February 25, 2015

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ESRC Chairman

Subject: March 31, 2015 ESRC meeting
SunEdison Hawaii HCP Post-Intensive Monitoring

The following summarizes the results of intensive downed wildlife monitoring conducted since commercial operations commenced at four wind energy projects operated by First Wind Energy, pursuant to each project's approved Habitat Conservation Plan (HCP). The purpose of this summary is to support a decision by DOFAW and USFWS to allow intensive monitoring to be discontinued at each site and determine what type of long-term monitoring, if any, should be required going forward.

The primary objective of monitoring is to ensure that take is adequately accounted for so that mitigation can be provided that ensures a net conservation benefit for each covered species. A secondary but also important objective is to accomplish the first objective as cost effectively as possible. Options for determining take (and thus the required mitigation) include, (1) intensive monitoring over the life of the project, (2) intensive monitoring for 2-3 years followed by a reduced monitoring protocol, or (3) projecting take over the permit term based on rates determined during the intensive monitoring phase with no further monitoring.

Continuing Intensive Monitoring Over the Permit Term.

Intensive monitoring is labor intensive and very expensive when extended over many years. In addition, continuing intensive monitoring does not assure a greater benefit to the covered species and the return on this additional effort diminishes over time. In addition, constant accounting is required at agency and applicant expense, which could result in either more or less mitigation being provided. And even under ideal conditions (which are atypical), no amount of monitoring will determine the actual take with absolute precision – there will always be uncertainty. For these reasons continuous intensive monitoring beyond an initial 2-3 year period was not proposed in the original HCP and is not recommended now. This is clearly stated in the text of the original HCP and reflected in the accompanying funding estimates.

Intensive Monitoring Followed by Reduced Monitoring.

A reduced monitoring program could consist of sampling a subset of turbines, reducing plot sizes, reducing search frequency, or some combination of these. The objective would be to verify over time that the estimate of take was within confidence limits. However, obtaining an accurate estimate of

take, especially for rare events, is difficult even under intensive monitoring protocols. A subsampling approach is statistically weaker due to the combination of reduced sampling intensity and challenging search conditions (as reflected in SEEF and CARE results). Thus, any results would have the potential to raise more questions than answers.

For example, reduced monitoring might be proposed to confirm that no unusually large fatality events go undetected. However, in 16.5 years of intensive monitoring conducted across four operating projects in Hawaii (KWP I, KWP II, Kahuku, and Kawailoa) no unusually large fatality events have ever been documented. The most observed fatalities found on a single day was two bats at Kawailoa on August 12, 2013. Otherwise there has never been more than one observed fatality of covered species documented at any site on any day. In up to seven consecutive days there has only been two observed bat fatalities in April 2012 at Kahuku, two bats in April 2013 at KWP I and two bats each in September 2013, August 2014 and September 2014 at Kawailoa. The most observed take of any species in a calendar month was three Nene in January 2013 at KWP I and three bats in September 2013 at Kawailoa. All fatalities documented to date were detected under an intensive protocol. The chances of detecting such events by searching less intensely are remote at best. And if such an event were detected there would be no valid way to statistically incorporate the data into an estimate of take.

One alternative is to repeat intensive monitoring at regular intervals after the original three years (e.g., every fifth year). Logistically this approach would require remobilization in advance of every monitoring year to reestablish search plots and transects, re-initiate vegetation management and predator control, and to hire and train staff and possibly canines (or out-source to a consultant). Once completed the additional year's data would presumably be used to verify that rates of take hadn't changed. Any significant change in the rate would presumably trigger a consideration of whether mitigation has been sufficient (or conversely, excessive). However it is unclear whether – or how - the additional data would be used and no assurance the new estimate would be more accurate. Given these shortcomings it is not clear this approach would provide any benefit in return for the costs.

Recommended Approach: Projected Take with No Further Monitoring.

This approach projects take over the permit term based on the rates that are documented during the initial intensive monitoring period. No further monitoring is conducted. Estimates of take during the intensive monitoring period are corrected for natural biases (searcher efficiency, scavenging, search interval, etc.), and use an 80% credibility level to ensure all likely take is accounted for. When projected into the future the 80% credibility yields an extra-conservative result because it is applied to all years, whereas by definition that level of take would only be expected to be exceeded in 2 out of every 10 years. Because of this, the take projected over the permit term is inherently conservative (i.e., an overestimate). This in turn ensures that the mitigation provided will result in a net conservation benefit for the covered species. This is the most cost-effective approach and ensures that money is spent where it will do the most good – toward conservation of the covered species. Unnecessary costs associated with monitoring, accounting and reporting, and use of agency staff time and resources can be greatly reducing benefit to the species.

HCP Monitoring Guidelines

Each project HCP provides for an initial multi-year intensive monitoring period to establish take trends followed by "long-term" monitoring to verify trends/detect variances. Initial intensive monitoring obligations are as follows:

KWPI	Kahuku	KWPII	Kawailoa
1-2 yrs	2 yrs	3 yrs	3 yrs
Extended March 2015	Complete	Fulfilled July 2015	Fulfilled Nov 2015

Generally each HCP indicates that intensive monitoring may be reduced subject to approval of DOFAW and USFWS. The HCPs also suggest that, "…Discussion with ESRC, USFWS and DLNR has indicated a preference for the reallocation of effort whereby mitigation efforts are increased in exchange for a reduction in on site fatality monitoring…". With this in mind, the Adaptive Management provisions of each HCP would also potentially allow monitoring to be discontinued altogether and take projected forward based on the results of intensive monitoring conducted to date. For this to be possible DOFAW and USFWS would have to conclude that the mitigation being provided was sufficient to ensure a net conservation benefit for each species.

Relevant excerpts from each HCP include the following:

KWP I HCP (Appendix 9, pg. 2): "…Depending upon the outcome of the initial intensive surveys, it may be possible to develop a less labor-intensive protocol for the long-term monitoring of bird and bat fatalities at the site. Long-term methods may include sampling a subset of turbines, searching smaller plots or subplots, or simply conducting less frequent searches if it is determined that scavenging rates are low. Methods will continue to be adapted in consultation with, and subject to the approval of, USFWS and DLNR…."

Kahuku HCP (pg. 98): "…It is expected that the approach will be reduced to a sampling method based on the results obtained up to that point; Systematic searches of 50% reduced effort will subsequently be conducted at five-year intervals and a further reduced but regular sampling method conducted during the interim years…"

Kawailoa HCP (pg. 121): The intensive monitoring approach, "…may be reduced to a sampling method based on the results obtained up to that point, subject to the approval of DOFAW and USFWS…"

KWP II HCP (pg. 122): "…The approach may be reduced to a sampling method based on the results obtained up to that point, subject to the approval of DOFAW and USFWS. For example, systematic searches of 50% reduced effort could subsequently be conducted at five-year intervals and a further reduced but regular sampling method conducted during the interim years…"

Summary of Intensive Monitoring Results to Date

All four projects have been subject to intensive monitoring since commencement of commercial operations. This has extended for nine years at KWP I, three years at Kahuku, two years at Kawailoa and

two and one-half years at KWP II. During this period, Observed Take, Searcher Efficiency (SEEF) and Carcass Persistence (CARE) have varied annually and by site (Appendices 1 and 2). Following is a summary of results to date for each site.

KWP I

KWP I is unique in having been the first project constructed with an approved HCP, and it has been a testing ground for many of the methods that are used across all four sites today. Although the HCP includes provisions for scaling back monitoring after an initial period, intensive monitoring has continued for over nine years due to low confidence by DOFAW and USFWS in search results. Methods have been relatively consistent across sites in recent years, leading to greater confidence in the search results. KWP I also has some of the most challenging search conditions due to rugged terrain and vegetation cover, and the use of canine assistance has until recently been restricted due to concerns about disturbance to on-site Nene. As a result SEEF has consistently been lower at KWP I, although it has increased and become more consistent over time with improvements in methods and training.

For KWP I the average annual observed bat take is nearly one (Figure 1). Average observed annual take of Nene at KWP I is approximately two. Average observed annual take for HAPE at KWP I is approximately 0.75.

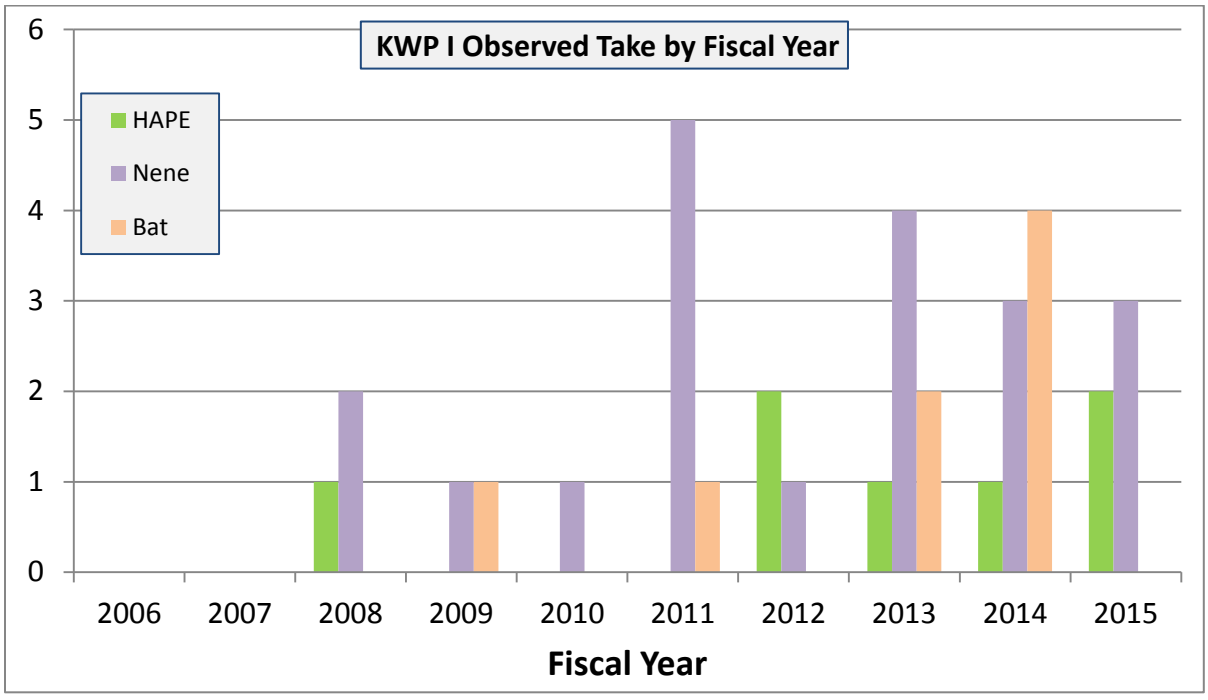

Figure 1. KWP I observed take by fiscal year.

Searcher Efficiency (SEEF) has averaged approximately 50% for bats at KWP I. SEEF has averaged nearly 75% for both Nene and HAPE at KWP I.

Carcass Retention (CARE) is measured in 14-day trials[1] in order to compare all years at all sites. CARE has averaged approximately seven days for bats at KWP I. HAPE at KWP I averaged 12 days, while Nene at KWP I averaged 14 days. Search interval has been approximately seven days at KWP I, although due to provisions specific to this project's HCP, the search interval at KWP I was longer initially in FY 2007 and shorter through FY 2009 during Nene and HAPE breeding periods.

SEEF trial surrogate carcasses at KWP I for bats used through fall 2010 were small song birds which are easier to see than the small rat carcasses used there since late 2010. Although not ideal, small birds were considered the closest available surrogate in the early years and deemed acceptable. In 2010 First Wind began using rats that were closer to bats in size and color. Nonetheless rats are not exact matches for bats either: for example they lack wings making rats harder to find than bats; thus using rats may bias take estimates upward.

Given the above, it is suspected that the SEEF results from small bird trials may have overestimated searcher efficiency, while small rats may be yielding an underestimate. While the SEEF results from small bird surrogates (58%) are similar to those from FY 2014-2015 using small rats (58%), they are noticeably different from the results using small rats in 2011 through mid-2013 (33%) (Appendix 2). The result would be a bias that underestimates bat take during the early years, with a potential bias toward overestimating take in later years.

In general the searching conditions, search training, and techniques have improved over the years and may partially account for the higher observed take of bats in FY 2014-2015. Higher observed take during this period may also be influenced by annual variation. As an added assurance, from April 2014 through March 2015 SEEF trials at KWP I and KWP II are being independently proctored by West Inc., including blind, random placement of trial carcasses. SEEF trial results using small rats is 25% higher in FY 2014-2015 compared to FY 2011-2013 suggesting that searcher efficiency has improved in FY 2014-2015. SEEF improvement would be expected to affect observations of bat take more than the larger birds.

Searcher efficiency may have also improved over time for the medium and large birds. During the 3.5 year period including FY 2007 and FY 2010, one HAPE and four Nene takes were found at KWP I. This 3.5 year period represents 39% of the entire nine year period while the take represents only 18% of the total observed in nine years. Observed take of Nene and HAPE at KWP I in FY 2014-2015 (representing 17% of the nine year monitoring period) are 30% and 43%, respectively, of the total observed take of these species over the nine years. Although more Nene take has been observed at KWP I in the later years the annual variation from FY 2008 through FY 2015 does not appear to be an increasing trend (Appendix 2). And, although three HAPE take were found at KWP I in the end of FY 2014 and the first quarter of FY 2015 the trend by FY since FY 2008 also does not appear to be increasing.

[1] Trial lengths at all sites have been 28 days in fiscal years 2013-2015 and earlier at KWP I.

KWP II

KWP II also has challenging search conditions due to rugged terrain and vegetation cover, and like KWP I, the use of canine assistance has until recently been restricted due to Nene concerns. However, KWP II has benefitted from lessons learned at KWP I as a result of operations starting several years later, and monitoring results have generally been more consistent at this site.

For KWP II the average annual observed bat and Nene take is nearly one for each species (Figure 2). No take of HAPE or NESH have been documented.

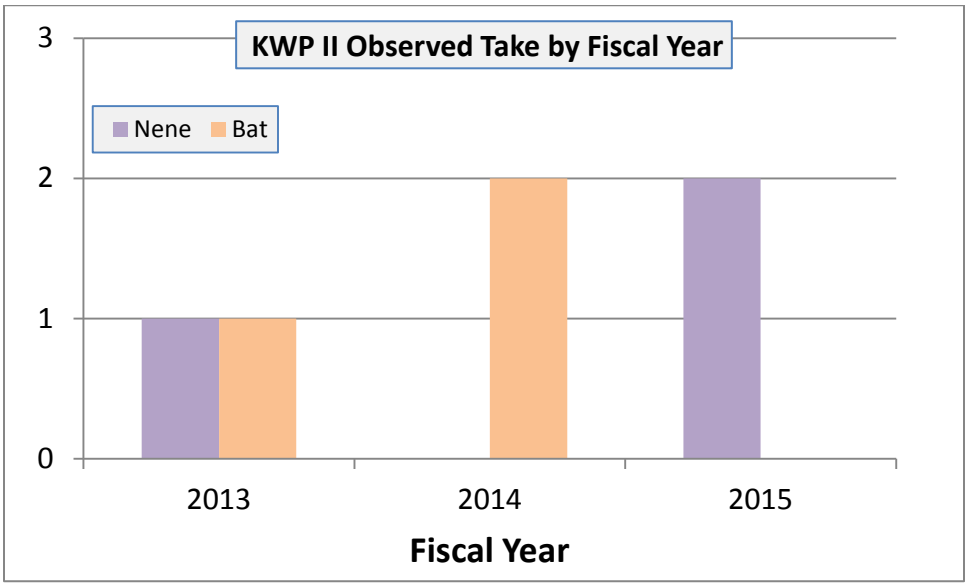

Figure 2. KWP II observed take by fiscal year.

Searcher Efficiency (SEEF) has averaged approximately 50% for bats at KWP II. SEEF has averaged nearly 75% for Nene and about 65% for HAPE at KWP II.

CARE has averaged approximately six days for bats at KWP II. HAPE at KWP II averaged 12 days, while Nene averaged 14 days. Search interval has been approximately seven days at KWP II.

Kahuku

For Kahuku the average annual observed bat take is nearly one (Figure 3). No take of any of the other covered species has been documented.

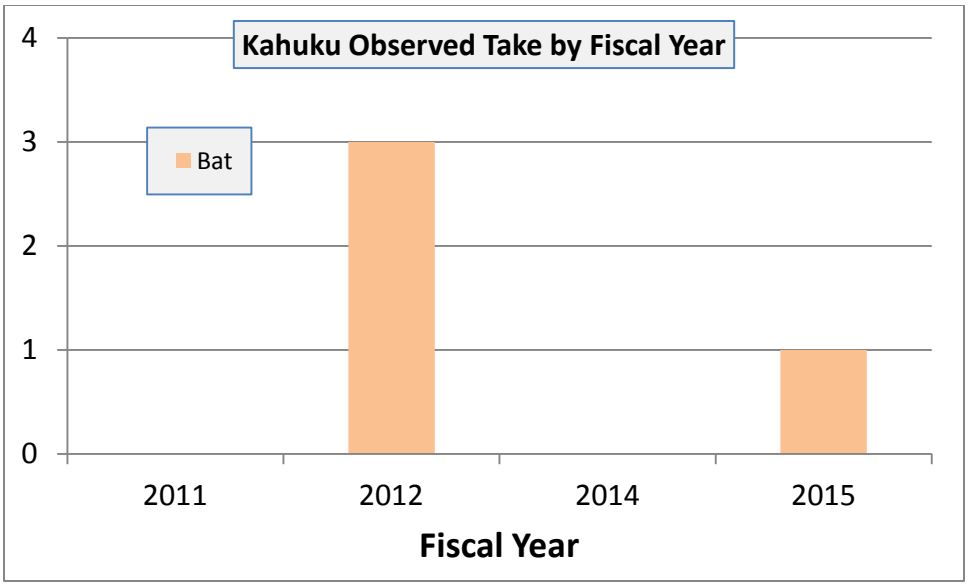

Figure 3. Kahuku observed take by fiscal year.

Searcher Efficiency (SEEF) has averaged approximately 75% for bats at Kahuku. The higher average SEEF results at Kahuku reflect the easier search conditions at this site as well as the use of trained dogs. Searching conditions at Kahuku have consistently been very favorable - manicuring relatively flat plot areas at this site has been standard practice since the beginning of the intensive searching period. Also beginning in July 2012 at Kahuku dogs have assisted human searchers and significantly improved the already very good conditions for finding the bats. SEEF results at Kahuku for the bat are as high as those for very much larger geese at KWP I and KWP II (75%) and results for petrel size birds is nearly 100%.

CARE has averaged approximately seven days for bats and 12 days for medium size birds at Kahuku. Search interval has been approximately 3.5 days at Kahuku.

Kawailoa

Average observed annual bat take at Kawailoa is notably higher at approximately 10 (calendar years 2013 and 2014) and very similar over the two years of monitoring (Figure 4). No take of any of the other covered species has been documented.

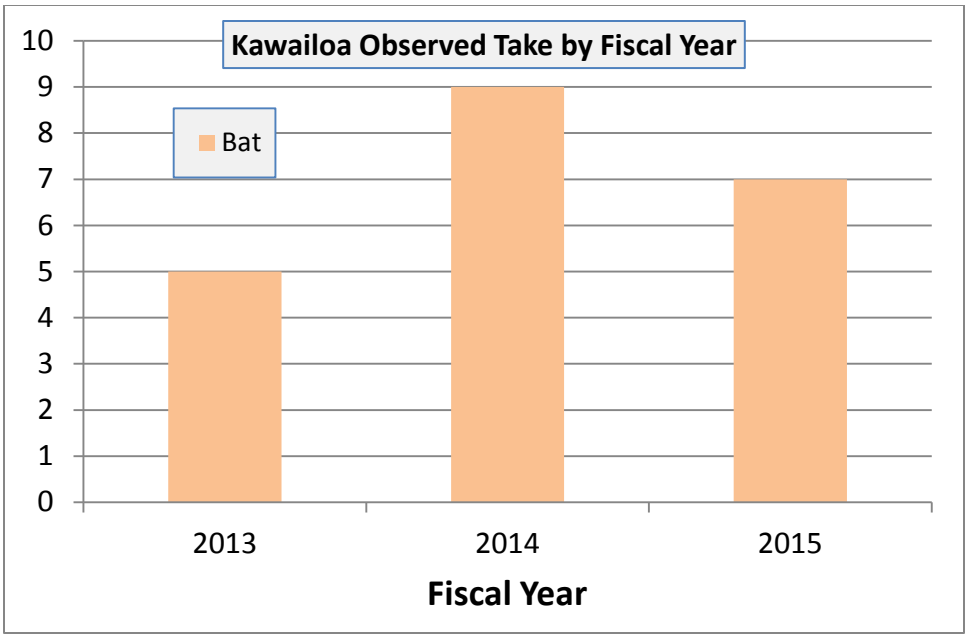

Figure 4. Kawailoa observed take by fiscal year.

Searcher Efficiency (SEEF) has averaged approximately 75% for bats at Kawailoa. The higher average SEEF results at Kawailoa reflect the easier search conditions at this site as well as the use of trained dogs. Searching conditions at Kawailoa have consistently been very favorable - manicuring relatively flat plot areas at this site has been standard practice since the beginning of the intensive searching period. Also beginning in July 2013 at Kawailoa dogs have assisted human searchers and significantly improved the already very good conditions for finding the bats. SEEF results for the bat are as high as those for very much larger geese at KWP I and KWP II (75%) and results for petrel size birds is nearly 100%.

CARE has averaged approximately seven days for bats and 12 days for medium size birds at Kawailoa. Search interval has been approximately 3.5 days at Kawailoa.

Estimating Take

An estimate of the take that has actually occurred, accounting for take that may not have been found ("Estimated Take") is derived from Observed Take using an algorithm that accounts for the above biases (SEEF, CARE, Search Interval, etc.). The results shown in Figure 5 and Appendix 1 were calculated using the latest method from Huso et al (*In press*), also referred to as the Evidence of Absence estimator. This method yields estimates at various levels of credibility. An example result would be 80% credibility (or other chosen level) that the actual take does not exceed the estimate. Any length of time can be selected as an interval, although typically one year is used.

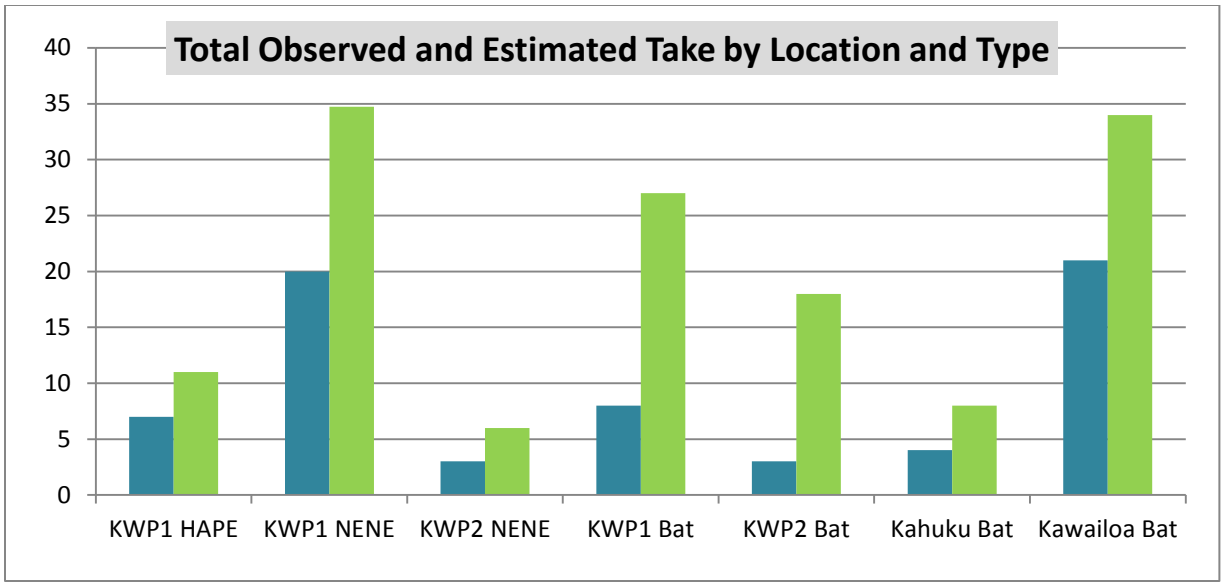

Figure 5. Total observed and estimated take during operations for each species type and at each location (for species with observed take). These estimates do not include indirect take.

This estimator also has the ability to provide a total estimate from multiple intervals having differing SEEF, CARE and Search Intervals, weighted relative to what portion of the estimate period each interval represents. The multi-interval estimation includes take that was estimated to have occurred during every interval even when no take had been observed. Because the purpose of the estimator is to account for take that may have gone undetected, the estimator always yields a number that is higher than the observed take. How much higher depends on the combined effect of the various biases. In this paper we present the estimated take at the 80% credibility level.

At each site, multiple intervals having different combinations of SEEF, CARE and Search Interval are combined for each species. The resulting estimated take is 1.7, 2.0, 3.4 and 5.3 times observed take for bats at Kawailoa, Kahuku, KWP I and KWP II, respectively (Figure 5, Appendix 1 and 3). The estimated take is 1.7, 2.5, and 1.6 times observed take for Nene at KWP I and KWP II and HAPE at KWP I, respectively.

At Kawailoa, the only site averaging 10 observed bat takes per full calendar year, SEEF has averaged from 63% to 89% and observed take by month during the initial two years has been consistent (Appendix 4). As a general rule real patterns are more likely to be revealed if sample size is greater. Therefore and considering the high SEEF results and low standard deviations (SDs), the estimated bat take at Kawailoa may be close to the actual take.

By comparison, the SD for observed take is nearly equal to the mean for bats at Kahuku, KWP I and KWP II, Nene at KWP I and KWP II, and HAPE at KWP I. This is expected given the very low annual rates of take, and the large effect on SD of relatively small changes annually for the small sample sizes. Importantly however, because the observed take is relatively low, the difference between the upper and lower SD is not large in terms of real numbers of birds and bats.

Appendix 1. Observed take, SEEF, and estimated take of each species by project. Note that no take of Newell's Shearwaters or waterbirds has been observed at any site. No HAPE take has been observed at KWP II or Kahuku. HAPE are not included at Kawailoa and none have been observed.

	Bats				**Nene**		**HAPE**
	KWP I	KWP II	Kahuku	Kawailoa	KWP I	KWP II	KWP I
Years	9.1	2.6	3.0	2.1	9.1	2.6	9.1
Observed Take	**8**	**3**	**4**	**21**	**20**	**3**	**7**
Maximum Annual Observed Take	4	2	2	11	6	1	3
Annual Observed Take Mean	0.88	1.15	1.33	10.0	2.20	1.15	0.77
Observed Take SD	1.4	1.0	1.5	2.8	1.7	0.6	0.8
Mean SEEF	**53**	**49**	**73**	**75**	**70**	**75**	**67**
SD SEEF	13	6	9	13	8	11	13
Mean CARE	**7.2**	**5.9**	**7.6**	**7.0**	**14.0**	**14.0**	**11.7**
SD CARE	5.2	4.8	5.3	5.4	0.0	0.0	3.9
Estimated Take (80% credibility)	**27**	**16**	**8**	**35**	**34**	**6**	**11**
Current Indirect Take	N/A	2	1	2	5	3	13
Estimated Take/Observed Take	3.4	5.3	2.0	1.7	1.7	2.0	1.6

Appendix 2. Observed Take and SEEF by fiscal year at each site for each species.

Observed Take							
	Bat				Nene		HAPE
Fiscal Year	KWP I	KWP II	Kahuku	Kawailoa	KWP I	KWP II	KWP I
2006	0				0		0
2007	0				0		0
2008	0				2		1
2009	1				1		0
2010	0				1		0
2011	1		0		5		0
2012	0		3		1		2
2013	2	1		5	4	1	1
2014	4	2	0	9	3	0	1
2015	0	0	1	7	3	2	2

SEEF							
	Bat				Nene		HAPE
Fiscal Year	KWP I	KWP II	Kahuku	Kawailoa	KWP I	KWP II	KWP I
2006	*none*				*none*		*none*
2007	*none*				*no large bird*		0.8
2008							0.63
2009	0.63						0.78
2010	0.55						0.7
2011	0.42		0.69		0.75		0.71
2012	*				0.75		0.38
2013	0.33	0.42		0.63	0.56	0.67	0.67
2014	0.59	0.52	0.84	0.72	0.7	0.83	0.76
2015	0.65	0.52	0.67	0.89	0.75		0.71

* small mice instead of small rats incorrectly used as surrogates

no OPS	<1 yr	>1 yr

Appendix 3. Observed Bat Take by Month at Kawailoa from November 2012 to February 2015.