

2022 Report on Seabird Searcher Efficiency Trials for the Kauai Seabird Habitat Conservation Plan



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Executive Summary

The Kauai Seabird Habitat Conservation Plan (KSHCP) was developed to address light attraction impacts on the listed seabirds in several fallout hotspot areas on Kauai. All participants permitted under the KSHCP are required to monitor the number of birds impacted by the lights in their premises and implement a formal organized search strategy to find grounded seabirds twice per night during the fallout season.

This study was developed to repeat the seabird search efficiency validation at two participants' premises in 2022, Royal Sonesta Kauai Resort and Sheraton Kauai Resort. Accordingly, 20 model birds (decoys) were installed in randomly selected locations at both places and in locations with various cover types such as vegetation or infrastructure. Participants were asked to find and report decoys throughout the fallout season. Participants' searcher efficiency was measured through the number of decoys reported in various cover types and the time until the decoy was found.

Both participants improved their searcher efficiency in 2022 in comparison to their performance in 2021. Royal Sonesta Kauai Resort increased their success in finding the decoys to 40% in 2022 from 17% in 2021. Sheraton Kauai Resort increased their success in finding the decoys to 65% in 2022 from 5% in 2021.

The time passes until the decoy is found after its deployment is an important parameter as the downed birds are known to seek cover. The average time Royal Sonesta Kauai Resort found the decoys was 382 minutes, or more than six hours whereas this value was 76 minutes, or less than two hours for Sheraton Kauai Resort. Although the number of decoys reported by the Royal Sonesta Kauai Resort does not provide a good sample size for rigorous statistical testing, and therefore difficult to draw conclusions, cover type of the decoy does not seem like the most important factor impacting the time to discovery. Half of the decoys placed in open areas were also reported in more than two hours by the Royal Sonesta Kauai Resort.

The consistency in searcher efficiency throughout the fallout season is important as the fledgling season for many seabird species on Kauai lasts a couple of months and as participants are dealing with more than one covered species with different breeding schedules. This study has not investigated the consistency in detail but there was a drop in the performance of the Royal Sonesta Kauai Resort team after mid-November. None of the decoys were found after this date.

Authors think that the results of this study is providing unbiased information on the search efficiency of two participants in 2022 fallout season. Two participants included in this study improved their searcher efficiency in comparison to 2021. We recommend both participants to evaluate the factors driving these improvements and continue following the best practices. There is a clear need for both participants to improve their search effort and methods in covered areas. Finally, the searcher efficiency can be changed depending on several different factors and therefore searcher efficiency validation should be carried out periodically for each participant of the KSHCP.

Introduction

One of the major threats to breeding seabirds on Kauai is light pollution. Artificial lights at night cause young seabirds to become disoriented and become grounded (fallout) when they leave the colonies for the first time. Fallout started to be recorded intensely after the 1960s (Banko, 1980), coinciding with the increased tourism on Kauai (Bardolet & Sheldon, 2008). The Kauai Seabird Habitat Conservation Plan (KSHCP) was developed by the State of Hawaii, Department of Land and Natural Resources (DLNR) with technical assistance from the U.S. Fish and Wildlife Service (USFWS), and in consultation with various scientific experts in the field of seabird and turtle biology. The aim of the KSHCP was to address light attraction impacts on the listed seabirds in several fallout hotspot areas. Accordingly, multiple non-Federal entities (participants) that have the potential for causing unavoidable take of Kauai's listed seabirds applied for incidental take permit (ITP) and incidental take license (ITL) under KSHCP and asked to follow mitigation and minimization measures. To minimize the impact of light attraction on the endangered seabird populations, all participants permitted under the KSHCP are required to monitor the number of birds impacted by the lights in their premises and implement a formal organized search strategy to find grounded seabirds twice per night during the fallout season (between September 15 and December 15).

Historically, even well-trained biologists conducting intense searching have been unable to locate many of the birds. Therefore, KSHCP estimates that for every bird found alive, another downed bird remains unfound, resulting in a default 50% discovery rate. In the KSHCP, submitted estimates of searcher efficiency by the participants ranged from 50% up to 100% within searchable areas, but with little evidence to support these proposed numbers. KSHCP Administration developed and conducted a searcher efficiency validation study at six participants' premises in 2021 to quantify their search efficiency. The results of this study showed varying actual discovery rates ranging from 5% to 93% (Rossiter, 2021). The KSHCP states that if the results of the validation program indicate a participant's discovery rate is lower than the discovery rate identified in their approved PIP, the agencies will recommend measures that could be undertaken to raise the discovery rate to the approved level (i.e., updated search protocols, staff training, predator control actions). Among the participants, The Royal Sonesta Kauai Resort and Sheraton Kauai Resort had the lowest reported discovery rates of all participants, 5% and 17% respectively (Rossiter, 2021). Following agency recommendations and changes to their training and search methods these participants requested a re-evaluation in 2022.

We conducted the same validation study at two participants' premises to determine whether the measures were effective in raising the discovery rate to the approved level. This report serves as an update on the outcome from the searcher efficiency study conducted in 2022. One important different approach from last year's study was that we provided a brief training to both participants' seabird search teams before the start of decoy study early in the fallout season. This training included detailed information on the covered species, how to identify them and how best to conduct the searches, followed by a practical session in each participants' premises together with the search teams.

Methods

Searcher efficiency study was carried out following the methodologies set in 2021 study (Rossiter, 2021). Minor changes were implemented after consultation with and feedback from the researcher designed the 2021 study and are made to improve upon the effectiveness of this study.

This study was conducted between October 5 and December 15, which coincides with the seabird fallout season on Kauai that runs from September 15 through December 15. As in the 2021 study, participants were informed about the implementation of this study, potentially creating experimental biases that arise from a participant's expectations or awareness. Therefore, every effort was made to minimize further experimental bias and replicate the realistic level of required effort in seabird searches. Deployment date, number of decoys deployed per visit, decoy location, and cover type were randomized. In contrast to 2021 study, the low number of study sites allowed for both sites to be visited on the same day, even though one site was scheduled for no deployment (i.e. blank visit).

Seabird Decoys

Seabird decoys were 3D printed out of white PLA plastic and painted to match the black and white color of a sitting Newell's Shearwater (Figure 1). The same design and printing method was used from the previous study to create additional decoys, which replaced those stolen or destroyed. Given the overall similarities in size and color pattern of two of the covered species, Newell's Shearwater and Hawaiian Petrel, the decoy serves as a rough analog for detectability of both species. However, Band-rumped Storm-petrels are much smaller and rarer and so the searcher efficiency estimate from this work should not be assumed to be equal for this more elusive species.



Figure 1 Seabird decoy modeled after sitting Newell's Shearwater or Hawaiian Petrel

Printed instructions on the underside of the decoy were kept largely the same, the only edits being small changes to sentence structure and updated contact information.

Sample Size and Decoy Deployment Schedule

A total of 20 decoys were deployed at each study site. In a change from the 2021 study, a stratified randomization was used in deployment dates to replicate the fluctuations in fallout intensity and required search effort throughout the fallout season. Accordingly, the whole deployment period was divided into four “blocks” of time (Table 1). These blocks were designed to primarily mimic the Newell’s Shearwater fledging period which begins in late September and continues through early December with peak fledging levels in October (Raine et al., 2023). Data from the Save Our Shearwaters program also shows a marked increase in the number of Newell’s Shearwater fledglings rescued in October compared to other months (Raine et al., 2017, 2023). We followed the fallout trends of fledging Newell’s Shearwater as they are the listed species and age group most impacted by light attraction and constitute the highest levels of take in the HCP.

Table 1 Stratified randomization was followed and deployments were implemented in four blocks throughout the fallout season.

| Block | Date Range | Number of Decoys Placed |
|-------|---------------------------|-------------------------|
| 1 | October 3 – 17 | 5 |
| 2 | October 18 – 31 | 5 |
| 3 | November 1 – 23 | 5 |
| 4 | November 24 – December 15 | 5 |

Our goal was to ensure the peak fallout period (i.e. October) gets at least half of the decoys. In order to have grounded birds throughout October (realistic scenario) we split the month into two blocks of 14 days and number of birds to five birds at each block (total of ten birds). For staffing reasons, we had to limit the maximum number of visits at each time block to seven. With the condition of one decoy in the first visit and maximum three decoys at any visit, we obtained a range of three to seven visits at each site in each block. Both sites were visited until five decoys had been deployed at each location. The use of blocks was made to ensure testing of a properties’ search efficiency throughout the fallout season, to increase the number of deployment visits, and to account for extremes in randomization; e.g., all 20 decoys being deployed in consecutive visits or three decoys deployed on each visit thus a site only being visited seven times etc. A detailed schedule with the number of decoys deployed at each visit is given in Appendix 1.

Decoys were deployed between 30 minutes to two hours after sunset, but before the first scheduled downed bird search as recommended by the KSHCP (three to four hours after sunset). This deployment schedule ensures that decoys are in place by the hours of peak Newell’s Shearwater fledging (Raine et al., 2023). Due to staffing limitations and based on the experience from 2021 study showing the difficulty of surreptitiously deploying decoys after midnight it was decided to eliminate pre-dawn deployments in this study.

Decoy Locations

For each property, decoy placement points were randomly generated in QGIS V3.26 (QGIS Development Team, 2023). The study area was determined by property maps provided in each participant’s PIP. A total of 20 random points were generated with ten points “in cover” following the assumption that

grounded birds will seek cover, and ten were “no cover”. Points which fell on flat or gently sloping roofs, in swimming pools, steep slopes hazardous to human safety, full fenced areas, inside buildings, and in the middle of driving paths were discarded from the survey. A new randomized point was then created in replacement so that each site received 20 decoys. Although live birds can and do fallout in all of these areas, the logistical constraints associated with placing a decoy in these locations necessitated their exclusion.

Points which fell onto a location opposite the designated cover type (i.e. an “in cover” point in the middle of a lawn or conversely a “no cover” point in vegetation) were moved to the nearest possible location which fulfilled the necessary cover type description. For all decoy placements, the amount of cover at the actual placement point was judged based on:

- the maximum distance away that a person could stand and still see the decoy,
- the minimum distance away that a person could stand and look in the direction of the decoy and be blocked from seeing it,
- whether there was cover within a few inches of the decoy’s head
- subjective assessment of the amount of artificial light illuminating the decoy (low, med, high)

Based on these metrics a subjective categorization summarizing the placement as in the open (no cover), partially in cover, or in full cover was made. For example, a decoy visible from a distance from a majority of angles would be considered open, a decoy either shielded from view from more than 50% of angles or with some overhead cover would be considered partial cover, and a decoy not visible from a distance from any angle and/or close overhead cover would be considered in full cover (see photo examples below). Decoys considered to be in full cover often require changing stances (crouched or on knees), moving raised cover items (valet trolley, wheeled dumpsters, etc.), or searching under dense vegetation to find. There was no predetermined ratio of partial cover vs. full cover and the ensuing cover type was a result of the closest available cover to the randomized point. Some examples of cover types are given in Figures 2 to 4 below.

Participants were told that placements would be spatially randomized but not told that 50% would be placed in the open and 50% in covered locations.



Figure 2 Examples of decoys placed in 'open' or 'no cover' areas



Figure 3 Examples of decoys placed in 'partial cover' areas



Figure 4 Examples of decoys placed in 'full cover' areas

A photograph of each decoy taken *in situ* after deployment, either at night or during retrieval the next day is provided in Appendix 2. While the intent was to take a picture of a decoy in the relevant lighting conditions (i.e., decoy detectability may in part be determined by light illumination in the area) pictures were not taken if it was believed that the act of taking a picture or the associated flash (if needed) would draw extra attention to the decoy location.

Decoy Retrieval and Reporting

After consulting with seabird biologists and the author of the 2021 study it was decided that the cut off time for reporting decoys in the “open” cover category would be 40 minutes before sunrise. This is a change from the previous study which considered a decoy in the open to be found if reported prior to 30 minutes of sunrise. This change was made to better reflect the natural instinct of a live seabird which is to hide in dense vegetation or cover, as even 40 minutes before sunrise it is quite light. In 2021, all reported decoys that were in the open were reported at least 40 minutes prior to sunrise so this change does not impact the comparability of this year's results to those of the prior year. Participants were informed about this change.

The same reporting method employed last year was used for this study. A free Google Voice account was created specifically for reporting purposes. Text instructions printed on the underside of the decoy instructed finders to either send a picture of the decoy or voicemail with relevant information proving a decoy was found. Time of discovery was determined either by the time indicated in the message or if no

time was stated, the time the message was received. The hotline was tested by calling at the beginning of every deployment night.

Results and Discussion

Out of 20 decoys placed throughout the fallout season in 2022, Sheraton Kauai Resort's searcher efficiency is 65% and Royal Sonesta Kauai Resort's searcher efficiency is 40%.

Each participants' results are provided separately in detail in the following sections. For each participant, discovery rate (i.e. searcher efficiency), average time the decoy was first reported (Time until reported), any observation of target predator species during decoy deployments and recommendations for improvement are provided. Photos of the location for each decoy and detailed data tables for both sites are given in Appendices 2.

Graphs of the time to discovery, that is the time between when the decoy was deployed and when the first report was received, are sorted chronologically by deployment order. Only decoys which are found within the reporting window are counted when averaging the time to discovery.

As in 2021, the sample size had to be kept rather small, this time mainly due to staffing issues, however, as we applied stratified randomization in deployment schedule, we think the small sample size did not affect the results and their comparison to last years' results significantly.

Royal Sonesta Kauai Resort

Discovery Rate

The discovery rate for the Royal Sonesta in 2022 was 40% (8 of 20 decoys) in contrast to 17% in 2021. 60% of the decoys placed in "open" areas (6 of 10 decoys) were found while only 20% of decoys placed in cover (2 of 6 decoys) were found, both were considered to be in the "partial" cover category. None of the full cover decoys were found (n=4) (Table 2).

Table 2 Details of decoys deployed and reported at Royal Sonesta Kauai Resort

| Cover Type | # Deployed | # Found | Discovery Rate |
|---------------|------------|----------|----------------|
| Open | 10 | 6 | 60% |
| Partial Cover | 6 | 2 | 33% |
| Full Cover | 4 | 0 | 0% |
| TOTAL | 20 | 8 | 40% |



Figure 5 Locations, types and status of decoys placed in Royal Sonesta. Numbers indicate decoy points. Green: reported decoys, Red: not reported. Circles: Open, Squares: in cover. Yellow line delimits the search area, provided by Royal Sonesta.

Time until Reported

Royal Sonesta Kauai Resort's average time to discovery (time the decoy was first reported) for all decoys found was 382 minutes, or more than six hours; 615 minutes (n=2, range 584 - 646) for decoys placed in cover and 304 minutes (n=6, range 23 - 604) for decoys placed in open areas. The KSHCP states that the first seabird search of the night should occur three to four hours post sunset. By this time, 38% of decoys (3 of 8 decoys reported) had been found.

Royal Sonesta Discovery Times

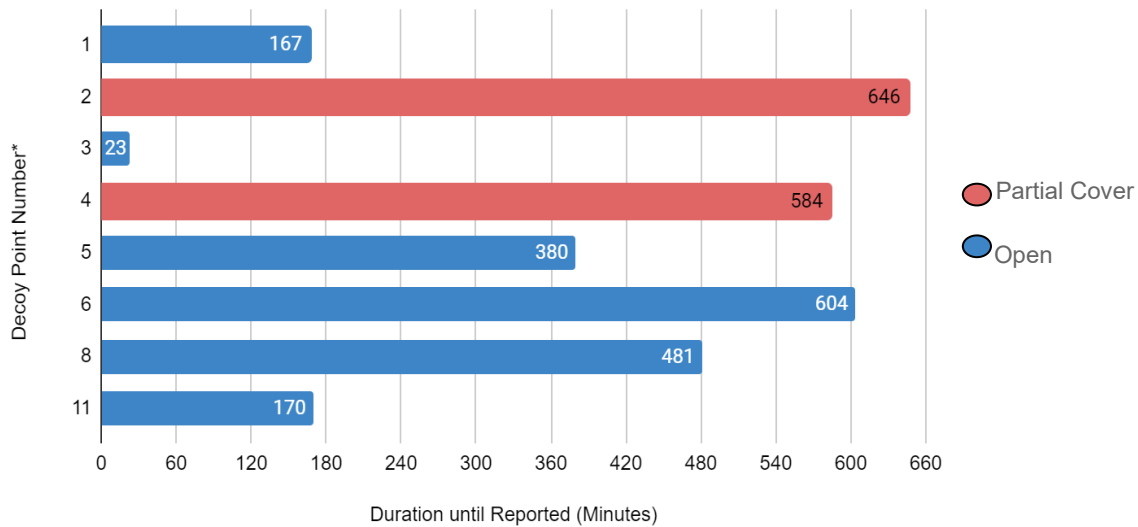


Figure 6 The time (minutes) between when the decoy was deployed and when the first report was received for Royal Sonesta. Note: Decoy Point Number can be linked to the numbers on the Figure 5 to see the locations.

Royal Sonesta Kauai Resort did not report any of the eight decoys deployed after November 11, despite half of them being deployed in open areas, potentially indicating reduced search efficiency in the second half of the fallout season in 2022. For the multiple decoys deployed in the same night on four occasions, Royal Sonesta Kauai reported all decoys on October 14, one (placed in open area) out of three decoys on October 22 and none of the decoys in the last two occasions. These results potentially indicate insufficient search in covered areas and again, later in the fallout season in 2022. It should be noted that these results are based on a rather small sample size of deployment dates and number of decoys.

According to reports received from Royal Sonesta, all decoys were reported by or through security staff. No decoys were found or reported by members of the public.

Encounter with Seabird Predator Species

One cat was seen on property during decoy deployments. This cat appeared very friendly and was lounging near the Duke's Restaurant. Resort staff were informed the next day and the cat was later captured. No loose dogs or pigs were observed.

Suggestions for Improvement

While 40% searcher efficiency is an improvement from the prior rate of 17% there are still areas that can be improved. From the search trial results in 2022, it appears that search effort is concentrated in locations where guests are likely to congregate, namely the pool and the restaurant areas (Duke's, Cafe Portofino, and Kukui's). 75% of the reported decoys were placed in this area. While these areas are most brightly lit, and therefore pose a high risk of fallout, it is expected that participants search the entire property. It should not be assumed that birds will fallout only in areas of high artificial lighting. It also appears as though the back parking lot is not being searched effectively. Three decoys (Decoy number 9,

15, 18) placed here were not found, including one (# 15) sitting in plain view under a street light (Figure 7).

Royal Sonesta Kauai found two of the six decoys placed in partial cover but none of the full cover decoys. These results show there is some effort in searching covered areas but this effort should certainly be increased.

Despite improved searcher efficiency, discovery time of the decoys were on average longer than the time window of the searches, which is one hour. Only three of the eight decoys found were within the first four hours after deployment and overall, the average time to discovery was very high, over six hours. This poses a significant amount of time for a live bird to find cover or for predators to find it. This indicates that there might be an issue with the search effort during the first dawned bird search of the night. Ideally any decoy placed in the open should be found during the first search of the night, yet three such decoys were not found for at least six hours despite being in fairly high trafficked areas (two near the Duke's Valet parking and one near the poolside cabanas).



Figure 7 Decoy #15 at the time of deployment in the back guest parking lot of Royal Sonesta. This decoy was not found.

Sheraton Kauai Resort

Discovery Rate

The discovery rate of Sheraton Kauai Resort in 2022 was 65% (13 of 20 decoys) in contrast to 5% in 2021. All but one of the decoys in open areas were found (90%, 9 of 10 decoys) and 50% (4 of 8 decoys) of the decoys in partial cover were found. None of the full cover decoys (n=2) were found (Table 3).

Table 3 Details of decoys deployed and reported at Sheraton Kauai Resort

| Cover Type | # Deployed | # Found | Discovery Rate |
|---------------|------------|-----------|----------------|
| Open | 10 | 9 | 90% |
| Partial Cover | 8 | 4 | 50% |
| Full Cover | 2 | 0 | 0% |
| TOTAL | 20 | 13 | 65% |



Figure 8 Locations, types and status of decoys placed in Sheraton Kauai Resort. Numbers indicate decoy points. Green: reported decoys, Red: not reported. Circles: Open, Squares: in cover. Yellow line delimits the search area, provided by Sheraton.

Time until Reported

Sheraton Kauai Resort's average time to discovery (time the decoy was first reported) for all decoys found was 76 minutes, or less than two hours. Decoys placed in cover were found in, on average, 122 minutes (n=4, range 43 - 294) and those placed in the open were found in, on average, 55 minutes (n=9, range 26 - 138). The KSHCP states that the first seabird search of the night should occur three to four hours post sunset. By this time, 92% of decoys (12 of 13 decoys reported) had been found.

The results of Sheraton Kauai Resort show a rather stable searcher efficiency throughout the fallout season in 2022 except a slight decrease in the performance around late October and early November,

none of the three decoys were reported around this time despite one of them placed in the open area. For the multiple decoys deployed in the same night on four occasions Sheraton Kauai Resort staff reported all decoys placed in open but failed to report some of those under cover, potentially indicating insufficient search in covered areas. It should be noted that these results are based on a rather small sample size of deployment dates and number of decoys.

Based on the reports received from Sheraton Kauai Resort, all decoys found were reported by staff from various departments including Security, Food and Beverage, and Engineering. No decoys were reported by members of the public despite several decoys being in very obvious public locations. As per an end of season recap report provided from the Sheraton Kauai Resort to KESRP, 62% (8 of 13) of decoys were found during the designated downed bird searches by staff whose sole purpose was looking for downed birds/decoys, 23% (3 of 13) were found by staff taking personal or free time to search, and 15% (2 of 13) were found incidentally by staff while performing other work duties.

Sheraton Discovery Times

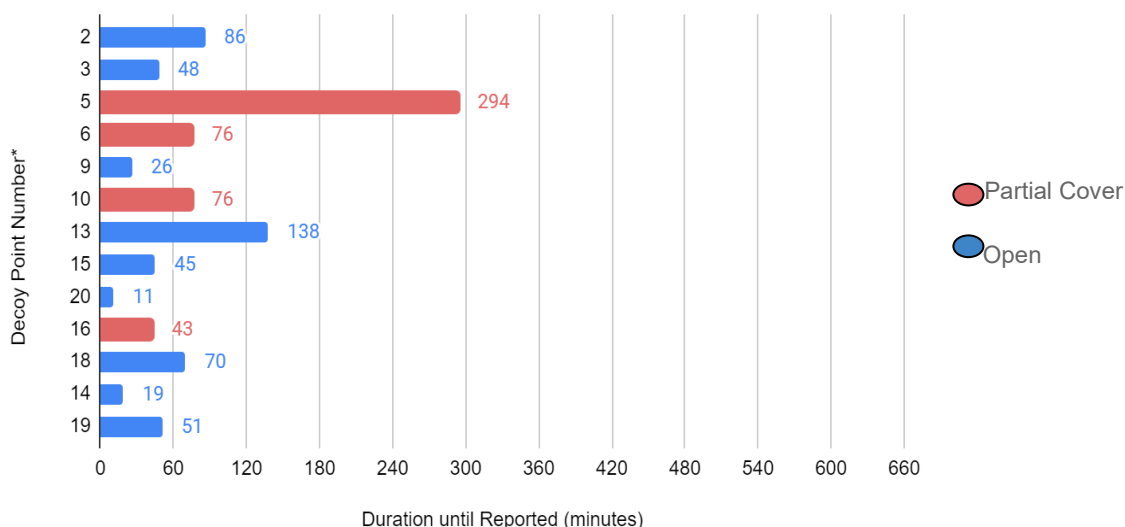


Figure 9 The time (minutes) between when the decoy was deployed and when the first report was received for Sheraton. Note: Decoy Point Number can be linked to the numbers on the Figure 8 to see the locations. The scale of time to discovery was kept the same as in Figure 6 to make both participants' graphs comparable.

Encounter with Seabird Predator Species

No predators (cats, dogs, or pigs) were observed on property during decoy deployments.

Suggestions for Improvement

The improvements made by the Sheraton Kauai Resort in 2022 are reflected in their search efficiency results when compared to the previous year's study. In 2022 only one decoy in the open was not found compared to all decoys that were placed on open lawns and sidewalks went unreported in 2021. In 2022 four decoys placed in cover were reported. This shows that there is an active and dedicated seabird searching plan involving staff who are able to recognize locations where seabirds may be hiding. Half of decoys placed in partial cover were found. From the results, it is clear that vegetation edges are being searched and searchers are scanning lawns and large open areas for decoys, even those that may be in

dark unlit areas. However, Sheraton Kauai Resort failed to find any of the two decoys placed in full cover therefore should improve their search efficiency for the full cover areas.

In addition to the decoys, Sheraton Kauai Resort reported eight downed Newell's Shearwater and eight Wedge-tailed Shearwaters recovered from the property and transferred to Save Our Shearwaters (SOS), compared to just two the year prior. Although the number of live birds found cannot by itself be used as a proxy for search efficiency, it does show that there may be a greater understanding of the search method and the importance of locating birds in comparison to 2021.

To understand the factors driving this improvement, we requested additional information on the incentives implemented from Sheraton Kauai Resort at the end of fallout season. The Sheraton Kauai Resort implemented a rewards program in 2022 that was available to both staff and guests and offering \$250 for any live or decoy birds found. In addition to the incentives program, seabird searches were conducted by designated staff members whose sole purpose during that time was to search for seabirds. Although it is difficult to draw conclusions without a detailed study on these incentives, it is possible that it increased the motivation of staff and quality of seabird searches.

Conclusions

The results of this study show an improvement in search efficiency of Royal Sonesta Kauai Resort and Sheraton Kauai Resort in comparison to their performance in 2021. While acknowledging the positive changes implemented to improve their performance, we highly recommend both teams to aim for a stable searcher efficiency throughout the fallout season and efficient searches in all types of areas in their premises. The results of this study, together with last year's result, highlight the ongoing need for increasing search efficiency in covered areas as well as the need for reducing the time that a bird is found after sunset.

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