endangered Species Act in the United States. The coterminus United States population of murrelets is also considered significant in accordance with the criteria of the DPS Policy, as the **loss of this distinct population segment would result in a significant gap in the range of the taxon and the loss of unique genetic characteristics that are significant to the taxon.**

Geographic gaps in distribution within the DPS, if manifested, would impede gene flow essential to protecting genetic variability. It follows, then, that extirpation or functional extirpation[8] of Washington's subpopulations could create a geographic gap within the tri-state

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DPS that could threaten the entire DPS, as stated in USFWS (2009, page 25), *"… it is reasonable to expect that additional fragmentation could isolate remaining populations genetically and demographically, ultimately increasing the risk of local extinctions (Peery et al. in press, p.19)."*

Nest success rates[9] (BiOp, Appendix D, p. 11) in northwest Washington was documented at just 0.20—i.e., 2 chicks fledging from 10 nest starts (Bloxton and Raphael 2005, p. 5). In central California, it was 0.16 (Peery et al. 2004, p. 1098), and in northern California it was 0.31 to 0.56 (Hebert and Golightly 2006, p. 95). No studies Oregon were available.

Furthermore, the Service (BiOp, Appendix D, p. 12) expresses concern that the current estimates for murrelet juvenile ratios[10] (**Ŕ)** *"appear to be well below what may have occurred prior to the murrelet population decline (Beissinger and Peery 2007, p. 298)…Therefore, the best available scientific information … indicates that the murrelet reproductive rate is generally insufficient to maintain stable population numbers throughout all or portions of the species' listed range.*" And in regard to Washington's two subpopulations, BiOp further reaches this conclusion:

> Considering the best available data on abundance, distribution, population trend, and the low reproductive success of the species, the Service concludes the murrelet population within the Washington portion of its listed range currently has little or no capability to self-regulate, as indicated by the significant, annual decline in abundance the species is currently undergoing in Conservation Zones 1 and 2.

Conclusion: Washington murrelets are at grave risk of actual or functional extirpation, which would create an extensive gap within the tri-state DPS and threaten its future viability, let alone, recovery. Clearly there is a need for much more aggressive protection measures in Zones 1 and 2.

Question 5.— Do the NWTT exercises in Washington create a more potent threat to Zone 1 and 2 murrelets than presumed by the NWTT BiOp?

[Yes]

Even though the Service declared a need to "*develop landscape-level management strategies for each Zone,"* in the final analysis it failed to honor that and treated the tri-state DPS as an aggregated whole. That is, instead of examining the tensile strength of each link in the chain, it focused on the average of all the links and thereby masked the weak link—i.e., Zones 1 and

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As used here, functional extirpation refers to a population reproductive threshold that once crossed below, the species or population may not be able to recover from and reestablish its historic population levels but manages to exist indefinitely in a crippled state.

9 Nest success is the annual number of known hatchlings departing from the nest (fledging) divided by the number of nest starts.

10 The juvenile ratio (**Ŕ**) is calculated from marine survey data of the total number of 1-year old murrelets enumerated divided by the tally of all murrelets older than age 1.

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2—with stronger links (Zones 3-5) that mask the problems in those two zones. That mistaken inattention to Zone 1 and 2 landscape-level differences, thereby discounts the impacts exerted by the NWTT and opens the door to extirpation of Zone 1 and 2 murrelets, which ultimately threatens the entire tri-state DPS.

That oversight is examined further in Parts II and III, specifically the potentials for damage to the marbled murrelets imposed by the NWTT exercises, whether they were adequately addressed by the NWTT BiOp, and to what extent the important USFWS policy of erring on the conservative side of caution has been actually applied or disregarded.

Appendix E.2-B

Navy's Northwest Training and Testing EIS: An Analysis of the Biological Opinion and Impacts on Marbled Murrelets

Dr. Robert Dillinger [11]
November 27, 2018

1.—Overview

This reviews the Biological Opinion (BiOp) for the Navy's Northwest Training and Testing Environmental Impact Statement (EIS). The critical element issued by the U.S. Fish and Wildlife Service (USFWS) in that BiOp is the incidental take permit--indeed, it is the ONLY reason for preparing the BiOp. The USFWS assumes this take will only consist of harassment of sub-adult and adult birds by the activities of the Navy, which is indeed take, but will not result in direct mortality. The fact this is a rapidly declining population (the small amount of surveys, and demographic evidence and modeling confirms this), heading dramatically and seemingly inexorably, toward extinction, appears to have little bearing on this decision. This is done despite the whole point of the Endangered Species Act being to prevent such things from occurring.

The USFWS has identified a number of areas in which, or from which, take may occur, and it has attempted to demonstrate how this take will have no negative impact on the population. These problems are delineated and examined in detail below. The USFWS has either failed to provide evidence supporting their claim, critically examine the assumptions they use to support their finding, or they just outright ignore the substantial scientific evidence that argues against their

[11] Dr. Dillinger's qualifications are listed in Appendix A below.

contentions. They fail to consider the true extent of the harm and what allowing any take at all to this population does to its existence, much less its future recovery. This recovery is the responsibility of the USFWS, under law. They acknowledge areas necessary for this recovery, but then fail to prevent actions in these very areas that contribute toward the continued jeopardy of extinction in marbled murrelets.

2.—Habituation

Navy assumes species present in the study area are habituated to noise. [EIS Appendix page A-194, EIS page 4-205] Murrelets are included in this assumption. [EIS page 5-22]. Noise from aircraft landing and takeoff may cause cumulative wear and tear on individual murrelets, causing avoidance of continued exposure or stress through changes in heart rate, blood pressure, and gastrointestinal activity. Navy assumes the birds habituated to noise. [Biological Assessment (BA) page 4-4]

Research into the effects of aircraft disturbances on marbled murrelets is limited. One study found murrelets in marine waters decreased in response to increasing numbers of boats and low-flying planes. EIS page 4-209.
Navy cautions that it is difficult to generalize animal responses to noise or draw inferences across species since reactions to aircraft appear to be species specific. EIS Appendix, page A-194.

Low flying aircraft may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests. EIS Appendix page A-188, BiOp pages 206-207.

The action area is within the zone designated by FWS in the Recovery Plan for the Marbled Murrelet. BA page 4-1.

The USFWS claims, in its BiOp, that marbled murrelets “habituate” to

noises and disturbance. Habituation is defined by USFWS as “the waning of a preexisting response as a result of repeated stimulation when the stimulation is not followed by any kind of reward or punishment (i.e., reinforcement).” Welty (1982) the citation used for the definition is an ornithology textbook. The definition is a bit simplistic, but adequate.

The claim then is based on observations of murrelets in the area, allowing the presumption that since the Navy has been doing things for decades, and the birds remain, this must mean they are habituated. Their claim is also based on an environmental consutant’s (Hamer Environmental 2009, cited in the BiOp) observations of murrelets in the vicinity of a pile-driving operation. The observations consist of birds being initially startled, but then returning to the site, and or the diminishing of flight behavior (e.g. flushing) or flight initiation distances (FID).

A further claim is the absence of any response is therefore an absence of deleterious behavior, apart from perhaps the initial flushing activity. A somewhat cursory examination of the literature demonstrates a lack of understanding of how to determine habituation, and a highly flawed interpretation of its outcomes. Therefore, **the USFWS presumes murrelets will habituate, and habituation has no effect on lifetime reproductive output—a key consideration in determining murrelet population dynamics and long-term species survival. They further presume that the short-term effects are negligible at most.**

The flaws in these claims and assumptions are examined in order.

2.1—Habituation Claim Not Warranted

Claim 1: USFWS definition of habituation, “the waning of a preexisting response as a result of repeated stimulation when the stimulation is not followed by any kind of reward or punishment (i.e., reinforcement).” A review published by Blumstein (2014), asserts that habituation can really only be determined using marked animals. This has not been done, either by the Navy/USFWS or in the earlier Hamer

Environmental study cited as evidence. There is no way to determine whether arrivals after the disturbance were returnees, or new immigrants. Furthermore, there is no documentation of how long the murrelets are displaced and how frequently they would be flushed.

2.2—Habituation Data Lacking

Claim 2: Numbers pre- and post-disturbance support the contention of no effect. The statement the Navy has been doing "things" in the area for the decades and therefore the birds have habituated and are likely suffering no harm is specious. Under that same unscientific logic, since the Navy has been doing things for decades in the area and over that period and location the murrelets have shown a steady decline, the conclusion should be Navy is causing them harm and has effected the decline. Whether there is an actual causal relation is unresolved, so it is scientifically inappropriate to assume one or the other.

2.3—Habituation Conclusion Unsubstantiated

Claim 3: Habituation has ensured no effect on lifetime reproductive output. The assessment of the diminution of flushing behavior with repeated stimuli, as occurring, or being beneficial is also wrong. Numerous studies have shown the birds that remain in place, or return quickly to the site of disturbance, do so because they have no better place to go, and they have been shown to be the birds in the poorest condition (Smit andVisser1993, Stillman and Goss-Custard 2001, Swart 2000, Beale and Monaghan 2004, Goss-Custard et al. 2006, Gill 2007, Yasue et al. 2008, Rutten et al. 2010). This suggests the murrelets considered "habituated" to disturbance are, most likely, those in the worst condition who can't afford any more disturbances. Gill et al. (2001) suggest it is very important to NOT assume no population-related problems simply because no apparent response was noted.

Smit and Visser (1993) suggest birds displaced may have to feed in

higher densities than is typical , which could result in increased competition and decreased food intake (see also Goss-Custard1980, Swart 1980). Studies supplementing the food supplies of some birds, while not others, have demonstrated the better-fed birds left the area after the disturbance (Beale and Monaghan 2004).

Shock or disturbance has been shown to result in the cessation of feeding, decreased foraging (Yasue et al. 2008, Rutten et al. 2010), or dropping of food. USFWS admits this in their text, but then appears to deny it will happen in the next paragraph. While most of the studies have been done on foraging shorebirds, murrelets approached by boats have been shown to swallow or drop their food (Speckman et al. 2004,). Agness et al. (2008, 2013) suggest fish-holding birds do not fly until they are ready to return to the nest to feed their young. Therefore, they should not be expected to "flush" when approached, especially when holding fish. But they can drop their fish. Or swallow them. Either way, it is a loss to the nestling.

Any loss of food by a breeding murrelet should be considered significant. Murrelets only feed two times a day (after dawn and before twilight) so the loss of food likely means the bird will be unable to feed again, and the chick has lost a significant portion of its daily ration. This does not include the effect on the adult doing the feeding (Speckman 204). Agness (2008, 2013) documents and models the loss of energy associated with murrelets flushing from foraging areas and suggest this is critical, and a real energetic problem for the birds. This is yet another of those sub-lethal effects the USFWS downplays that, as will be demonstrated below (see discussions on demographic responses and forage fish), plays a crucial role in long-term reproductive output and juvenile recruitment into the breeding population.

Iterative suboptimal daily feeding rates impact nestling success and consequentially, the population's lifetime reproductive output. Fledgling survival to reproductive recruit and into peak breeding years is the critical element affecting the long-term reproductive health of the population.

Losses of chicks have a detrimental outcome on the population dynamics of marbled murrelets by reducing or eliminating year-classes (Cam et al. 2003, Peery et al 2004). These demographic holes (low numbers for that recruitment year) mean, as a weak year-class passes through its life cycle and is subjected to the mortality rates typical of a sustaining population, the number of birds reaching peak breeding years will be further decreased. That means continued reduced recruitment from this diminished breeding year-class because fewer birds remain. Hence, density-independent factors further suppress recruitment. This year-class hole is a self-reinforcing negative spiral toward extinction.

This also has a negative impact on the individual breeding female's lifetime reproductive output—a metric the USFWS has defined as critical to the survival of the species. In other long-lived, reproduction-rate limited birds (highly specialized life history strategy) the loss of a single female has been shown to have a devastating outcome on the population dynamics of the species (Mattson et al. 2008).

For murrelets that do remain in areas of naval disturbance and appear therefore to be habituated, there may be indirect affects on feeding and vigor related to stress. For example, of 157 radio-tagged in Washington State water, only 20 individuals (12.7%) attempted to breed; the authors estimated breeding propensity (i.e., the proportion of sexually mature females that initiate egg production) was 13.1–20.0%. This is the lowest breeding propensity reported for a population of murrelets to date. <http://onlinelibrary.wiley.com/doi/10.1002/jwmg.21192/abstract;jsessionid=09A11ECFBF8A2554C907E2BCEB84F296.f04t01>

The authors suggested the cause was "poor-quality marine habitat" in Washington compared with other parts of the murrelet's range." Harassment and its related stress for birds that do remain in the area could well be a part of the marine environment contributing to this lowest propensity level.

3.0. Hearing Damage from Loud Noises

These are some of the problems associated with the USFWS analysis on the effects of hearing damage resulting from explosions and other loud noises. In their assessment of potential take of marbled murrelets, the USFWS contends any actual physical damage associated with explosions or other loud noises will be temporary, lasting only a matter of days, and will have no impact on either short-term or long-term survival and/or reproductive output.

The BiOp assumes outlines a number of scenarios for the production of loud noises in the vicinity of marbled murrelets. They eliminate the effect of F-18 takeoff noise by discussing the dBAs associated with it and the amplitude of the sound (slow onset to peak, gradual return). They assume 92 dBAs as the threshold above which significant disruption to murrelets would occur, defining significant as flushing or failed feeding. They did not undertake any organized, detailed systematic observation of this.

The USFWS cited Yelverton et al. 1973, 1981 for their blast criteria. However, their mortality estimates seem low and there was no discussion of sub-lethal effects, which could lead to mortalities not realized by Yelverton due to temporal (the short period of the study relative to the lifetime of the birds used) or logistical study limitations.

The USFWS assumed a linear relationship between sound injury and body size, but the evidence presented is insufficient for such a claim. Issues of scale, as they relate to the size of the organisms are critical.

The only effect USFWS assumes is inner ear damage—no vertigo—but provides no reference for this assumption. Vertigo would be extremely serious for both a foraging individual and one attempting to return to the nest with food for its nestling. As discussed in Section 2.3, the loss of even one day's feeding is likely critical to a nestling fledging for its short-term survival, which if diminished, has consequential reductions on the population's lifetime reproductive output. Fledgling survival to reproductive recruit and into peak

breeding years is the critical element affecting the long-term reproductive health of the population.

USFWS consistently understates impacts of sub-lethal effects. They assume the birds won't die later, or these sub-lethal effects won't seriously impact reproductive fitness. They present no evidence for this, merely hopeful thinking.

The USFWS use of budgies as a surrogate for murrelets in the assessment of hearing damage (inner ear) and recovery is highly questionable. The use of surrogates in ecological risk assessment has been well-established in USEPA's Ecological Risk Analysis, but the activity requires definitive and quantitative statement of uncertainties associated with the surrogate in question. The greater the phylogenetic difference (i.e., the genetic dissimilarity), the higher the uncertainties, and the more caution must be used in interpreting the results and applying them to the species of interest (Suter 2006, 2008). The ecological literature is casts considerable hesitation and distrust over the use of surrogate species (Caro and Doherty 1999, Adelman and Fagan 2000, Munns 2006, Banks et al. 2000, Banks et al. 2014).

These problems with the USFWS analysis negate their contentions that any hearing loss caused by explosions and other loud noises presents no problem for marbled murrelets, either in the short- or long-term. To simply treat the lack of evidence as justification to conclude that no problem exists compounds the already existing high levels of uncertainty surrounding the duration, magnitude, and intensity of the problems already caused. Again, the agency is stacking up unknown sub-lethal problems (more fully discussed in the section below on Demographics), which tend to present themselves by diminishing lifetime reproductive output, and assuming these won't contribute to increased jeopardy of murrelet population extinction. Without long-term demographic analyses of the affected population, these sublethal effects can simply be ignored, despite having a significant role iin the long-term viability of the population. This

attempted “segmentation” of outcomes and effects has no basis in biological fact, and the USFWS fails to provide any evidence supporting it. Segmentation is the consideration of problems caused by actions only as individual effects and not as cumulative effects.

3.—Direct Losses

3.1—Surveys to Identify Losses

Direct losses can have a huge impact on the lifetime reproductive output of the marbled murrelet population, a bird both rare and secretive. So, valid measures of Naval testing impacts, using appropriate survey techniques are critical (Stauffer et a. 2002, Gancy et al. 2004, MacKenzie et al. 2004, McDonald 2004, O’Shea 2004, Peterson and Bayley 2004, MacKenzie and Roitle 2005, Peterson and Bayley 2004, Bigger et al. 2006, Wilson et al. 2011, Lorenz et al. 2017, Thaxter et al. 2017). Assessment of direct mabled murrelet mortalities requires survey procedures and intensities beyond the scope and protocols established by the Pacific Seabird Group (PSG).

In addition, any and all surveys need to be done by trained AND experienced observers to be effective and credible. Typically, the trainers aren’t doing the surveys, so they are done, at best by, individuals with no experience other than a short period of training, or worse, no trained at all. Such inadequacies to identify murrelet mortality in the region of Navy testing creates significant uncertainties for the USFWS conclusions on impacts.

3.2.—Airstrike Losses

The BiOp claims no direct losses from aircraft strikes. Again, these are direct mortality losses to the population, removing them from the breeding population. In a healthy population, this would perhaps be a problem, but under density-dependent population regulation,

compensatory mortality occurs, and this mortality is compensated for by mortality from another source. That in essence, keeps the mortality factors balanced and in check leading to homeostasis (i.e, constancy). In a steeply declining population, this compensatory mortality does not occur. Instead the mortality becomes depensatory, such that thepopulation mortality rate increases as the size of the population decreases. This can be effected byfactors such as difficulty in finding mates and reduced egg production or survival of young).

No evidence concerning bird strikes by aircraft or, for that matter, vessels, is provided in the BiOp, and no surveys are noted to look for dead or injured birds that might be attributed to any of the Naval operations. The single reference provided is a personal communication from someone in the Navy. In addition, the Navy provided the FWS with approximately three years of site specific Bird Aircraft Strike Hazard data (2008 to 2010) for Whidbey Island where Ault Field and OLF Coupeville are located and no murrelets were detected among the 63 recorded strikes (John Mosher, U.S. Navy, pers. comm., 2010).

This is highly insufficient evidence. Documentation of search protocols and results, and identification of the bird involved in the collision needs to be provided.

However, information obtained via the Freedom of Information Act provides some insights. Navy data for Prowlers and Growlers stationed at Naval Air Station Whidbey Island cataloged a total of 133 bird aircraft strike hazard (BASH) events between June 26, 2001, and September 6, 2013 (Appendix B). Hardly any birds were taxonomically identified to family level, let alone species. Note, this BASH number is minimal because strikes go unrealized by the crew (e.g., see 4/19/12 in Appendix B) or can otherwise undetected by ground crew. The BA (page 4-2) confirms that murrelets are at risk for bird strikes with planes and that 275 bird strikes occurred between 2005 and 2015 at Whidbey Island. They further confirm that the actual number is likely higher since only an estimated 20% to 47% of bird strikes are

reported, and collisions with small birds may go unnoticed [DEIS pages 4-212 and 4-213]. Bird strikes included 153 unknown birds and 108 songbirds, raptors, and shorebirds [DEIS page 4-213, footnote 24]. The impacts on murrelets may be modest taken alone, but when added in with all the other taking potentials, clearly no take should be discounted, whether small or large, especially for a small population whose numbers are in significant decline.

3.3 —Explosion-Related Mortality

The BiOp fails to consider mortality from explosive-induced concussion. Again, no evidence is presented and no surveys have been done. Anecdotal reports of regular discoveries of numbers of dead adult murrelets found on local beaches suggest “at-sea” mortality is indeed occurring. While there is no question that all organisms die, the fact that numbers well above a single bird are discovered at one time, suggest that mortality above that expected in a “healthy” population may be occurring. Mortality clusters on beaches are particularly significant because they would indicate a very constrained geographic event as causing the mortality.

Even the mortality expected in a population undergoing density-dependent regulation gets replaced with compensatory mortality. In a declining population with depensatory mortality (i.e., population mortality rate that increases as the size of the population decreases as effected by, e.g., difficulty in finding mates and reduced egg production or survival of young), not only is this “expected” mortality not replaced, but the added anthropogenically caused mortality serves to drive the population toward extinction at a faster rate (Tilman et al. 1994, Liermann and Hilborn 2001, Hanski and Ovaskainen 2002, Irwin et al. 2009, Jackson and Tree 2010)

5.—Demographic Responses

The most critical questions relate to demographic responses. All other question feed into this. Every sub-lethal condition, all the questions,

and all the assumptions made by the USFWS, ultimately have their impact here. The following assertions by the USFWS are problematic.

1. The USFWS states marbled murrelets are highly constrained by poor fecundity (page 128 and following). Murrelet life history has evolved with the birds producing a single, large egg, laid in the crotch of a tree, or as is the case in the Aleutians and other places where trees are not around, on the ground (Nelson 1997). This highly specialized reproduction strategy met the species survival needs in its historically stable environment, but it does not serve it well under a fast-changing environment that provides too little time for adaptation. Because murrelets evolved narrowly to survive effectively with high, but not extremely high juvenile/young adult mortality, their life history strategy was particularly vulnerable to changes impacting that strategy.

Peery et al. (2004) suggest strongly that murrelet populations require a fecundity rate range of 0.20 to 0.46, and a juvenile survival rate of 0.18 to 0.28 to be stable, according to existing population models. Increasing the population in the face of instability caused by anthropogenic activities requires addressing this mortality issue, as the murrelets at this point are quite likely typically energetically constrained to producing a single egg, especially with a forage base reduced by anthropogenic activities (see Tranquilla et al. 2003, below).
http://www.sfu.ca/biology/wildberg/bertram/mamurt/research.htm

2. The USFWS use the single egg laid by murrelets as a reason why any small losses cannot be made up by natural reproduction, and justify allowing take because of this (BiOp Appendix B, P 13). This is may well be true (but also see Tranqulla et al. 2003 below), but there are other ways of increasing population size. Increasing recruitment of young into the breeding population is an excellent way to do so under the constraints on natural reproduction stated by the USFWS above. This means increased

survival, which could be related to nest predation, or increased success of adult feeding efforts. If due to disturbance, birds are swallowing, or dropping food for chicks, or foraging less, this will eventually have an effect on survival and recruitment.

Tranquilla et al. (2003) have documented what appears to be evidence of repeated egg laying, or re-nesting, in marbled murrelets, if conditions are appropriate. This suggests at least the possibility of a greater capacity to respond to loss of the initial egg, and produce a "best-case scenario" range of 13-63% re-nesting, although they only found one bird certain to have re-nested and two others as strong possibilities. They used three different techniques, radio-telemetry, egg production (elevated levels of vitellogenin in blood samples), and production of a brood patch) to produce this ratio. While highly interesting, the use of indirect measurements such as these on birds only caught a single time, are somewhat speculative as to the actual incidence of re-nesting. The authors are quite open about the uncertainties in their study.

This could mean improvements in murrelet fecundity are possible, but it is imperative the conditions that created the loss in the first place are no longer present, or the re-nesting will also fail, causing an even greater loss of lifetime reproductive output in the nesting female. The amount of energy required to re-nest and successfully fledge a young birds is quite high in murrelets.

3. The USFWS uses the theory of fixed versus flexible response to food limitations, to justify murrelet low recruitment, based on a study by Ronconi and Burger (2008) (P. 110 and following). That is, Ronconi and Burger (2008) concluded low recruitment was due to the inability of murrelets to switch to alternative food sources when the preferred source is limited. That declaration, however, was at best premature because they had only three years of murrelet data. During this time, one year had high levels of food food-fish abundance in the foraging areas, and no data existed on the other two years for at least one preferred food species. There was also no indication that

switching to alternate prey species was not done, or was unsuccessful. Really, Ronconi and Burger were presenting a hypothesis in need of much greater evaluation, not establishing a theoretical construct.

4. USFWS states there is no measurable reduction in murrelet annual reproductive output (P 132). No evidence of this is presented. The USFWS has not conducted studies of breeding success and population size to support this claim, nor do they cite any scientific literature in its support. If this was indeed the case, and adult survival continued to be high, the population should increase. Instead, it is far more likely the population of birds at their peak breeding potential continues to decline, as older birds senesce out of their peak, and fewer young recruit into the peak breeding population. This is a trend that will continue until the recruitment of juveniles increases and the age structure becomes more stable. At that point slight population increases will begin and the population will be regulated by density-dependent factors, and mortality will become compensatory (i.e, survival increases as the population size increases) rather than depensatory. Peery et al. (2004) suggest strongly that murrelet populations require a fecundity rate range of .20 to .46, and a juvenile survival rate of 0.18 to 0.28 to be stable, according to existing population models. Currently, juvenile survival rates range from 0.01 to 0.09 (Beissinger and Nur 1997). Fecundity rates are for the population as a whole. This rate is the number of female young produced per female of breeding age. This includes more successful older birds, and a lower rate for unsuccessful younger birds, as well as any mortality associated with the eggs themselves. Juvenile survival is calculated from at-sea surveys of birds that have not fledged and includes all birds below three years of age-the age of first breeding. Also it includes nest mortality.

5. USFWS assumes all birds 3+ years old are equally successful breeders and equally represented (i.e., each age-class has the same reproductive rate) in population. (BiOp Appendix B, P. 7 and following). No data exists to support this contention/assumption.

Again, the USFWS has failed to conduct any research to support this contention, nor do they cite any population studies substantiating this claim. Breeding in birds is known to have an experience quotient associated with it, and so the older birds tend to be more successful breeders (Hamer and Furness 1991; Weimerskirch 1990, 1992; Pinaud and Weimerskirch 2002; De Forest and Gaston 1996; Sanz-Aguilar et al. 2009).

Also, as the birds get older, senescence becomes a problem. As mentioned above, the extremely low, or even lack of recruitment of juvenile murrelets into the peak breeding years means the population will continue to age, and its reproductive output to decline (Catry 2006, Rebke et al. 2010, Bowhuis et al. 2012, Kvalnes et al. 2016). The older the population, the more food and nesting resources get concentrated into birds whose reproductive output is below peak, and getting worse (Homes and Austad 1995, Vieck et al. 2007, Reed et al. 2008, Ricklefs 2008, Hammers et al. 2012, Patrick and Weimerskirch 2014). The population will therefore continue to decline until this severe imbalance in the survival rates and diminished recruitment are addressed.

6. USFWS assumes abundance of females is high. No sex ratio data are presented. As cited earlier, the USFWS presents no data in support of this, nor do any scientific studies confirm this contention. The surveys conducted by the Washington Department of Fish and Game do not seem to produce a sex ratio. This ratio is crucial, especially in the recruiting classes (I.e., those becoming of reproductive age), which are not counted at all.

7. The USFWS discounts impacts of sublethal effects on demographics, and ignores the role of depensatory mortality on the marbled murrelet population (P 131-2)

Sublethal effects such as depressed lifetime reproductive output from effects on longevity or annual reproduction may be a main contributor to the current decline of the marbled murrelets. These need to be better understood in order to fully evaluate the effects of permitting a

level of incidental take associated with the Navy’s activities.

Sublethal effects are caused by changes in the lifetime reproductive output of individuals, or changes in birth and death rates of a population due to changes in physical physiological condition, food supply, changes in habitat conditions, or displacement to less-suitable habitat. Negative impacts from displacement include low reproductive rates, high levels of energy expenditure, and decreased nestling survival and juvenile fitness. (Divoky and Horton 1995) (Hull et al. 2001) (Patton and Kelly 2010) (Becker and Beissinger 2006) (Ronconi and Burger 2008) (Gutowsky et al. 2009) (Janssen et al. 2009) (Beissinger and Peery 2007).

Sublethal effects are not immediate, but their influence on lifetime reproductive output of a species may be enough to cause extinction (Loehle et al. 1996, Hanski and Ovaskainen 2002, Schloepfer et al. 2002, Tilman et al. 2002, Bulman et al. 2007, Jackson and Sax 2009, Kuusari et al. 2009). Because of the significant time lag, populations may decline considerably before standard survey methods can detect the effects of a specific action. (Boulanger 1999). This is known as extinction debt and has been implicated in a number of historical extinctions.

Sublethal effects that impact the marbled murrelet's lifetime reproductive output must be better understood to assess the effects of the Navy’s activities and the USFWS' permitting action to avoid jeopardizing the marbled murrelet. These should have been undertaken prior to issuing the incidental take permit.

Prior to issuing an Incidental Take Permit (ITP), the USFWS should have modeled the affected population using both Leslie Matrix population models and Population Viability Analysis in order to predict the impact of the loss of even a single bird (Beissinger 1995, Boulanger 1999, Cam et al. 2003, Steventon et al. 2006, Beissinger and Westphal 1998). An ITP is the major, if not sole, purpose of the BiOp. Incidental take is allowed under section 9 of the Endangered Species Act, which in Section 4 (I believe) prohibits take, which has a broad, all-encompassing definition far exceeding actual mortality.

Take can however, be classified as incidental' to the survival of the species/population unit. The ITP lists the conditions under which take can occur and the amount of individuals allowed to be "taken". This is the vitally important Reasonable and Prudent Measures, or Terms and Condition in the BiOps, under whichthe permit is valid. It lists out what the permittee must do to avoid non-incidental take, and to confirm it is abiding by the permit and only committing "incidental take." Not complying with these conditions invalidates the permit. A crucial point is the allowed incidental take cannot cause the population to move from threatened to endangered, or endangered to extinct.

Furthermore, despite any future effort to mitigate impacts of the Navy's activities, it is likely that the marbled murrelet population will continue to diminish due to a depensatory mortality response, in which a population in decline exhibits increasing mortality rates (Liermann and Hilborn 2001). This response can occur in populations below a threshold size due to a combination of factors including depressed reproductive rates and consistent predation. (Liermann and Hilborn 2001).

Under these circumstances, the population often fails to show any positive growth associated following a decrease in factors contributing to mortality (Liermann and Hilborn 2001). When a population reaches this threshold size, it loses the capability to compensate for loss by increasing reproduction, and any mortality serves to drive the population numbers lower (Saether and Bakke 2000, Saether et al. 2004) (Liermann and Hilborn 2001) (Peery et al. 2004) (Irving et al. 2009). Therefore, any additional mortality becomes depensatory, not compensatory, and adds to the decline (Liermann and Hilborn 2001).

Finally, little is presently known about predation rates on existing marbled murrelet populations. Studies have documented an increase in corvid (crow and jay family, which prey on murrelet nests) nesting and predation on marbled murrelets following fragmentation of habitat. (Nelson and Hamer 1995, Burger et al. 2004, Zharikov et al. 2206, 2007a,b, Burger and Page 2007, Burger and Waterhouse 2009, Malt and Lenk 2009). Other predators have also been shown to increase

predation rates on murrelet nests following habitat fragmentation (Burger et al. 2004). Information on increased mortality rates resulting from predation needs to be gathered and incorporated into the population modeling because increases in predation rate become depensatory. Statements concerning population mortality becoming density-independent because of low densities only serve to demonstrate a profound lack of understanding of population regulation, and obfuscate comprehension of the problem.

8. USFWS states any incremental reductions in future (lifetime) reproductive rate are not detectable (P 131-2). No assessment of population age structure and age-specific reproductive rates is presented, so this putative reduction is, at best, speculative and not or credible. Nevertheless, this type of demographic information has been demonstrated to be crucial in the assessment of population status and future trends (Adams et al. 2007, Beissinger and Peery 2007, Peery et al. 2007).

9. The USFWS did not project any increased juvenile mortality occurring as the result of direct mortality, or through sub-lethal mechanisms through the entire population life cycle (P 104-107). This is crucial. Given the extremely low apparent juvenile recruitment occurring (lowest in the Salish Sea zone), this puts the majority of the recruitment on the middle of the age distribution, always known to be the most “fecund” and successful, i.e., the most experienced breeders. Even given the low mortalities associated with murrelet adults, in the absence of density-independent factors such as weather, aircraft strikes, explosive concussion, etc., this means the number of successful breeders will continue to decline, as the core group senses, and are not replaced by maturing juveniles. This is clearly an “extinction debt,” meaning the population is definitely declining, but the number of adult individuals will still seem high, right up until the population falls off a cliff (Stephens and Sutherland 1999, McLellan et al. 2010, Schlaepfer et al. 2001, Jackson and Sax 2010, Mosquet et al. 2011, Jeffres and Moyle 2012).

The solution to this is to decrease juvenile mortality, such that the age distribution becomes stable, with a more typical recruitment into the productive age-classes (Beissinger and Nur 1997, Peery et al. 2004). Unfortunately, this takes time, and the population is likely, in the case of marbled murrelets, to decline to dangerous levels. Currently, mortality is such that it is no longer compensatory, as would happen in a more robust population under density-dependent population growth, but instead is depensatory, which does nothing to increase juvenile survival, but instead drive the population even lower. Mattson et al. (2008) demonstrate how the loss of even a single breeding female could have a dramatic effect on the demographics of a small population.

10. Curiously, USFWS states the problems with murrelet population growth are low "fecundity" and anthropogenic mortality (BiOp Appendix B, Page 1). Nevertheless they allow incidental take, which has, as its components, both of these things. These are the factors that result in decreased juvenile recruitment—i.e., direct mortality, and loss of feeding opportunities by adults. Other factors include loss of nestlings through increased nest predation brought about by human presence, or through startling of adults at the nest, causing abandonment.

Evidence from other long-lived populations suggests that population growth is less sensitive to changes in fecundity than in survival (Stearns 1992; Heppell et al. 2000, Sæther & Bakke 2000, Cam et al. 2003). This is not to say changes in productivity have no effect, just that it is short-sighted to base recovery strictly on them, while ignoring a factor widely considered the most important in long-lived species-survival.

11. The USFWS cites models concluding adult mortality is the driving force in determining marbled murrelet population size (P72, P 127 and following, P. 133). These models have shown the largest influence on marbled murrelet populations to be adult mortality, followed by juvenile mortality (Beissinger 1995, Beissinger and Nur

1997, Boulanger et al. 1999, Beissinger and Westphal 1998, Cam et al. 2003). This is not surprising because murrelets are long-lived and appear to have always had low recruitment of nestlings (Beissinger and Peery 2007). Furthermore, populations of long-lived species typically aren't as sensitive to fecundity-based parameters (Stearns 1992, Cam et al. 2003). This does not argue against juvenile recruitment into the breeding population as the key factor, however, because the data these models are based on do not separate the population into age-classes or use age-specific fecundity. At some point, the numbers of individuals in the older, more senescent age-classes become predominant, and population size drops as a result.

There are serious problems with all these assumptions. There are serious problems associated with their data sources (the surveys and estimated populations). Surveys were only done twice yearly, and now they have been changed to every other year. It is difficult enough to deduce trends when the surveys are yearly, given the presence of British Columbia birds that do not recruit into the Washington populations (Pearson et al 2014). Also, the large confidence intervals associated with a small number of samples create a serious problem. The tendency is to accept the mean, but in the presence of low population numbers, and high variability, it is far more prudent to consider the lower confidence level for management purposed —i.e, to do what USFWS says it does and err of the side of caution: "*If there is uncertainty about the proposed action or the biology of the species, we err on the side of the species when conducting our exposure analyses*" [BiOp Appendix A, page 1]. More surveys, not less, would clarify this. A small number of samples also allows a single survey year to have an inordinate effect on trend analysis. For instance, a single year's atypically high population, as assessed by survey, is sufficient to halve the population percentage decrease from almost 8% to just over 3%. This serves to mask the accelerating level of population decrease expected with increased extinction debt, and it presents a false picture of a "steady decline." During 2001–2010, murrelet populations decreased by over 30%, and this rate, given the demographic situation, it will likely only accelerate.

The USFWS constantly assumes and interprets that where there uncertainties in parameter estimates the attendant effects on murrelets are insignificant or even non-negative. This, in the absence of supporting data or scientific literature to validate the assumption, is professionally problematic, and it is how populations go extinct. An underestimate of population decrease, coupled with increased anthropogenic mortalities and decreased recruitment, leads to sudden and drastic declines in numbers. The presence of numerous, uncertainties at high levels is reason to be judiciously conservative in assessing the lack of impact associated with incidental take.

Incidental take of marbled murrelets is poorly monitored, or not monitored at all, yet its effects can be sub-lethal and therefore hard to detect. While undetected effects are often considered to be insignificant, just because something is difficult to quantify does not mean it is insignificant

All of these things allow the USFWS to justify incidental take represented by both mortality and harassment in a population of already catastrophically low numbers, decreasing at a rate optimistically assumed to be around 5%, but may well be closer to 10%, or even higher. The trend appears to be accelerating rather than stable.

6.—Effects of Noise

Noise may affect the marbled murrelet in profound ways:

- Noise may mask important biological signals and change signal structure

- Noise may cause physiological stress

- Noise increases have been shown to be associated with declines in avian reproductive success

- Noise may cause direct harm (see hearing loss discussion)

- Noise may provide distracting stimuli

USFWS accepts the possible direct harm consequences of noise caused by explosions, but suggest it is merely temporary, based on the afore-mentioned budgie studies(Yelverton et al . 1973,1975). They fail to acknowledge the sub-lethal effects associated with interruptions this may cause to feeding of young, and to the overall health of the birds affected.

As stated earlier, the emphasis placed by the USFWS on assessing "recoverable" hearing damage, based on studies done on members of the parrot family (budgerigars or "budgies") is problematic. Even if such results could be translated directly to murrelets, which seems highly improbable, the loss of days, weeks, or months of foraging efficiency would have a profound effect adult energy expenditures and their ability to capture prey to feed their young. That, of course, could affect the survival and fledging of nestlings and juveniles—i.e., both being the most important age group in producing a recovery of the population. Noise may also affect the proximate health of the breeding birds, leading to declines in reproductive behavior and breeding propensity and, hence, juvenile recruitment, and lifetime reproductive potential. Instead, this is merely passed over as suggesting it may occur, but is not important.

The problems associated with using surrogate species are noted above. A greater problem is ignoring noise disturbances create by anthropogenic sources, and how this affects the feeding of nestlings and the overall foraging ability of the sub-adult and adult birds. Abundant literature for both marbled and Kittlitz's murrelets, closely related alcid seabirds (e.g., common murre), and other seabirds (e.g.

black-legged kittiwakes) and shorebirds demonstrates close approaches by small watercraft cause disruptions in foraging areas and feeding rates (Speckmanet al. 2004, Agness et al. 2008, 203, Bellefluer and Ronconi 2009). Other research, done on larger ships (Hentze 2006, Agness et al. 2008, 2013, Roby 2014, shows disruptions to foraging occur at distances well beyond those measured in the small craft studies.

Any sort of noise disruption, beyond a single, unrepeated incident, is likely to increase stress. The USFWS admits this in their discussion of allostatic loading, or "*the cumulative wear and tear on the body as adrenal hormones, neurotransmitters, or immuno-cytokines are released in response to the event*" [BiOp page 123], but then downplays its potential effects on (1) the proximate or a single-year's reproduction, (2) the ultimate success of an individual bird or its lifetime reproductive output, and by expansion (3) the population's reproductive output as a whole. Proximate refers to a single year, while ultimate takes into account the lifetime reproductive output. Murrelets are highly philopatric (Divoky and Horton1995)—i.e., animals that tend to stay in or habitually return to a particular area; e.g., more frequently than not they return to their birthplace to breed (Greenwood 1980,Harvey 1982, Divoky and Horton 1995, Nelson and Hamer 1995, Pasinelli et al. 2004, Oro et al. 2011, Shitikov et al. 2012, Coulson 2016, Pavesky 2016). Murrelets show a low tendency to return to the same tree, but a high level of fidelity to the same area, i.e., they tend to use either in the same tree, or a nearby tree, during their breeding lifetime (Divoky and Horton 1995, Nelson and Hamer 1995).

Constant, in terms of recurring noise disturbances, whether regular, sporadic, or episodic, cannot be avoided by moving to another location. Any movement that would occur would likely result in the loss of at least one, and more likely, several year's reproduction because the birds would need to accommodate to the new environment. A recent study of Washington State's marbled murrelets revealed that only 12.7% attempted to breed and breeding propensity

was just 13.1–20.0%, the lowest breeding propensity reported for a population of murrelets. In addition, nest-to-sea commuting distances were greater than reported previously, four breeders traveling farther than the previously reported maximum of 125 km. Naval activities could be part of that unresolved cause and effect.
<http://onlinelibrary.wiley.com/doi/10.1002/jwmg.21192/abstract;jsessionid=09A11ECFBF8A2554C907E2BCEB84F296.f04t01>

The noise associated with fixed- or rotary-wing aircraft could provide a distraction or disruption of the communication between birds on the nest and those returning from foraging. This signaling is a very important part of the nesting behavior of murrelet, and may well affect the overall survival potential of the nestling.

7.—Effects on Murrelet Food

The marbled murrelet's health and well-being depends heavily on forage fish abundance. The research conducted by Norris et al. (2007), using historical analysis of stable isotope ratios in marbled murrelet feathers, presents an interesting case for the role of diet in the population dynamics of marbled murrelets. Basically, they conclude the marbled murrelet populations in British Columbia were still increasing when they fed on a diet composed mainly of forage fish, but declines began when their diet switched to macroinvertebrates. This reinforces the importance of the forage fish food base for murrelets in the area of concern.

Becker and Beissinger (2006) and Becker et al. (2007) performed similar analyses looking at stable isotope ratios in marbled murrelets from California. They concluded broad-scale changes in oceanographic conditions favored increased production of macroinvertebrate prey species (e.g. euphausiids) over the more energy-dense forage fish. They hypothesize this change may have played a role in the declines seen in murrelet populations.

Common murres adjusted their foraging rates over a 10-fold range in food availability in order to continue feeding their young, with this rate dropping only at the low end of prey availability (Harding et al. 2007). The effect of this adjustment on lifetime reproductive output was not investigated, but the necessary increase in foraging rates needed over such a range in prey density likely had a proximate (single year or short-term) effect on adult condition.

Other, non-alcid seabirds demonstrate similar responses to changing food types. Northern fulmars shifted their at-sea distributions, moving farther north, in response to northward shifts in pelagic fisheries, and warming oceans (Renner et al. 2013). Black-legged kittiwakes acted counter to what theory would suggest in times of food shortage by sacrificing long-term reproductive success and devoting more energy to feeding present broods at increased energetic cost to the adults (Satterthwaite et al.2010).

Other long-lived seabirds, like kittiwakes, will decrease production of young under stresses caused by low food abundance and may even suffer mortality from stress (Kitaysy et al 2010). Where there were low food availability stresses, and the adult survived, no young were produced (ibid.). Other studies have related variability in seabird productivity, as represented by poor reproductive success, with fluctuations in diet (meal delivery and size) (Jodice et al. 2006, Gustowsky et al. 2009). Clearly, any factors interfering with either foraging or food delivery have a critical role in determining both short-term and long-term population survival (Sattherwaite et al. 2010).

The fact that an egg weighs as much as 25% of the total body mass of an adult murrelet, which represents a significant energetic investment. Hence, abandonment of breeding would best occur prior to egg-laying because once then egg is laid, the need for replenishment of the female's energy reserves and the maintenance of the investment of energy represented by the egg would be high. Peery et al. (2004) found a range of almost 70% of murrelets failed to nest in central California, despite the presence of nest sites deemed suitable. This

suggests the threshold of energy available was insufficient for successful egg laying. They attributed this to a lack of sufficiently energy-rich food resources. It may also represent the continuing senescence of an aging population, with insufficient juvenile recruitment into the breeding population.

The USFWS state they have no way of assessing whether the effects of the Navy's activities had or will have a negative impact on forage fish populations, but they did perform an empirical calculation of a relative effect of activities on Pacific herring. Unfortunately, they did no assessment of population dynamics and loss in any manner for surf smelt and sand lances, two primary forage fish for murrelets. As discussed above, the presence of these "oily" forage fish species is critical to the well-being of marbled murrelet populations. The information presented on habituation (Section 2) suggests murrelets in the area may well already be at the "ragged edge" as far as foraging is concerned. Any further disruption resulting in loss of fish prey species can only result in greater potential recruitment failure through loss of nestlings from diminished food resources (Peery et al. 2004, Becker and Beissinger 2006, Becker et al. 2007, Norris et al. 2007).

8.—Cumulative Effects

The USFWS failed to give proper consideration to the role of cumulative effects when they considered issuing an incidental take permit. The agency admitted the major areas of concern for marbled murrelet populations were juvenile survival and adult fecundity, or lifetime reproductive output. As USFWS admitted, individual fecundity cannot be easily increased simply because murrelets lay an egg that is 25% of their body weight. They may no longer have the genetic diversity (evolutionary ability, needed genetic variation) to adaptively change egg weight and thereby increase fecundity while at the same time maintain survival of the hatchling (note: this assumes such a change would be beneficial to hatchling survival, which seems

unlikely). The best way to increase lifetime reproductive output of a marbled murrelet is to increase survival of juveniles recruiting into the breeding population. This, coupled with already high adult survival, will serve to increase lifetime reproductive output (Beissinger and Nur 197, Peery et al. 2004, Becker and Beissinger 2006, Becker et al. 2007, Beissinger and Peery 2007, Norris et al. 2007, Peery and Henry 2010).

Juvenile survival is determined, in large part, by survival in all stages of development, from egg through fledging, to adulthood. Sources of mortality are poor nesting habitat, nest predation, and poor nutrition during growth and development. Obviously, nest abandonment due to harassment would also result in mortality.

Cumulative effects not addressed by the USFWS include:

> (1) the continue logging occurring on private timberlands and proposed for Washington State Trust Lands by the Washington Department of Natural Resources, will destroy critically needed nesting habitat, forcing them into suboptimal areas, and will exacerbate fragmentation of the existing habitat, which will increase edge acreage unsuitable for nesting, indirectly cause secondary loss of nesting trees to blow-down, and increase access to the nesting areas for predators;
> (2) increase in human populations which will result in increased water-related recreational activities, causing increased harassment of feeding murrelets; and associated loss of feeding opportunities, and
> (3) increased predation brought about by the logging activities and the increased human recreational use of the nesting areas.

As evident in the literature below, predators key upon any and all human activities, including otherwise benign activities as hiking, etc. The scientific literature is very clear on these impacts, as discussed below.

8.1—Effects of Logging on Habitat Selection

The majority of researchers take the view the most desirable patches for murrelet nesting are large, late-seral stage forests, with large trees (Nelson and Hamer 1995 and others). However, they also noted that apparent lack of population response to changes in patch characteristics demonstrated resilience in the system (Zharikov et al.2006, 2007). They theorized that philopatry (i.e., tendency of an organism to stay in or habitually return to a particular area) was the cause for birds continuing to occupy habitat that apparently was unsuitable in California (Meyer et al. 2002). Philopatry has been documented for other alcids, and is most likely to be the case here, albeit the lack of population response remains questionable. Meyer et al.(2002) hypothesized that murrelets evince a time lag in response to fragmentation of habitat, which may be the result of philopatry.

Zharikov et al. (2006) contended that birds should continue to occupy a habitat as long as nesting structures are suitable and nesting remains successful. This fails to account for the lag effects in perceiving a change, the ability of a philopatric species to perceive such changes and subsequently act to avoid falling into an ecological trap (Duggan et al. 2010). It further ignores the fact that numerous studies suggest continued predation during the lag period. Zharikov et al.(2006) dubiously concludes the lack of a negative population trend shown by modeling done on the same Desolation Sound population by Cam et al. (2003) as evidence of *no such problem*. However, an even cursory reading of Cam et al. (2003) finds the authors stating that while, at best, their work showed a stable to slightly declining population, there was so much variation the population could easily be declining.

One of the extremely interesting aspects of Zhariko et al. (2006) was they identified nesting sites (or putative nesting sites), but also randomly chose non-nesting sites for comparison. As well, at their most heavily fragmented site (Desolation Sound), they found marbled

murrelets selected for smaller than average old-growth patches. About one-quarter of the nests located occurred in classes of habitats (young or secondary forest, regenerating burned areas) that did not possess structural elements necessary for nesting. They hypothesized these nests were likely located in small pockets of old-growth imbedded in an otherwise unsuitable habitat matrix.

Zharikov et al. (2006) contended patch size is neither a consistent nor an important nesting habitat predictor for marbled murrelets and contend this criterion should not be applied for marbled murrelet habitat management on its own. They also found marbled murrelets do not 'pack' into large patches even if their nesting landscape is highly fragmented. This means that although habitat loss will cause population declines, forest fragmentation per se, may have no immediate additional negative effect on the species. Needless to say, this (and the earlier-cited conclusions) provoked an immediate attack from Burger et al. (2007), criticizing methods and conclusions, and a rebuttal from Zharikov et al. (2007).

Steventon et al. (2003, 2006) performed a risk analysis for populations on Vancouver Island and came to several conclusions somewhat at odds, or at least tangential, to the commonly held beliefs concerning population persistence. They concluded the following:

- Gross habitat supply and its quality in terms of nesting density, combined with survival and reproductive rates as affected by future at-sea conditions, are the dominant predictors of projected outcomes
- Edge effects (representing habitat configuration) were minor, declining in importance with increasing habitat amount.
- The rate of habitat decline (when separated from final habitat amount) had only a weak effect

A linear relationship was found between murrelet numbers and habitat area when habitat quality was not known or was averaged across large spatial units (which really should be expected). The slope of this relationship, however, appeared to vary by geographic location. Several factors might influence the slope of this line including forest habitat quality, marine food availability, and the effects of commuting distance for the murrelets (Burger et al. 2004).

Bahn and Lank (2002) addressed the issue of habitat quality in their comparison of actual nest sites in Clayoquot Sound, BC, relative to the rankings produced by the Bahn and Newsom (2002) habitat suitability model. Based on the availability of suitable nesting structures, their model did a reasonable job in predicting where the nests might occur. The upper two ranks (Excellent and Good) had twice the probability of nest use compared with the lower two ranks (Low and Suboptimal), but little difference was evident between the use of higher ranks (Excellent vs. Good). Two of the 31 nests (6%) fell within the “Unsuitable” category of the best model. Bahn and Lank (2002) suggest that natural selection has not led to strong aggregations of murrelets in nesting habitat that offers the most or best nesting structures. They speculate that murrelets use behavioral strategies to keep nesting densities low overall, perhaps to avoid detection and search-image formation by predators. For example, blue jays (part of the crow family that predates on murrelet nests) have trouble dividing their attention among for more than one type of prey at the same time. Hence, tighter densities of nests would tend to sponsor formation of a search image (conditioned reponse) and a sparse nest distribution would tend to inhibit conditioning and formation of a search image.
<http://evolution.berkeley.edu/evolibrary/article/happyface_11 > Steventon et al. (2003) and others, however, would give quality a bit larger role in determining density and abundance.

Burger and Waterhouse (2009) looked at the issue of murrelet nesting density and habitat quality and came to a somewhat different

conclusion than Steventon et al. (2003, 2006). Burger's previous radiotelemetry work (2001, 2002) had described and defined a relationship between numbers of murrelets flying inland, building on Raphael et al. (2002) who found a high correlation of murrelets at sea and total amount of high quality habitat directly onshore. This work (and that of Raphael et al. 2002) had described a highly significant positively correlated linear relationship between numbers of murrelets and adjacent high quality habitat. This was then further investigated to determine if the relationship was reflected in the amount of nesting and use of what was considered "high-quality" nesting habitat (sensu Steventon and the prevailing paradigm).

Raphael et al. (2002) used radar estimates of birds flying inland in various drainages, calculated the area available in each drainage, took estimates of nest spacing from nests in three previous studies, and estimated 150 hectares could support more than one pair of murrelets. They concluded changes in the amount or distribution of nesting habitat should result in detectable changes in murrelet numbers at the scale of individual drainages. Burger et al. (2001) had found a similar relationship, but a much higher density of nesting birds. Both concluded the amount and distribution of nesting habitat may play a role in the regulation of Marbled Murrelet populations, supporting the contention that providing nesting habitat is an effective conservation and restoration technique for this species.

8.2—Effects of Logging on Fragmentation of Habitat

A number of authors, in fact the great majority of the more recent field work on marbled murrelets, has been directed at 1) identifying the habitat necessary for stabilizing, and eventually, recovering marbled murrelet populations, and 2) preserving the "integrity" of the above habitat (i.e. ostensibly protecting it) and determining what sort of continued insults it could sustain and still, in theory, fulfill its purpose.

The most critical issues are associated with fragmentation. Fragmentation has both direct effects (e.g., the destruction of habitat structures through road-building, logging, increased windthrow) and indirect effects (e.g., increased edges and subsequent attraction to predators). These effects are thought to extend from between 50-150 m into the interior forest (Chen et al. 1995, Burger and Page 2007). Fragmenting larger patches of habitat also increases forest edge habitat, decreasing the amount of central core habitat relative to the edge (Raphael 1995, Meyer and Miller 2002, Meyer et al. 2002, Raphael 2002, Burger et al. 2004, Burger and Waterhouse 2009, Malt and Lank 2007, 2009).

Research has shown marbled murrelets more commonly nest in core areas (again this is interpreted as selection, but see above discussion). Core areas have microclimatic characteristics such as cooler, more moist environments inferred as being more preferable to murrelets (not tested), and greater area considered as a buffer against nest predation. Decreasing the central core of forests may lead to nest failure along edges by exposure to high heat or evaporative water loss, factors which may stress marbled murrelets, as they are coldwater-adapted seabirds. Chen et al. (1993) found that within old-growth Douglas-fir forests in Washington, edges had higher afternoon temperatures and lower humidity than interiors.

Meyer et al. (2002) found fragmentation and isolation of old-growth forest had an adverse effect on both murrelet occupancy and abundance. Fragmentation variables, such as old-growth core area, were more predictive than area of old-growth forest alone. Fragmentation effects were also most identifiable in the larger-sized landscape plots, which gave the most predictive models.

Once habitat is fragmented into smaller patches, changes in vegetation assemblages and wildlife use patterns are also observed. (Zharikov et al. 2006, Burger et al. 2007, Zharikov et al. 2007). These observations include birds using smaller, younger trees, and

smaller sized patches embedded into a matrix of less-suitable vegetation.

8.3.—Anthropogenic Effects on Predation

A number of studies have demonstrated the vulnerability of all life history stages of murrelets to predation by birds and mammals. Adults are preyed upon by hawks and owls, while nestlings and young face a number of different avian and mammalian predators, chiefly corvids (crow family), but also squirrels, and perhaps even deer mice Maltand lank 2007, 2009). Little is presently known about predation rates on existing marbled murrelet populations. Studies have documented an increase in corvid nesting and predation on marbled murrelets following fragmentation of habitat. (Nelson and Hamer 1995, Burger et al. 2004, Zharikov et al. 2206, 2007a,b, Burger and Page 2007, Malt and Lank, 2007, 2009, Peery and Henry 2010).

Malt and Lank (2007, 2009), using wildlife cameras and artificial nests came to the following conclusions regarding predation risk:

- Accounting for landscape-scale fragmentation, disturbances by avian predators were significantly more frequent at forest hard edges relative to interiors, but less frequent at soft edges.
- There were no edge effects at natural-edged sites. These results imply that detrimental edge effects adjacent to recent clearcuts may decline with time due to plant successional processes.
- Survey data suggest that this pattern was caused by Steller's jays that were observed more often at hard edges than soft edges in one region.

The authors recommended where corvids are important predators, managers maintain reserves that lessen the amount of hard edge per patch area. Harvest adjacent to reserves should proceed in stages to limit hard edge effects at any given time.

Fragmenting larger patches of habitat increases forest edge habitat (as pointed out above), which increases the vulnerability of marbled murrelet nests to predation, especially by but not limited to ravens, crows, and jays. Raphael et al. (2002) found forest fragmentation lead to increased patches and increased edge. This edge effect led to higher predation into a depth of 150 meters into the forest interior. Proximity to human activity also led to higher rates of predation.

Marbled murrelets demonstrate high rates of nest failure. Studies show that more than half of established nests "fail," or do not produce a fledgling, and predation of marbled murrelet nest sites by corvids is the primary cause of nest failure. It is clear that increased predation by corvids is a significant threat to the continued survival of the species. Other predators have also been shown to increase predation rates on murrelet nests following habitat fragmentation (Burger et al. 2004).

Corvids are attracted to both thinned areas and open edges created by clearcutting. Marzluff et al. (2004) found the highest use of areas within corvid home ranges to be those areas with high densities of contrast edge. These include young forest, barren, agricultural, and settled land. They also found increased use of areas with a high density of clover patches (caused by fragmentation). Use of these areas with many patches was stronger when clearcuts were present. They also found young seral stages were used more than mature.

Burger et al. (2002) found jays most often close to clearcuts. They were also more abundant in fragmented rather than in continuous patches. Raphael et al. (2002) found Steller's jays more abundant along edges, while gray jays frequented continuous patches. Burger et al. (2004) found jays and other corvids most common at disturbed sites, with higher predation along the clearcut edges of old growth forest, concluding hard, not natural, edges had higher predation risk.

Corvids frequently nest in larger trees within thinned plantations and in edge areas and smaller patches of trees created by stand harvest (Marzluff & Neatherlin 2006). Clearing activities also produce berries and insects, beneficial food sources for corvids, as part of the initial stages of regeneration. The juxtaposition of mature forest and regeneration forest produces conditions considered optimal for Stellar's jay nesting. Marzulff et al. (2004) found all corvids to use younger seral stages, such as those occurring after an area has been clearcut . Burger et al. (2004) found jays and other corvids most common at disturbed sites, with higher predation along the clearcut edges of old growth forest.

The distribution and abundance of the American crow strongly correlates with the presence of human activities (Marzluff and Neatherlin 2006), as does the presence of the common raven (Luginbuhl et al. 2001). Numbers and predation rates increase dramatically within one kilometer of humans. Fledgling of young increases, and there is a significant increase in survivorship. Common raven populations show similar, but more moderate, increases under the same conditions. All three corvid species are known to increase their home range in the presence of human activities. Crows have exhibited home ranges over 8,000 hectares, and made long unidirectional flights of tens of kilometers to gain access to human sites for feeding. Ravens exhibit home ranges of approximately 2,800 hectares. Steller’s jays have a home range of approximately 60 hectares (Marzluff and Netherlin 2006).

Peery and Henry (2010) in their modeling effort, stated that sufficient habitat area existed for all California murrelets to breed (Peery et al, 2004); they implied predation was the cause for the declines. Their model showed even a 40% decrease in corvid predation would reduce murrelet population extinction from 95.8% to 4.6% over 100 years. This is not insignificant.

By simply ignoring these studies, and the impact of human activities on all stages of murrelet life history, the USFWS actually defeats its own recovery plans. The activities permitted by the USFWS in its incidental Navy take permit will work in conjunction with these terrestrial-base threats to the marbled murrelet population to further increase juvenile mortality, both directly through nest predation, and indirectly through the destruction of nesting habitat. That mistake can only serve to speed extinction.

8.4 Conclusion or Dilution?

The BiOp is required to consider the cumulative effects on marbled murrelets, which it defines as follows:

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion.

The BiOp does briefly mention (1 page) the wide range of significant nonmilitary anthropogenic impacts and then in the subsequent 14 pages, it ignores those impacts entirely and focuses only on the naval actions in marine waters and their putative negligible impacts. Even if modest, and that is arguable, the stated intent above is ignored because there is no substantive analysis of the overall aggregate of all the impacts.

Furthermore, the BiOp in those 14 pages focuses on the marine impacts within the *action area*, and avoids considering any land-based impacts of its actions to marbled murrelets nesting in the adjacent forests. But, action area flight operations include murrelet nesting areas and hence add significant risks on nesting success, that is not addressed or tallied into the overall impact. The BiOp does briefly acknowledge, however, that "marbled murrelets will continue to be affected by ongoing activities within Puget Sound and along rivers and streams draining into Puget Sound (page 248)," meaning the murrelet's critical habitat extends from sea onto land.

Nevertheless, and strangely and inexplicably, although those 14 pages fixate on the Navy actions in the marine action area, USFWS concludes in Sec 12.2.8 with this:

> The proposed action is not likely to affect the **distribution** of murrelets within the action area because it would not result **in the loss of any murrelet nesting habitat**, which is identified as the primary driver of the current population decline (USFWS 2012b). The essential conservation role of the Olympia MOAs to provide nesting habitat necessary for murrelet survival and recovery would not be precluded or diminished by the proposed action. The essential conservation role of marine waters to provide prey resources necessary for murrelet survival and recovery is not likely to be precluded or measurably reduced by the proposed action. Therefore, the proposed action taken together with cumulative effects is not expected to affect the **distribution** of murrelets in the action area or within the listed range of the species. (emphasis added)

The cumulative impacts of deforestative logging resulting in increased predation and decreased murrelet nesting area are considered only as they contribute to the decline curve through 2035. Ignored are two critical questions: (1) whether any additional take, even if small, could have a meaningful impact on the murrelet population, and (2) are the Navy take estimates even remotely reliable given the vast number of unknown indirect impacts requiring highly dubious assumptions, which interestingly always produce a negligible effect? Those BiOp shortfalls endanger an already endangered (by WA State) species and undermine the USFWS's stated policy to err on the side of caution, when confronted with significant uncertainties, requiring creative assumptions.

Finally, this may just be a semantics thing, but it is not the "distribution" of murrelets that is critical, but rather the population numbers. This calls for clarification because if USFWS is actually

speaking of distribution rather than population numbers, then this whole conclusion side-steps the very thing it is supposed to be addressing.

LITERATURE CITED

Adams, A.A.Y., S.K. Skagem, and J.A. Savidge. 2008. Population-specific demographic estimates provide insights into declines of lark buntings (*Calamospiza melanocorys*). *The Auk* 124(2):578–593

Agness, A.M., J.F. Piatt, J.C. Ha, and G.R. VanBlaricom. 2008. Effects of vessel activity on the nearshore ecology of Kittlitz's murrelets (Brachyramphus brevirostris) in Glacier Bay, Alaska. The Auk 125:346-353.

Agness, A.M., K.N. Marshall, J.F. Piatt, J.C. Ha, and G.R. Van Blaricom. 2013. Energy cost of vessel disturbance to Kittlitz's murrelets (Brachyramphus brevirostris). Marine Ornithology 40: 1-9.

Andelman, S. J., and W. F. Fagan. 2000. Umbrellas and flagships: Efficient conservation surrogates or expensive mistakes. Proceedings of the National Academy of Sciences USA 97:5954–5959.

Bahn, V., and D. Newsom. 2002 (Chapter 5). Can Marbled Murrelet use of nesting habitat be predicted from mapped forest characteristics? **Multi-Scale Studies of Populations, Distribution and Habitat Associations of Marbled Murrelets in Clayoquot Sound, British Columbia.** Edited by Alan E. Burger and Trudy A. Chatwin

Banks, J., J.D. Stark. R.I. Vargas. and A.S.Ackleh. 2014 Deconstructing the surrogate species concept: a life history approach to the protection of ecosystem services. Ecological Applications, 24(4), 2014, pp. 770–778.

Banks, J. E., A. S. Ackleh, and J. D. Stark. 2010. The use of surrogate species in risk assessment: using life history data to safeguard against false negatives. Risk Analysis 30:175–182.

Beale, C.M., and P. Monaghan. 2004. Behavioral responses to human disturbance: a matter of choice. Animal Behaviour 68(5);1065-1069

Becker, B.H. and S.R. Beissinger. 2006. Centennial decline in the trophic level of an endangered seabird after fisheries decline. Conservation Biology 20(2):470-79.

Becker, B.H., M.Z. Peery, and S.R. Beissinger. 2007. Ocean climate and prey availability affect the trophic level and reproductive success of the marbled murrelet, an endangered seabird. Inter-Research Marine Ecology Progress Series 329:267-79.

Beissinger, S.R. 1995. Population trends of the marbled murrelet projected from demographic analyses. Pages 385-93. *In*: Ecology and conservation of the marbled murrelet. General Technical Report: PSW-GTW-152. Chapter 37. Pages 385-393.Pacific Southwest Experimental Station, U.S. Forest Service, Albany, California.

Beissinger, SR and I Westphal. 1998. On the use of demographic models of population viability in endangered species management. Journal of Wildlife Management 62(3):821-841.

Beissinger, S.R. and M.Z. Peery. 2003. Range-wide analysis of juvenile ratios from marbled murrelet monitoring programs: implications for demographic analyses. University of California, Berkeley, CA. 30.

Beissinger, S.R. and M.Z. Peery. 2007. Reconstructing the historic demography of an endangered seabird. Ecology 88(2):296-305.

Bellefleur, D., P. Lee, and R.A. Ronconi. 2009. The impact of recreational boat traffic on marbled murrelets (*Brachyramphus marmoratus*). Journal of Environmnetal Management 90:531-538.

Biggar, DB, MZ Peery S Chinnici, and SP Courtney. 2006. Efficacy of Audiovisual and Radar Surveys for Studying Marbled Murrelets in Inland Habitats. The Journal of Wildlife Management 70(2):506-516.

Blumstein, D. T., 2014. Attenuation, habituation, and antipredator behavior: Implications for urban birds. Chapter 4 In:

Boulanger, J, K Martin, G Kaiser, and AE. Derocher. 1999. Evaluating uncertainty in estimating population trends of Marbled Murrelets. Society of Canadian Ornithologists Special Publication No. I. 1999. Biology and Conservation of Forest Birds 53-63.

Bouwhuis S, van Noordwijk AJ, Sheldon BC, Verhulst S, Visser ME (2010) Similar patterns of age-specific reproduction in an island and mainland population of great tits Parus major. J Avian Biol 41:615–620

Bulman, CR, RJ Wilson, AR Holt, L G Bravo, RI Early, MS Waren, and CD Thomas. 2007. Minimum viable metapopulation size, extinction debt, and the conservation of a declining species. Ecological Applications, 17(5):1460–1473.

Burger, A.E. (2001). Using radar to estimate populations and assess habitat associations of Marbled Murrelets. Journal of Wildlife Management 65:696-715.

Burger, A.E. (2002). Conservation assessment of marbled murrelets in British Columbia: A review of the biology, populations, habitat associations, and conservation. In: Canadian Wildlife Service Technical Report Series No. 387.

Burger, A.E. et al. (2004). Effects of habitat fragmentation and forest edges on predators of Marbled Murrelets and other forest birds on southwest Vancouver Island, In: Proceedings of the Species at Risk 2004 Pathways to Recovery Conference (T.D. Hooper ed.).

Burger, A.E. & R.E. Page (2007). The need for biological realism in habitat modeling: a reinterpretation of Zharikov et al. (2006). Landscape Ecology 22:1273-1281.

Burger, A.E. & F.L. Waterhouse (2009). Relationships between habitat area, habitat quality and populations of nesting Marbled Murrelets, B.C. Journal of Ecosystems and Mgmt. 10:101-112.

Cam, E., L Loughheed, R. Bradley, and F. Cooke. 2003. Demographic assessment of a marbled murrelet population from mark-recapture data. Conservation Biology 17(4):1118-1126.

Caro, T.M. and G. O'Doherty. 1999. On the use of surrogate species in conservation biology. Conservation Biology 13(4):805-813.

Catry, P., Phillips, R.A., Phalan, B. & Croxall, J.P. (2006) Senescence effects in an extremely long-lived bird: the grey-headed albatross *Thalassarche chrysostoma*. Proceedings of the Royal Society of London – Series B: Biological Sciences, 273, 1625–1630.

Chen, T. et al. (1995). Growing-season microclimatic gradients from clearcut edges into old- growth Douglas-Fir forests. Ecological Applications 74-86.

Coulson,J.C. 2016. A Review of Philopatry in Seabirds and Comparisons with Other Waterbird Species. Waterbirds 29(3):229-326.

de Forest, L., and A. Gaston. 1996. The Effect of Age on Timing of Breeding and Reproductive Success in the Thick-Billed Murre. Ecology, 77(5), pp. 1501-1511

Divoky, G and M. Horton. 1995. Breeding and Natal Dispersal, Nest Habitat Loss and Implications for Marbled Murrelet Populations Chapter 7**.** USDA Forest Service Gen. Tech. Rep. PSW-152. P 83-87.

Dugger, K. M., R. G. Anthony, and L. S. Lawrence. 2011. Transient dynamics of invasive competition: barred owls, spotted owls, habitat, and the demons of competition present. *Ecological Applications* **27**:2459–2468.

Entranco, Inc. and Hamer Environmental, L.P. 2005. Marbled murrelet hazing report - SR 104 Hood Canal Bridge east-half replacement and west-half retrofit project. Washington State Department of Transportation, 22 pp + appendices

Ganey, J.L.G.C. White, D.C. Bowden, and A.B. Franklin. 2004. Evaluating methods for monitoring population of Mexican spotted owls. pp337-388. In. Thompson, W.L. (ed) Sampling Rare or Elusive Species. Island Press, Washington.

Gill, J. A. 2007. Approaches to measuring the effect of human disturbance on birds. Ibis **149** (Suppl. 1), 9–14

Goss-Custard JD, dit Durell SEAlV. 1988. The effect of dominance and feeding method on the intake rate of oystercatchers, Haematopus ostralegus, feeding on mussels. J Anim Ecol. 57:827–844.

Goss-Custard, J.D., P. Triplet, F. Seur, and A.D. West. 2006. Thresholds of disturbance by people and raptors in foraging wading birds. Biological Conservation 127(1):88-97.

Gutowsky, S, MH. Janssen, P Arcese, T Kyser, D Ethier, MB. Wunder, DF. Bertram, L McFarlane Tranquilla, C Lougheed, and D. R Norris. 2009 Concurrent declines in nestling diet quality and reproductive success of a threatened seabird over 150 years. Endangered Species Research 9: 247–254

Hamer, K.C., and R.W. Furness. 1991. Age-specific breeding performance and reproductive effort in Great Skuas Catharacta skua. *Journal of Animal Ecology* 60(2): 693-704.

Hammers, M, D.S. Richardson, T. Burke, and J. Kondeur 2012. Age-Dependent Terminal Declines in Reproductive Output in a Wild Bird. PLOS 7(7). e40413.

Hanski, I. and O. Ovaskainen 2002. Extinction debt at extinction threshold. Conservation Biology 16(3):666-673.

Harding AMA, Piatt JF, Schmutz JA, Shultz MT, Van Pelt TI, Kettle AB, Speckman SG (2007) Prey density and the behavioural flexibility of a marine predator: the common murre (*Uria aalge*). Ecology 88:2024–2033

Heppell, S., H. Caswell, and L. R Crowder. 2000. Life histories and elasticity patterns: perturbation analysis for species with minimal demographic data. Ecology **81**:654–665.

Hockin, D., M. O. Uested, M. Gorman, D. Hill, V. Keller, and M. Barker. 1992. Explanation of the effects of disturbance on birds with reference to its importance in ecological assessments. Journal of Environmental Management 36(1):253-286.

Holand, H, T. Kvalnes, M. Gamelon, J. Tufto, H. Jensen, H. Pärn, T. H. Ringsby, and B.-E. Sæther. 2016. Spatial variation in senescence rates in a bird metapopulation.
Oecologia 181 (3):865-871.

Holmes, D.J. and S.N. Austad. 1995. The Evolution of Avian Senescence Patterns: Implications for Understanding Primary Aging Processes. American Zoologist: 35:307-317

Hull CL, Kaiser GW, Lougheed C, Lougheed L, Boyd S, Cooke F (2001) Intraspecific variation in commuting distance of marbled murrelets (Brachyramphus marmoratus): ecologi- cal and energetic consequences of nesting further inland. Auk 118:1036–1046

Irwin, BJ. LG Rudstam, JR Jackson, AJ Vandevalk, JL Forney, and D.G. Fitzgerald. 2009. Depensatory Mortality, Density-Dependent Growth, and Delayed Compensation: Disentangling the Interplay of Mortality, Growth, and Density during Early Life Stages of Yellow Perch. Transactions of the American Fisheries Society 138:99–110.

Jackson, S.T, and D.F. Sax. 2010. Balancing biodiversity in a changing environment: extinction debt, immigration credit and species turnover. Trends Ecol Evol 25(3):153-60. .

Janssen MH, Arcese P, Kyser TK, Bertram DF, McFarlane- Tranquilla L, Williams TD, Norris DR (2009) Pre-breeding diet, condition, and timing of breeding in a threatened seabird, the marbled murrelet Brachyramphus marmora- tus. Mar Ornithol 37:33–40.

Jeffres, C. & P. Moyle (2012) When Good Fish Make Bad Decisions: Coho Salmon in an Ecological Trap, North American Journal of Fisheries Management, 32:1, 87-92

Jodice, PGR and NW Collopy. Activity patterns of marbled murrelets in Douglas fir old growth forests of the Oregon Coast Range. The Condor 102:275-285.

Kitaysky, A.S., Piatt, J.F., Hatch, S.A., Kitaiskaia, E.V., Benowitz-Fredericks, Z.M., Shultz, M.T. *et al.* 2010. Food availability and population processes: severity of nutritional stress during reproduction predicts survival of long-lived seabirds. *Funct. Ecol.*, **24**: 625–637.

Kuussaari M, Bommarco R, Heikkinen RK, Helm A, and K. Krauss (2009) Extinction debt: a challenge for biodiversity conservation. Trends in Ecology & Evolution 24: 564–571.

Liermann, M. and R Hilborn. 2001. Depensation: evidence, models and implications. Fish and Fisheries 2:33-58.

Litzow, M.A., J.F. Piatt, A.K. Prichard, D.D. Roby. 2002. Response of pigeon guillemots to variable abundance of high-lipid and low-lipid prey. Oecologia 132(2):286-295. July 2002.

Loehle, C. and Li, B-L. (1996) Habitat destruction and the extinction debt revisited. Ecol. Appl. 6, 784–789

Lorenz, T.J., M.G. Raphael, T.D. Bloxton, and C.G. Cunningham. 2017. Low breeding propensity and wide-ranging movements by Marbled Murrelets in Washington. Journal of Wildlife Management 81(2):306-321.

Luginbuhl, J.M. et al. (2001). Corvid survey techniques and the relationship between corvid relative abundance and nest predation. Journal of Field Ornithology 72:556-572.

MacKenzie, D.I., J.A. Royle, J.A. Brown, and J.D. Nichols. 2004. Occupancy estimation and modeling for rare and elusive species pp 14-172. In. Thompson, W.L. (ed) Sampling Rare or Elusive Species. Island Press, Washington.

Malt, J. & D. Lank (2007). Temporal dynamics of edge effects on nest predation risk for the Marbled Murrelet, Biological Conservation 140:160-173.

Malt, J. & D. Lank (2009). Marbled Murrelet nest predation risk in managed forest landscapes: dynamic fragmentation effects at multiple scales, Ecological Applications 19:1274-1287.

Marcella, T.K. 2014. Cruise Ship Disturbance to Kittlitz's Murrelets (Brachyramphus brevirostris) in Glacier Bay National Park and Preserve, Alaska. Master's Thesis, Oregon State University, Corvallis, Oregon

Marzluff, J.M. et al. (2004). Relating Resources to a Probabilistic Measure of Space Use: Forest Fragments and Steller's Jays. Ecology 85:1411-1427.

Marzluff, J.M. & E. Neatherlin (2006). Corvid response to human settlements and campgrounds: Causes, consequences, and challenges for conservation. Biological Conservation 130:301-314.

Mattsson, B. J., R. S. Mordecai, M. J. Conroy, J. T. Peterson, R. J. Cooper, and H. Christensen. 2008. Evaluating the small population paradigm for rare large-bodied woodpeckers, with implications for the Ivory-billed Woodpecker. *Avian Conservation and Ecology - Écologie et conservation des oiseaux* **3**(2): 5. [online] URL: http://www.ace-eco.org/vol3/iss2/art5/

McDonald, L.L. 2004. Sampling rare populations. pp11-42. In. Thompson, W.L. (ed) Sampling Rare or Elusive Species. Island Press, Washington.

McLellan, B.N., Serrouya, R., Wittmer, H.U. & Boutin, S. (2010) Predator- mediated Allee effects in multi-prey systems. Ecology, 91, 286–292.

Mouquet N, Matthiessen B, Miller T, Gonzalez A (2011) Extinction Debt in Source-Sink Metacommunities. PLoS ONE 6(3): e17567. doi:10.1371/ journal.pone.0017567

Munns, W. 2006. Assessing Risks to Wildlife Populations from Multiple Stressors: Overview of the Problem and Research Needs. *Ecology and Society* **11**(1): 23. [online] URL: http://www.ecologyandsociety.org/ vol11/iss1/art23/

Munns WR, Jr Chapman J, Schappelle S, Cura J, Suter GW, Sorensen MT, Forbes T, Nacci DE, Newbold S, Pastorok R. 2008. Toward guidelines for population-level ecological risk assessment: Results of a U.S. EPA Risk Assessment Forum workshop. In: Proceedings of the Society of Environmental Toxicology and Chemistry (SETAC) 29th Annual Meeting; 2008 November 16–20; Tampa (FL). SETAC.

Nelson, SK, and TE Hamer. 1995. Nest Success and the Effects of Predation on Marbled Murrelets. Chapter 8. USDA Forest Service Gen. Tech. Rep. PSW-152. P 89-97.

Nelson, S.K. 1997. The birds of North America, No. 276 - marbled murrelet (*Brachyramphus marmoratus*). Pages 1-32. In: Poole, A. and F. Gill (eds). The birds of North America: Life histories for the 21st century. The Academy of Natural Sciences & The American Ornithologists' Union, Philadelphia, PA; Washington, D.C.

Norris, D.R., P. Arcese, D. Preikshot, D.F. Bertram, and T.K. Kyser. 2007. Diet reconstruction and historic population dynamics in a threatened seabird. *Journal of Applied Ecology* 44: 875-884

Oro, Daniel & Tavecchia, Giacomo & Genovart, Meritxell. (2011). Comparing demographic parameters for philopatric and immigrant individuals in a long-lived bird adapted to unstable habitats. Oecologia. 165. 935-45.

O'Shea, T.J., L.L. Ellison, and T.R. Standly. 2004. Survival estimation in bats: Historical overview, critical appraisal, and suggestions for new approaches. pp 297-346. In: Thompson, W.L. (ed.) Sampling Rare or Elusive Species. Island Press, Washington.

Pasinelli, Gilberto; Schiegg, Karin; Walters, Jeffrey R 2004. Genetic and environmental influences on natal dispersal distance in a resident bird species. Am. Nat. 2004, 164(5):660-9 SEP

Patrick SC and H. Weimerskirch . 2015 Senescence rates and late adulthood reproductive success are strongly influenced by personality in a long-lived seabird. Proc. R. Soc. B 282: 20141649

Pavesky, V.A. 2016. Sex-biased survival and philopatry in birds: do they interact? Biology Bulletin, 2016, Vol. 43, No. 8, pp. 1–15.

Pearson, S.F., M.M. Lance, and M.G. Raphael. 2014. Washington 2013 at-sea marbled murrelet population monitoring: Research Progress Report. Washington Department of Fish and Wildlife, Wildlife Science Division and USDA Forest Service Pacific Northwest Research Station, Olympia, WA.

Peery, M. Z., Beissinger, S. R., Newman, S. H., Burkett, E. & Williams, T. D. 2004. Applying the declining population paradigm: diagnosing causes of poor reproduction in the marbled murrelet. Conserv. Biol. 18, 1088–1098.

Peery, MZ, SR Beissinger, SH Newman, BH Becker, E Burkett, and TD Williams. 2004. Individul and temporal variation in inland flight behavior and temporal variation in inland flight behavior of marbled murrelets: Implications for population monitoring. *The Condor* 106:344–353

Peery, M.Z. et al. (2006). Combining demographic and count-based approaches to identify source-sink dynamics of a threatened seabird. Ecological Applications 16:1516-1528.

Peery, M.Z. & R.W. Henry (2010). Recovering marbled murrelets via corvid management: A population viability analysis approach. Biological Conservation 143: 2414-2424

Peterson, J.T. and P.B. Bayley. 2004. A Bayesian Approach to Estimating Presence When a Species is Undetected. pp 173-188. In: Thompson, W.L. (ed.) Sampling Rare or Elusive Species. Island Press, Washington.

Rebke M, Coulson T, Becker PH, Vaupel JW (2010) Reproductive improvement and senescence in a long-lived bird. Proc Natl Acad Sci U S A 107: 7841–7846.

Ronconi RA and AE Burger. 2008. Limited foraging flexibility: increased foraging effort by a marine predator does not buffer against scarce prey. Marine Ecology Progress Series Vol. 366: 245–258.

Pinaud, D., and H. Weimerskirch. 2002. Ultimate and proximate factors affecting the breeding performance of a marine top-predator. Oikos 99: 141-150.

Reed, T., E. Loeske, B. Crook, S. Wanless, M. Frederiksen, E.J.A. Cunningham, and M.P.. Harris. 2008. Reproductive Senescence in a Long-Lived Seabird: Rates of Decline in Late-Life Performance Are Associated with Varying Costs of Early Reproduction. American Naturalist Vol. 171, No. 2: 89-101

Ricklefs, R.E. 2008. The evolution of senescence from a comparative perspective. Functional Ecology 22:379-392

Rutten, A.L., K. Oosterbeck. S. Verlhulst, and N.J. Dingemanse. 2010. Experimental evidence for interference competition in oystercatchers (*Haemetopas ostralegus*) II. Free-living birds. Behaviorial Ecology 1261-1270.

Sæther, B-E, S Engen, A Pape Møller, H Weimerskirch, ME. Visser, W Fiedler, E Matthysen, MM. Lambrechts, A Badyaev, PH. Becker, JE. Brommer, D Bukacinski, M Bukacinska, H Christensen, J Dickinson, C du Feu, F Gehlbach, D Heg, H Ho¨tker, J Merila¨, JT Nielsen, W. Rendell, R. Robertson, DL. Thomson, Ja´nos To¨ro¨k, and P Van Hecke. 2004. Life-History Variation Predicts the Effects of Demographic Stochasticity on Avian Population Dynamics. American Naturalist 164(6):793-802.

Saether, B.-E. & O. Baake. 2000. Avian live history variation and contribution of demographic traits to the population growth rate. *Ecology* 81: 642-653.

Sanz-Aguilar, A., A. Martinez-Abrain, G. Tavecchia, E. Minguez, and D. Oro. 2009. Evidence- based culling of a facultative predator: Efficacy and efficiency components. *Biological Conservation* 142: 424-431.

Satterthwaite, A.H., A.S. Kitasysy, S.A. Hatch, J.F. Piatt, and M. Mangel. 2010. Unifying quantitative life-history theory and field endocrinology to assess prudent parenthood in a long-lived seabird. *Evolutionary Ecology Research* 12: 779–792.

Schlaepfer, M.A. et al. (2002). Ecological and evolutionary traps. Trends in Ecology and Evolution 17:474-480.

Shitikov, D., Fedotova, S., Gagieva, V., Fedchuk, D., Dubkova, E. & Vaytina, T. 2012. Breeding-site fidelity and dispersal in isolated populations of three migratory passerines. Orn. Fenn. 89: 53–62.

Smit, C.J.&Visser,G.J.M. 1993. Effects of disturbance on shorebirds: a summary of existing knowledge from the Dutch Wadden Sea and Delta area. Wader Study Group Bull.68: 6-19.

Speckman, S.G., A.M. Springer, J.F. Piatt, and A.M. Springer. 2004. Small boats disturb fish- holding marbled murrelets. Northwestern Naturalist 85: 32-3

Stauffer, H.B., C.J.Ralph, and S.L. Miller 2002. Incorporating Detection Uncertainty Into Presence-Absence Surveys for Marbled Murrelets. Chapter 29, Pages 357-369. In: Predicting Species occurrences: Issues of Accuracy and Scale, Scott M.et al. (eds.) Island Press, Washington.

Stearns, S.C. (1992) *The Evolution of Life Histories*. Oxford University Press, New York.

Stephens, P.A., Sutherland, W.J. and Freckleton, R.P. (1999) What is the Allee effect? Oikos 87, 185±190.

Steventon, J.D., G.D. Sutherland, and P. Arcese. 2003. Long-term risks to Marbled Murrelet (*Brachyramphus marmoratus*) populations: assessing alternative forest management policies in coastal British Columbia. Res. Br., B.C. Min. For., Victoria, B.C. Tech. Rep. 012.

Steventon, J.D., G.D. Sutherland, and P. Arcese. 2006. A population viability-based risk assessment of marbled murrelet nesting habitat policy in British Columbia. Can. Journal of Forest Research 36:3075-3086.

Stillman, R. A. & Goss-Custard, J. D. (2001). Seasonal changes in response of oystercatchers *Haematopus ostralegus* to human disturbance. *Journal of Avian Biology* **33**, 358-365.

Suter, G. W., II, R. A. Efroymson, B. E. Sample, and D. S. Jones, editors. 2000. *Ecological risk assessment for contaminated sites.* Lewis, Boca Raton, Florida, USA

Suter, G. W., II, S. B. Norton, and A. Fairbrother. 2005. Individuals versus organisms versus populations in the definition of ecological assessment endpoints. *Integrated Environmental Assessment and Management* **1**:1-4.

Thaxter, C.B., N.A. Clark, V.H. Ross-Smith, G.J. Conway, W. Bouten, and N.H.K. Burton. 2017. Sample size required to track area use of tracked seabirds. Journal of Wildlife Management 81(6):1098-1109

Tilman, D, RH May, CL Lehman, and ML Nowak. 1994. Habitat destruction and the extinction debt. Nature 65-66.

Tilman, D., Reich, P.B. & Isbell, F. (2012). Biodiversity impacts ecosystem productivity as much as resources, disturbance, or herbivory. Proc. Natl Acad. Sci. USA, 109, 10394–10397.

Vleck, C.M., Haussmann, M.F. & Vleck, D. (2007) -624. Journal of Ornithology, 148 (Suppl), 611-624.

Weimerskirch, H. 1990. The influence of age and experience on breeding performance of the Antarctic Fulmar, *Fulmarus glacialoides*. *Journal of Animal Ecology* 59(3): 867-875.

Weimerskirch, H. 1992. Reproductive effort in long-lived birds: age-specific patterns of condition, reproduction and survival in the wandering albatross. *Oikos* 64(3): 464-473.

Welty ,J. C. 1982. *The life of birds.* 3rd ed.. Saunders
College Publishing, New York.

Wilson, S., LaDeau, S. L., Tøttrup, A. P. and Marra, P. P. 2011. Range-wide e ects of breeding- and nonbreeding-season climate on the abundance of a Neotropical migrant songbird. – Ecology 92: 1789–1798.

Yasue, M., P. Dearborn, and A. Moore 2008. An approach to assess the potential impacts of human disturbance on Oryx 42(415-423.

Yelverton, J.T., D.R. Richmond, R.E. Fletcher, and R.K. Jones. 1973. Safe distances from underwater explosions for mammals and birds. Lovelace Foundation for Medical Education and Research, Albuquerque, NM, September 26, 1973, 64 pp.

Yelverton, J.T., D.R. Richmond, W. Hicks, K. Saunders, and E.R. Fletcher. 1975. The relationship between fish size and their response to underwater blast. Lovelace Foundation for Medical Education and Research, Albuquerque, NM, June 18, 1975, 39 pp.

Appendix A

Qualifications of Robert E. Dillinger, Ph.D.,
Principal, Coast Range Ecological Services

Dr. Dillinger has over 47 years of professional consulting and applied research and analysis experience in fish and wildlife biology and ecology. He has worked extensively on the biology and ecology of the following species: sockeye salmon, pink salmon, chinook salmon, coho salmon, kokanee, brown trout, rainbow trout, cutthroat trout, bull trout, and various species of chub. He has studied the biology and movements of moose, whitetail deer, groundhogs, opossums, red and gray squirrels, red-backed voles, prairie voles, and deer mice, and numerous birds and reptiles. He has done bioenergetic studies on the following species: brown trout, rainbow trout, cutthroat trout, Dolly Varden char, Arctic cisco, Bering cisco, humpback whitefish, broad whitefish, round whitefish, bull trout, Arctic cod, saffron cod, fourhorn sculpin, oldsquaw ducks, red phalaropes, northern phalaropes, glaucous gulls, black- and red-legged kittiwakes, and murres. He has also participated in proximate body composition analyses for the purpose of assessing energetic responses in the following species: Dolly Varden char, Arctic cisco, Bering cisco, humpback whitefish, broad whitefish. He co-developed and published seasonal growth models for juvenile Arctic cisco and broad whitefish, and participated and published seasonal body condition analyses for a number of species.

Dr. Dillinger has developed a number of methodologies for use in evaluating the effects of existing and proposed development on both aquatic and terrestrial ecosystems. He has developed a number of long-term, synoptic river and stream monitoring projects. Dr. Dillinger has developed a number of methodologies for use in evaluating the effects of existing and proposed development on both aquatic and terrestrial ecosystems. He is experienced in ESA Section 4, having successfully developed and completed Section 4 (d) compliance plans for a number of Oregon and Washington municipalities, as well as over 150 Biological Assessments, Biological Evaluations, and No-Effects letters for National Marine Fisheries Service and U.S. Fish and Wildlife Service Section 7 consultations, and Section 10 habitat conservation plans (HCP). He is extremely familiar with the existing programmatic consultations, having participated in the development of three for the Bonneville Power Administration. In addition, he has done wetland determinations and delineations and joint permitting for Section 404 compliance. He has also written a number of documents in support of the statewide planning goals (e.g. Oregon ESEE and Goals 2, 4 and 5 compliance). Dr. Dillinger has developed a number of methodologies for use in evaluating the effects of existing and proposed development on both aquatic and terrestrial ecosystems.

He is the author of numerous articles for such journals as the Canadian Journal of Fisheries and Aquatic Science, Transactions of the American Fisheries Society, Canadian Journal of Zoology, Biochemical Ecology and Systematics, North American Journal of Fisheries Management, and Canadian Field-Naturalist.

Education

PhD. Biology. Memorial University of Newfoundland, St. John's, Newfoundland
M.S. Biology. Texas A & M University, College Station, Texas
B.Sc. Zoology. University of Alberta, Edmonton, Alberta

Appendix B
BASH Records

Summary of Bird Strikes: Summary of FOIA data on bird strikes by EA-6B (Prowlers) and EA-18G (Growlers) based out of NASWI. Data summarized was just that from June 26, 2001, to September 6, 2013.

Number	Date	[a]	Jet type	Location	Notes
64556	6/26/2001	H	EA006B	NUW	THE OWL STRUCK THE PORT MAIN LANDING. THE ONLY EVIDENCE OF A BIRD STRI
52573	11/7/2001	H	EA006B	NUW	NO COMMENT.
52572	12/4/2001	H	E006B	NUW	NO COMMENTS.
52708	1/22/2002	H	EA006B	NUW	BIRD CONDITION FROM ATIS WAS GREEN, STRIKE OCCURRED WHILE IN TRAFFIC
52530	2/10/2002	H	E006B	NUW	HIT COYOTE ON LANDING ROLL-OUT ON RNWY 13 AT INTERSECTION WITH TAXIWA
52485	4/16/2002	H	E006B	NUW	AIRCRAFT BIRD STRIKE WAS DISCOVERED AT 0800 0N THE 17 APRIL 2002. A D
52680	6/2/2002	H	EA006B	NUW	REMIANS SENT IN FOR IDENTIFICATION. AIRCREW WAS ON APPROACH FOR TOUC
52625	6/17/2002	H	XX006	NUW	WHILE ON DET TO NAS WHIDBEY, THE JAPANESE NAVY WAS PERFORMING A TOUCH
52972	7/18/2002	H	EA006B	NUW	LANDING PATTERN, RWY 25
53019	9/10/2002	H	EA006B	NUW	OCCURED IN LANDING PATTERN
53612	9/11/2002	H	EA006B	NUW	REMAINS FOUND ON POST-FLIGHT INSPECTION. ACTUAL LOCATION OF STRIKE E
53468	12/2/2002	H	EA006B	NUW	BIRD IMPACTED LEFT WING AS AIRCRAFT WAS CLIMBING PAST 1000 FEET AGL O
83361	6/2/2003	C	EA006B	WDBYI	BIRD STRUCK PORT CHEEK PANEL/ENG INTAKE DUR APPR RESULTING IN ENG FOD.
65513	8/29/2003	H	EA006B	NUW	WHILE ON APPROACH TO RUNWAY 25 AT NUW A SMALL BIRD STRUCK THE RIGHT S
65506	9/2/2003	H	EA006B	NUW	MAINTENANCE CREW FOUND SIGNS OF IMPACT ON STATION 5 JAMMING POD RADOM
65596	9/12/2003	H	E006B	NUW	BIRD REMAINS DISCOVERED ON POSTFLIGHT INSPECTION IN THE STARBOARD WHE
65618	9/22/2003	H	EA006B	NUW	DURING POSTFLIGHT INSPECTION, FOLLOWING A FLIGHT IN THE LANDING PATTE
71734	9/30/2003	H	EA006B	NUW	/ON SHORT FINAL TO RWY 31, AIRCRAFT FLEW THROUGH A FLOCK OF SMALL BIRD
88423	4/1/2004	B	EA006B	NUW	BIRD STRUCK ACFT ON LOW LEV TRNG FLT, BIRD INGESTED DOWN PORT ENGINE.

78482	5/3/2004	H	EA006B	WDBYI	BIRD STRIKE ON THE VR-1351
69160	5/3/2004	H	EA006B	NUW	bird strike
67934	7/19/2004	H	EA006B	NUW	ON POSTFLIGHT INSPECTION, BIRD'S REMAINS WERE FOUND ON UNDERSIDE OF E
68315	9/16/2004	H	EA006B	NUW	REMAINS FOUND BY FIELD FACILITIES DURIING ROUTINE FIELD DUTIES.
68494	12/3/2004	H	EA006B	NUW	BIRDSTRIKE EVIDENCE FOUND ON POST FLIGHT INSPECTION AFTER THE SECOND
68772	12/22/2004	H	EA006B	NUW	BLOOD SAMPLE FOUND ON ACFT ON POST FLIGHT INSP.
68773	1/4/2005	H	EA006B	NUW	REMAINS FOUND ON ACFT DURING PRE-FLIGHT INSP.
68567	1/12/2005	H	EA006B	NUW	DURING NIGHT FCLP'S BIRD IMPACTED PORT OUTBOARD FLAP. DISCOVERED DUR
68774	1/13/2005	H	EA006B	NUW	BLOOD REMAINS FOUND DURING POST FLIGHT INSPECTION.
68776	3/22/2005	H	EA006B	NUW	ROBIN FOOUND BY FIELD ELECTRICIAN 64.
68775	4/8/2005	H	EA006B	NUW	SWALLOW FOUND ON DECK BY FIELD FACILITIES.
68920	5/3/2005	H	EA006B	NUW	AIRCREW FELT SMALL IMPACT WHILE DOWNWIND IN THE LANDING PATTERN. NO
68921	5/3/2005	H	EA006B	NUW	AIRCREW HAD NO INDICATIONS OF BIRDSTRIKE. REMAINS WERE DISCOVERED BY
88182	5/8/2005	C	EA006B	WDBYI	PORT ENGINE INGESTED BIRD ON CROSS COUNTRY FLIGHT. EXACT LOCATIONS UNK
73610	6/5/2005	H	EA006B	NUW	Barn owl found on deck by duty sweeper, acft unknown.
69072	6/15/2005	H	OTHER	NRA	THE BIRD STRIKE IS BELIEVED TO OCCUR DURING NIGHT FCLP AT OLF COUPEVI
70157	8/24/2005	H	EA006B	NUW	Bird Strike found on maintenance post flight.
73608	8/26/2005	H	EA006B	NUW	Dead Coyote found on runway.
71125	9/15/2005	H	EA006B	NUW	Bird Strike
73907	3/28/2006	H	EA006B	NUW	Aircraft had bird strike on low level route.
73190	4/20/2006	H	EA006B	NUW	BIRD STRUCK PORT MAIN LANDING GEAR FWD DOOR ACTUATOR DURING NIGHT FCLP
75549	4/20/2006	H	EA006B	NUW	BIRD STRIKE TO STARBOARD ENGINE DURING NIGHT FCLP.
73588	5/16/2006	H	EA006B	NUW	Birdstrike on Starboard Outboard Slat.
73271	5/23/2006	H	EA006B	NUW	Bird struck nose of aircraft while in FCLP/CCA pattern at nas.
73906	6/29/2006	H	EA006B	NUW	AIRCRAFT HIT BIRD WHILE ON A MILITARY TRAINING ROUTE.
76178	1/11/2007	H	EA006B	NUW	AIRCRAFT EXPERIENCES MULTIPLE BIRD STRIKES IN NIGHT FCLP PATTERN
77837	4/27/2007	H	EA006B	NUW	WING AIRCRAFT OF 10-SECOND SECTION TAKEOFF STRUCK FOUR BIRDS.

78213	5/1/2007	H	EA006B	AULT	Returning to base, descending at approximately 10000 ft.
78028	5/3/2007	H	EA006B	NUW	Small bird struck nose radome.
78649	5/16/2007	H	EA006B	NUW	Small bird struck right wing flap on landing rollout
78649	5/16/2007	H	EA006B	NUW	Small bird struck right wing flap on landing rollout
78800	6/9/2007	H	E006B	NUW	BIRDSTRIKE ON STARBOARD OUTBOARD FLAP
78800	6/9/2007	H	E006B	NUW	BIRDSTRIKE ON STARBOARD OUTBOARD FLAP
78711	6/11/2007	H	EA006B	NUW	Birdstrike discovered on postflight
78704	6/27/2007	H	EA006B	NUW	BIRD STRIKE DURING LANDING ROLLOUT
78863	7/10/2007	H	EA006B	NUW	BIRDSTRIKE DISCOVERED POSTFLIGHT
79397	7/15/2007	H	EA006B	NUW	Bird Strike in the landing pattern.
79069	7/31/2007	H	E006B	NUW	AIRCRAFT STRUCK BIRD ON RIGHT SIDE OF RADOME DURING LOW LEVEL.
79177	8/9/2007	H	EA006B	NUW	On low level route aircraft struck unknown type of bird.
79493	9/6/2007	H	EA006B	AULT	POST FLIGHT INSPECTION REVEALED BIRD STRIKE ON RADOME.
79532	9/17/2007	H	EA006B	NUW	Bird ingested down port intake.
80171	10/25/2007	H	EA006B	WDBYI	Bird Strike on take off from NUW.
80780	12/13/2007	H	EA006B	NUW	EVIDENCE OF BIRD STRIKE FOUND ON POST FLIGHT
83201	3/18/2008	H	EA006B	NUW	Bird strike during night flight
84253	4/21/2008	H	EA006B	NUW	Bird struck radome of aircraft during climbout.
84255	4/23/2008	H	EA006B	NUW	Bird Struck port inboard flap
84252	5/2/2008	H	EA006B	NUW	Bird Struck Port slat during climb through 2300 ft in boardman range
85944	7/1/2008	H	EA006B	NUW	Bird Strike
86308	8/19/2008	H	EA006B	NUW	Bird struck aircraft shortly after touch and go lift off.
86174	8/27/2008	H	EA006B	NUW	BIRD STRIKE
86344	9/9/2008	H	EA006B	NUW	Bird impacted pilot's windscreen just prior to landing.
88481	9/10/2008	H	EA006B	AULT	Birdstrike
86345	9/10/2008	H	EA006B	NUW	BIRD STRIKE
87133	10/31/2008	H	EA006B	NUW	VAQ130 MULTIPLE BIRD STRIKE ON TAKE OFF ROLL
93878	11/16/2008	H	EA006B	AULT	Birdstrike
90517	4/6/2009	H	EA018G	NUW	Bird Strike
90523	4/8/2009	H	EA006B	NUW	BIRD STRIKE DURING NIGHT FCLP'S
90522	4/20/2009	H	EA006B	NUW	Bird Strike
89813	4/20/2009	H	EA006B	NUW	Bird Strike
92182	6/15/2009	H	EA006B	NUW	Bird Strike
92186	6/23/2009	H	E006B	NUW	Bird Strike
92185	6/24/2009	H	EA006B	NUW	Bird Strike
92200	7/9/2009	H	EA018G	NUW	Bird Strike
92201	7/15/2009	H	EA006B	NUW	Bird Strike

92349	7/20/2009	H	EA006B	NUW	Bird Strike
92979	7/22/2009	H	EA006B	NUW	Bird Strike
92356	7/24/2009	H	EA006B	NUW	Bird Strike
99502	4/22/2010	H	EA006B	NUW	Bird Strike
99256	5/5/2010	H	EA006B	NUW	Bird Strike
99503	5/13/2010	H	EA006B	NUW	Bird Strike
99350	5/21/2010	H	EA006B	NUW	Near strike event on take off roll
98763	6/7/2010	H	EA006B	NUW	Bird Strike
98764	6/7/2010	H	EA006B	NUW	Bat Strike
4dd58859326cb47901326e15f4530b97	6/7/2010	H	EA006B	NUW	BAT FOUND ON MAIN LANDING GEAR DOOR.
100047	6/22/2010	H	EA006B	NUW	Bird Strike
100058	7/14/2010	H	EA006B	NUW	Bird Strike
100059	7/14/2010	H	EA006B	NUW	Bird Strike
4dd588593a69dcd1013a6f0ea1b21971	10/14/2010	H	EA006B	NUW	EA-6B - BIRD STRIKE DURING LANDING PHASE OF FLIGHT.
4dd58859321f5d0801324a3dcff77c4c	10/14/2010	H	EA018G	NUW	BIRD STRIKE DURING NIGHT FLIGHT
4dd588593a21ee25013a275b6b6d1c56	2/8/2011	H	EA006B	NUW	Damaging Bird Strike
4dd588593a69dcd1013a6b18a66c0bf7	3/8/2011	H	EA018G	NUW	BASH DURING NIGHT FCLP'S BIRD HIT PORT TRAILING EDGE FLAP
4dd58859337e03b50133b8146064445b	6/9/2011	H	EA006B	NUW	During flight A/C incurred a bird strike during a Basic Air Maneuvers over Roosevelt MOA.
4dd58859321f5d080132630513b7317a	7/19/2011	H	EA018G	NUW	BIRD STRIKE TO RIGHT AILERON, NEAR FLAP, DURING LOCAL FLIGHT.
4dd588593cfc905f013cfe3f0de211d2	9/15/2011	H	EA006B	NUW	BIRD STRIKE TO FRONT OF CANOPY WHILE ON TAKE OFF ROLE.
4dd588593cfc905f013cfe37663c1114	9/23/2011	C	EA018G	NUW	Bird strike to starboard ALQ-218 radome.
4dd588593cfc905f013cfe35210210d9	9/29/2011	H	EA006B	NUW	BIRD STRIKE ON LANDING ROLLOUT
4dd588593cfc905f013cfe3cce451191	10/4/2011	H	EA006B	NRA	NOTICED BIRD REMAINS AFTER LANDING.
4dd588593f3484ca013f57e3a0e17c7e	10/6/2011	H	EA006B	NUW	BIRD STRIKE
4dd588593cfc905f013cfe3a36b5113b	10/12/2011	H	EA018G	NUW	BIRD STRIKE ON SHORT FINAL
4dd588593d3c69c1013d4691c8963b5b	12/1/2011	H	EA018G	NUW	BIRD STRIKE TO TOP OF CANOPY.
4dd588593d3c	2/16/2012	H	EA018G	NUW	HIT BIRD ON TOP OF CANOPY, AND

69c1013d465a140c38ca4dd588593d3c					RIGHT SIDE FUSELAGE DURING LOW LEVEL FLIGHT.
69c1013d464b6fb837fe4dd588593d3c	4/19/2012	H	EA018G	NUW	AIRCREW WAS UNAWARE OF BIRDSTRIKE
69c1013d4661e0273947	5/16/2012	H	EA006B	NUW	BIRD HIT NOSECONE
4dd5885937ae9b810137c71fc04559d5	5/22/2012	H	EA018G	NUW	BIRD STRIKE FOUND ON DOOR OF NOSE LANDING GEAR. DISCOVERED DURING POST FLIGHT.
4dd58859389ae4810138c35e9bfa7836	6/6/2012	H	EA018G	NUW	BIRD STRIKE DISCOVERED DURING POST FLIGHT INSPECTION.
4dd5885937ae9b810137e11f0757131b	6/7/2012	H	EA006B	NUW	EA-6B experienced bird strike in the landing pattern.
4dd58859389ae4810138c34b0b1376e3	7/12/2012	H	EA018G	NUW	BASH ON POST FLIGHT INSPECTION, DISCOVERED SMALL BIRD IMPACT.
4dd58859389ae4810138bed258626955	7/16/2012	H	EA018G	NRA	BIRD STRIKE FOUND ON POST FLIGHT INSPECTION.
4dd588593a69dcd1013a6adae4fe0947	9/12/2012	H	EA018G	NUW	Bird strike to EA-18 on departure from KNUW.
4dd588593a69dcd1013a6b36599c0d6a	9/18/2012	H	EA018G	NUW	Bird strike found during post flight inspection.
4dd588593a69dcd1013a6b0ba5620b46	9/28/2012	H	EA006B	NUW	Bird remains found on port wing during daily inspection.
4dd588593a69dcd1013a6b04c7c10a8d	10/1/2012	H	EA018G	NUW	Bird srike discovered during post flight inspection, the next morning.
4dd588593a69dcd1013a6b88d9010fff	10/2/2012	H	EA018G	NUW	Bird strike noticed during post flight inspection.
4dd588593a69dcd1013a6b8ac4821011	10/3/2012	H	EA018G	NUW	Birdstike noticed duting daily inspection, last flight was the night before.
4dd588593a69dcd1013a79c0de2e05c8	10/11/2012	H	EA018G	NUW	Birdstrike during VR-1355 flight.
4dd588593cd395d9013cd91f90111729	2/12/2013	H	EA018G	NRA	EA-18G BASH bird strike on the ALQ-218 wingtip mount.
4dd588593e99f56d013ec243e5fc31e1	3/26/2013	H	EA018G	NUW	Bird strike discovered on port side of canopy following a night section training event.
4dd588593f3484ca013f51f2194d5f9e	3/27/2013	H	EA018G	NUW	A/C Impacted Bird during Landing Pattern
4dd588593f3484ca013f5205e8716009	4/25/2013	H	EA018G	NRA	A/C impacts bird during Night FCLPs
4dd588593ed662b5013ef1d5026e416c	5/21/2013	H	EA018G	NUW	EA-18G BASH Nose Landing Gear

4dd588593ed6 62b5013ef1d3b 4654152	5/21/2013	H	EA018G	NUW	EA-18G BASH Starboard TEF
4dd588593fcfef b8013fd3a9bd1 30d70	7/10/2013	H	EA018G	NUW	EA-18G BASH. Bird remains discovered in the port intake and on the device.
4dd5885941a3 b6680141a76a 5ace0acc	9/6/2013	C	EA018G	NUW	Bird strike discovered on EA-18G right aileron during post-flight inspection.

A Severity: H = hazard, A = greatest severity and C= least severe.

Appedix E.2-C

The following are excerpts from the NWTT BiOp in that support information in the expanded Growler BiOp on the impacts of jet noise harassment on marbled murrelets.

- Navy assumes species present in the study area are habituated to noise. DEIS Appendix page A-194, DEIS page 4-205. Murrelets are included in this assumption. DEIS page 5-22. Noise from aircraft landing and takeoff may cause cumulative wear and tear on individual murrelets, causing avoidance of continued exposure or stress through changes in heart rate, blood pressure, and gastrointestinal activity. Navy assumes the birds habituated to noise. BA page 4-4.
- Research into the effects of aircraft disturbances on marbled murrelets is limited. One study found murrelets in marine waters decreased in response to increasing numbers of boats and low-flying planes. DEIS page 4-209.
- Navy cautions that it is difficult to generalize animal responses to noise or draw inferences across species since reactions to aircraft appear to be species specific. DEIS Appendix, page A-194.
- Low flying aircraft may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests. DEIS Appendix page A-188, BO pages 206-207.