

EFFECTS OF KEEL CUSHIONS ON THE BEHAVIOR OF WESTERN GREBES ENTERING REHABILITATION

Final Report



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Prepared for: Oiled Wildlife Care Network

21 August 2015

This report contains unpublished data. Please do not cite.

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Budget Overview:

Personnel:	\$6,000.00
Travel expenses:	\$1,980.00
Equipment:	\$ 472.37
Total:	\$8,452.37

Introduction:

Western Grebes (*Aechmophorus occidentalis*) make up a large proportion of the birds collected during coastal oiling events in California (Hampton et al., 2003). During the Ventura Oiled Bird Incident in 2005, over 1000 Western and Clark's Grebes were admitted into care at the Los Angeles Oiled Bird Care and Education Center in San Pedro, California (OWCN, unpublished data). Keel lesions are sometimes seen in diving birds, such as Western Grebes, during temporary captivity (Tseng, 1999; Phillips et al., 2011), and are thought to form when birds that are anatomically unable to stand on land are forced to do so due to contaminated plumage. Abnormal weight bearing on ventral body surfaces may cause ischemic necrosis of the skin overlying the bony prominences of the keel and/or legs. Keel cushions are routinely used during the rehabilitation of these species to theoretically prevent development or worsening of these injuries during care, but published data regarding cushion use is lacking.

During previous Oiled Wildlife Care Network (OWCN) and International Bird Rescue (IBR) responses, these cushions were primarily constructed of a rolled towel, with Vetrap™ used to secure the cushion to the bird (OWCN, 2008). The utility of this design is highly dependent on the skill of the person applying the wrap; it also is wasteful of materials, is extremely labor intensive, and has a high failure rate. Consequently, several designs of reusable pre-manufactured wraps are currently being field tested on animals entering rehabilitation at IBR. Previous observations found that each design has pros and cons, and may elicit different behavioral responses. Calm behaviors, such as resting and preening, may improve a bird's final outcome, whereas behaviors such as flipping, jumping, and hyperactivity may be detrimental. These detrimental behaviors may contribute to worsening of lesions or delay the progress of the animal due to wasted energetic expenditures or failure to engage in beneficial behaviors (e.g., eating). This study was conducted to objectively compare the behavior of birds wearing two reusable designs and the older Vetrap™ and towel style cushion with that of birds wearing no cushion whatsoever. The ultimate goal of the study was to identify a reusable design that can be mass-produced and used during oil spills.

Materials and Methods:

Study birds were admitted to IBR's Los Angeles wildlife center and housed at the Los Angeles Oiled Bird Care and Education Center in San Pedro, California. Forty-one newly admitted individually oiled Western and Clark's Grebes were enrolled in the study. All birds that arrived at the facility during the study period were processed with standard intake procedures. Birds with one or more of the following were excluded from the study: injury with poor prognosis that necessitated immediate euthanasia, extant keel lesion, hematocrit < 25%, total protein < 2.5g/dL or > 8.0g/dL, or temperature < 101.5°F. Prior to participating in the study, birds were stabilized with standard fluid and nutritional therapy, which consisted of initial fluid therapy followed by nutritional tubings every 1.5 to 2.5 hours during operational hours, while housed overnight in a soft-sided, net-bottom pen with no keel cushion whatsoever.

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Each bird was randomly assigned to one of the four treatment groups: 1) no keel cushion, 2) Vetrap™ and towel cushion, 3) prefabricated U-shaped cushion, and 4) prefabricated parallel cushion. The same person (JS) applied all keel cushions. Immediately after being fitted with a cushion, the birds were placed in the pen and videotaped for 30 minutes undisturbed. A video human-infant monitor was also used to quickly identify birds having problems. All grebes that flipped over and were unable to return to normal position on their own were manually turned upright by the same staff person after 5 minutes passed. After the keel cushion study was completed, the birds returned to the regular rehabilitation population in care. Final disposition of each bird was included in final analyses.

All videos were assessed by the same observer (LG), and an ethogram of each bird's behavior was created. Specific behaviors were timed, such as jumping, flipping, labored breathing, preening, walking, and resting. Time budgets during each study session were assessed by quantification of seconds spent engaging in each behavior. Behaviors were classified as detrimental or non-detrimental (see Table 1).

Data Analysis:

The length of time spent engaging in each behavior was compared among birds in different groups. Kruskal-Wallis and Fisher's exact tests were used to evaluate differences among treatment groups. Pairwise comparisons were performed using Mann-Whitney U and Fisher's exact tests with Bonferroni correction if statistical tests showed significant differences between groups. R statistical software was used for data analysis (R, 2014).

Table 1. Table of behaviors included in each bird's ethogram.

Behavior	Behavior Pattern	Classification	Description
Flip	STATE	Detrimental	Roll over into lateral or dorsal <u>recumbency</u>
Sleep	STATE	Non-detrimental	<u>Sternally</u> recumbent and immobile, with neck flexed and beak resting on bent neck
Rest	STATE	Non-detrimental	Sternal <u>recumbency</u> , hocks flexed and weight resting on keel
Walk	STATE	Non-detrimental	Forward movement while standing from one area of pen to another
Out of Sight	STATE	N/A	Out of view of camera
Vocalize	EVENT	Non-detrimental	Vocalization
Defecate	EVENT	Non-detrimental	Any elimination of droppings from the cloaca
Jump	EVENT	Detrimental	Momentary extension of legs from a sitting position causing forward movement
Flap	EVENT	Non-detrimental	Extend wings and flap up and down
Head Shake	EVENT	Non-detrimental	Shake head laterally from side to side
Pick	EVENT	Non-detrimental	Pick with beak at foot coverings or anything in environment
Preen	EVENT	Non-detrimental	Run beak through feathers or on cushion, or rub head on dorsal back

Results:

Five of 10 grebes in each of the U-shaped and Vetrap™ treatment groups flipped over during the experiment, while only three of 11 grebes in the parallel treatment group did, and none of the 10

grebes in the control group did (Figure 1). The proportions of grebes in the U-shaped, Vetrap™, and parallel treatment groups that flipped over during the experiment were all significantly higher than the proportion in the control group ($p = 0.03$ for all three comparisons). The number of times grebes flipped over during the experiment was significantly higher in the U-shaped and Vetrap™ treatment groups relative to the control group ($p = 0.01$ for both comparisons). There was no difference in the number of times grebes flipped over between the parallel treatment group and the control group.

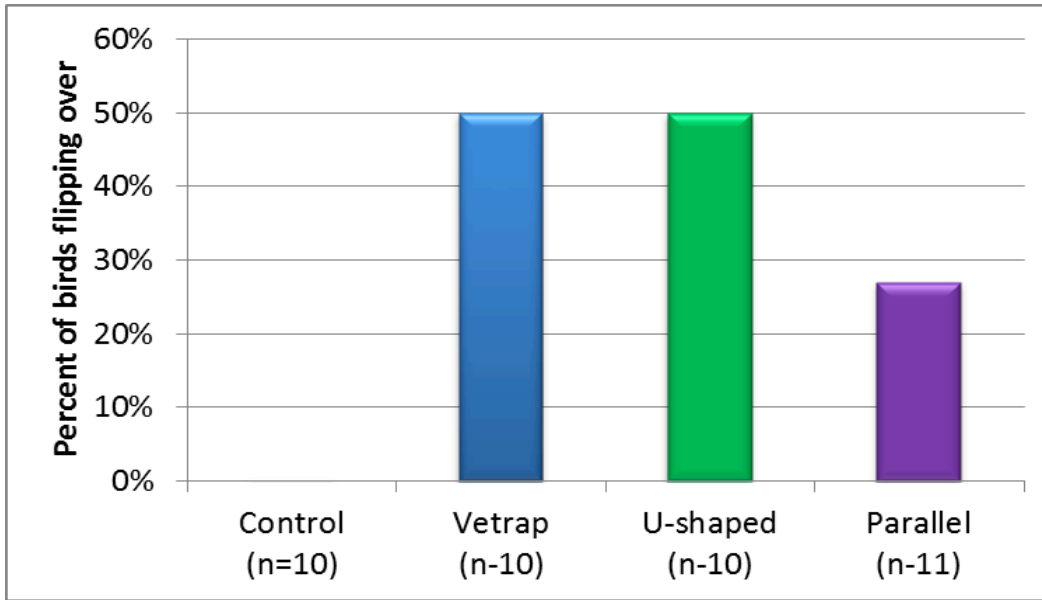


Figure 1. Proportion of grebes that flipped over during the experiment.

Six grebes (3 with U-shaped and 3 with Vetrap™ cushions) flipped over and required manual manipulation to return to normal upright position. Grebes in the U-shaped treatment group spent a significantly higher proportion of time flipped over during the experiment than did grebes in the control group ($p = 0.01$) (Figure 2). Similarly, grebes in the Vetrap™ treatment group spent a significantly higher proportion of time flipped over than did grebes in the control group ($p = 0.01$) (Figure 2). The difference in the proportion of time grebes spent flipped over for the control and parallel treatment groups was not significant (Figure 2).

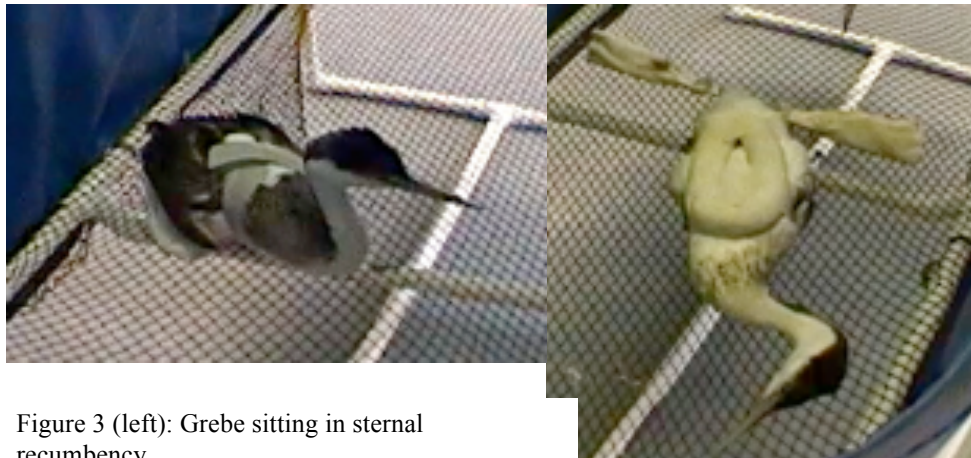


Figure 3 (left): Grebe sitting in sternal recumbency.

Figure 4 (right): Grebe flipped over in dorsal recumbency.

The proportion of time grebes spent flipped over differed significantly by final disposition ($p = 0.04$). Pairwise comparisons revealed that grebes that died spent a significantly greater proportion of time flipped over than did grebes that were euthanized ($p = 0.01$); however, there was no significant difference in the proportion of time spent flipped over for grebes that died and those that were released ($p = 0.46$), and for grebes that were euthanized and those that were released ($p = 0.14$).

There were no other significant differences between the control and treatment groups in the proportions of grebes exhibiting the different behavior types. In addition, the proportion of time spent exhibiting behaviors and the number of times the grebes exhibited the behaviors did not significantly differ for the control and treatment groups for any other behaviors evaluated in this study.

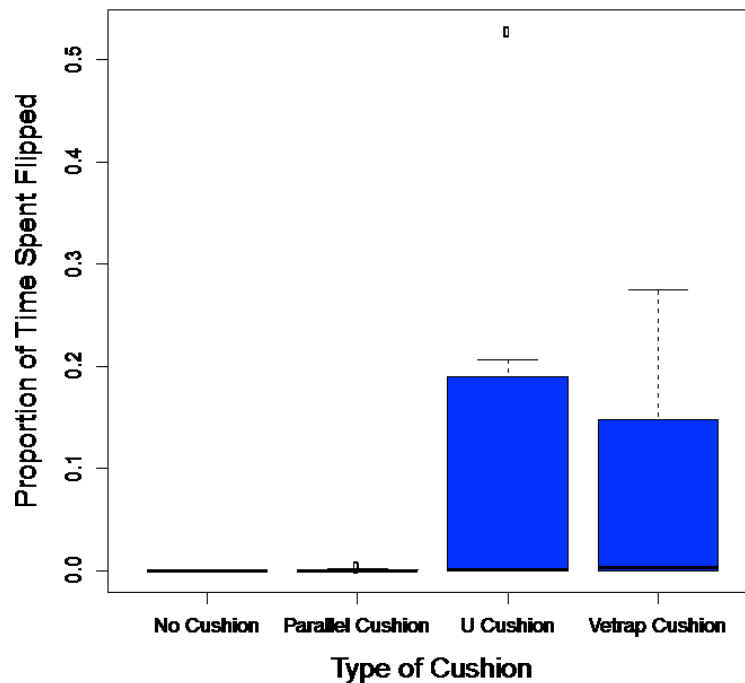


Figure 2. Mean proportion of time grebes spent flipped over on their backs.

Discussion:

The results of this study show that applying any one of the three keel cushion designs to a Western or Clark's Grebe causes increased stress to the individual, at least initially. The main stress behavior exhibited, flipping, is energetically very costly and has been observed during rehabilitation to be deadly when birds get stuck on their backs for long periods (e.g., overnight). The results of this experiment also show that, behaviorally speaking, no keel cushion is the best option for birds entering rehabilitation. The study found that a significant risk of inducing flipping and jumping in the initial stages of rehabilitation is associated with placing a U-shaped or Vetrap™ keel cushion on the bird. Not only does the use of these two keel cushion types cause grebes to flip over, but birds may also get stuck on their back, which is the most detrimental behavior for them and may lead to death. The parallel keel cushion showed an improvement in

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behavior compared to that seen with the U-shaped or Vetrap™ keel cushions in that none of the birds that flipped over became stuck on their backs. A larger sample size and longer testing period would be needed to explore this outcome more thoroughly. While it is possible that the shape of the parallel keel cushion makes it easier for the birds to return to normal position, we know anecdotally from rehabilitation efforts that birds do flip over and get stuck on their backs in the parallel keel cushions. Not using a keel cushion showed the least risk to the grebes overall, but development of a keel lesion can be fatal since birds with keel lesions are commonly euthanized during oil spills. Although birds do sometimes flip over and get stuck on their backs while wearing the parallel keel cushion, at this time the parallel keel cushion appears to be the best design. Because all cushions caused birds to flip over, all keel cushions should be used with caution, and birds should be monitored closely after application.

It is important to note that in this experiment, all keel cushions were applied by one person who was highly experienced in applying them. The experimental results could be significantly different if other or less experienced people were applying the cushions. This experiment also did not address other issues related to grebes wearing keel cushions, such as slipping or rotation, which can lead to very serious secondary injuries such as patagium injuries, asphyxiation, or blockage of the bird's vent. Although slipping did not occur during this experiment on any of the birds, putting an injury prevention device on a bird that can potentially lead to injury is a danger that must be considered. It has also been postulated that the use of keel cushions that are thicker and elevate the birds to a greater degree (like the U-shaped or Vetrap™ keel cushions) helps reduce hock hyperflexion and the development of pressure sores in and on the hocks. Further work is needed to determine if this potential benefit of higher cushions is supported by data. We know from clinical experience that birds may become accustomed to wearing keel cushions over time and flip over less, but this study only examined birds during the first 30 minutes of wearing a keel cushion. Western grebes have a relatively shallow keel compared to many diving species; hence, optimal keel cushion design will likely vary by species.

Further research needs to be done to examine other keel cushion designs for grebes. Specifically, the following questions need to be explored:

1. Do keel cushions successfully prevent the injuries we are hoping they prevent (i.e., keel lesions and hock lesions)?
2. During busy spills, do the benefits of application support the time it takes, time that could otherwise be invested in other care activities (e.g., more meals delivered)?
3. What is the frequency of injury and death caused by applying keel cushions during real usage scenarios?
4. How do detrimental behaviors, such as flipping, vary when people with different skill levels apply keel cushions?
5. What is the rate of keel cushion malfunction (i.e., cushion slippage or rotation) when people with different skill levels apply keel cushions?

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6. What is the success of keel surgeries and are they a more viable investment of time and resources than attempting prevention with keel cushions?
7. Does the use of more-elevated keel cushions help with hyperflexion of the hocks or with the prevention or worsening of pressure sores on the hocks?
8. How do grebes become accustomed to wearing a keel cushion over time?
9. What depth of keel cushion is required for grebes and different species?
10. Is the parallel keel cushion an optimal depth for Western Grebe keels?
11. What designs are optimal for other species?
12. Do other keel cushion designs not used in this study yield different results?

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Publications Resulting From This Project:

1. Poster at 2015 Effects of Oil on Wildlife conference in Anchorage, Alaska (see attached).
2. Publication of *Effects of Keel Cushions on the Behavior of Western Grebes Entering Rehabilitation* (in prep)