

**AN EVALUATION OF THE EFFECTS OF AND ALTERNATIVES TO  
THE EXISTING BIRD AND  
MAMMAL CONTROL PROGRAMS  
(Piscivorous Wildlife Control Study)**

**WELLS HYDROELECTRIC PROJECT**

**FERC NO. 2149**

**FINAL REPORT  
REQUIRED BY FERC**

September 2008

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East Wenatchee, Washington  
East Wenatchee, WA

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## ABSTRACT

The goal of this study was to evaluate existing practices and alternatives, and inform future management decisions related to piscivorous wildlife control measures at the Wells Hydroelectric Project (Wells Project) and associated hatchery rearing facilities.

From November 2007 through April 2008, the numbers and species of birds using the Wells Hatchery and their responses to non-lethal hazing were recorded. A total of 2,274 bird dispersals from the Wells Hatchery resulted from 810 hazing events (324 vehicle and 486 pyrotechnics), with a mean of 2.8 birds dispersed per event. Only 14 bird occurrences, primarily American coot (*Fulica americana*), did not respond to hazing events by dispersing. The three most frequently observed species during hazing were common merganser (*Mergus merganser*), bufflehead (*Bucephala albeola*), and great blue heron (*Ardea herodias*), while the three most abundant species observed during hazing were common merganser, bufflehead, and mallard (*Anas platyrhynchos*).

The numbers and species of birds using the same facility, during periods when hazing did not occur (weekends, evenings, and pre-dawn mornings), were recorded from November 2007 through May 2008. In the absence of hazing, the three most frequently observed species were great blue heron, mallard, and common goldeneye (*Bucephala clangula*), while the three most abundant species overall were mallard, American coot, and lesser scaup (*Aythya affinis*).

Observations during non-hazing periods documented 782 foraging attempts by 11 species of birds, including 67 fish captures and 436 unknown captures. Great blue herons made 67% of the foraging attempts, capturing 16 fish and 329 unknown prey during the index counting period. Osprey were the most efficient avian predator observed, capturing 26 fish in 27 foraging attempts during the index counting period. Over half (51%) of all observed foraging attempts were made in the four hatchery dirt ponds resulting in an index take of 65 fish and 183 unknown captures.

The significance of bird predation could not be assessed for Ponds 1 and 2, where only estimates of the number of fish released directly from the ponds into the Columbia River were available. However, estimated bird predation loss was compared to total fish (steelhead smolt) loss for Pond 3 and 4. Total fish loss was calculated by hatchery personnel using a water displacement method (pounds of water displaced multiplied by the number of fish per pound) when the fish are loaded into transport trucks. Estimated consumption of fish in Pond 3 accounted for only 25 percent of the total fish loss estimated by hatchery personnel. However, estimated consumption of fish by birds in Pond 4 was 4.5 times greater than the total loss calculated when fish were released from the pond. In both instances the rates of total fish loss did not correspond to the observed level of bird-related losses recorded for each pond.

Mammalian predators also may have contributed to losses of some fish at Wells Hatchery; however, these impacts were likely negligible. Observations of 1-4 raccoons (*Procyon lotor*) were recorded 15 times during focal observations but none were observed catching fish. River otter (*Lutra canadensis*) were observed four times during evening focal observations and were

documented capturing fish on two occasions. A nuisance wildlife control specialist contracted to trap furbearers at Wells Hatchery removed three raccoons during this study period.

From November 2007-March 2008, the number and species of birds attempting to use the Methow Hatchery also were recorded. Passive measures such as pond covers, bird wires, fencing and overhead netting were effective at reducing predation by birds as most bird observations were outside ponds and raceways. Only birds that entered ponds through open doors were observed foraging (one kingfisher and one great blue heron). Mink tracks were observed outside fencing, although no mammals were documented in ponds or raceways.

The current combination of active and passive non-lethal control measures implemented at Wells Hatchery appear to effectively limit avian and mammalian predation during daylight hours. Adding additional hazing during the evening or later at night should further deter avian and mammalian predators. Passive control measures also are effectively deterring predators at the Methow Hatchery. Because increasing gull presence at Wells Hatchery coincides with release of fish to the main channel, consideration should be given to extend active control measures until all fish are removed from the hatchery ponds.



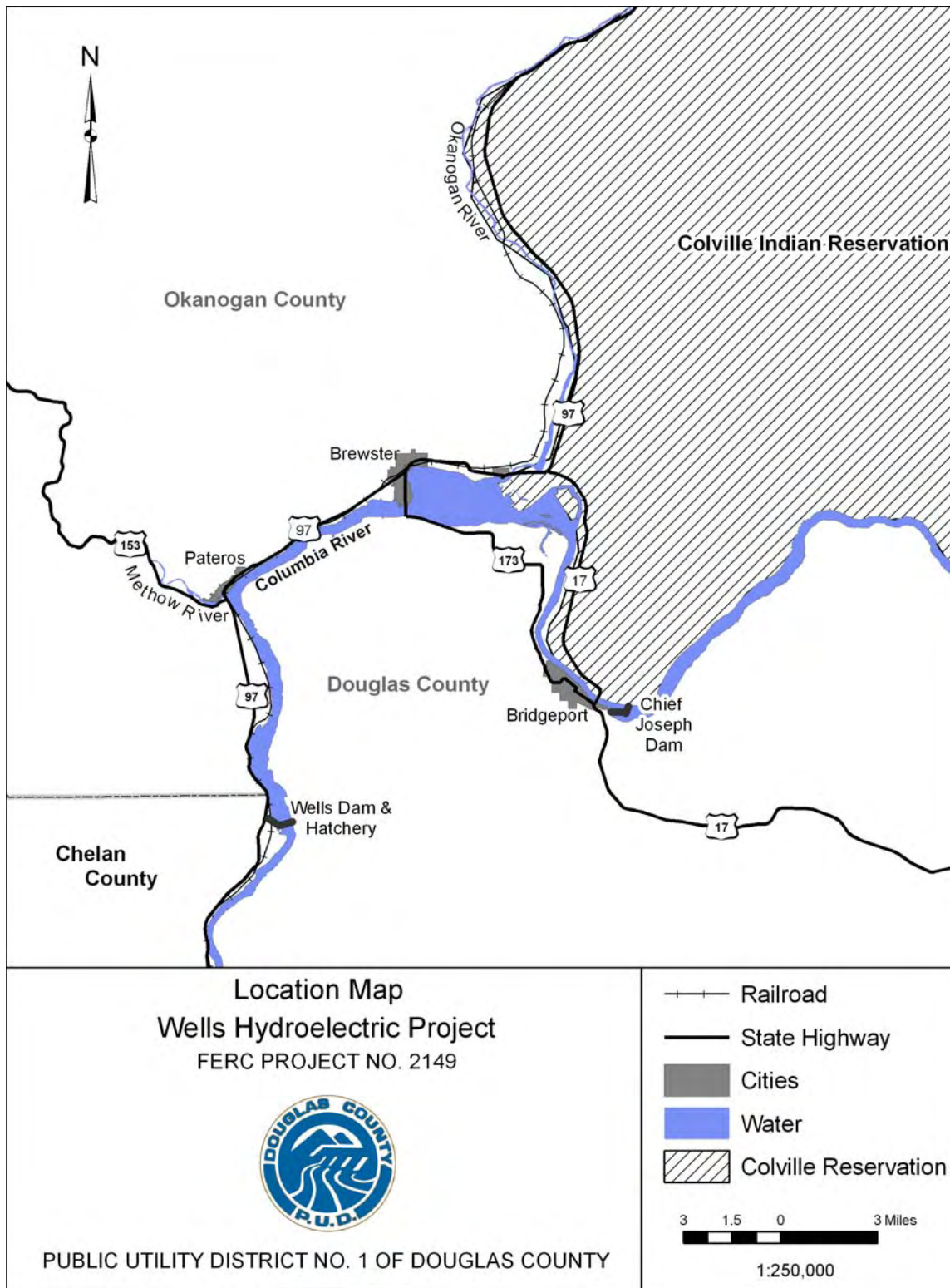
## **1.0 INTRODUCTION**

### **1.1 General Description of the Wells Hydroelectric Project**

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1.1-1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE); and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for the Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at the normal maximum water surface elevation of 781 above mean sea level (msl) (Figure 1.1-1).



**Figure 1.1-1 Location Map of the Wells Hydroelectric Project.**

## 1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) promulgated by Federal Energy Regulatory Commission (FERC) Order 2002 (18 CFR Part 5). Stakeholders consisting of representatives from state and federal agencies, tribes, local governments, non-governmental organizations and the general public have been participating in the Wells Project ILP, from a very early stage, to identify information needs related to the relicensing of the Wells Project.

In August 2005, Douglas PUD initiated a series of Resource Work Group (RWG) meetings with stakeholders regarding the upcoming relicensing of the Wells Project. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to identify resource issues and to develop preliminary study plans prior to filing the Notice of Intent (NOI) and Pre-Application Document (PAD). The RWGs were formed to discuss issues related to the Wells Project and its operations.

The primary goals of the RWGs were to identify resource issues and potential study needs in advance of Douglas PUD filing the NOI and PAD. Through 35 meetings, each RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed-Upon Study Plans. An Issue Statement is an agreed-upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWGs' efforts to apply FERC's seven study criteria to mutually determine the applicability of each individual Issue Statement. Agreed-Upon Study Plans are the finished products of the informal RWG process.

Douglas PUD submitted the NOI and PAD to FERC on December 1, 2006. The PAD included the RWGs' 12 Agreed-Upon Study Plans. The filing of these documents initiated the relicensing process for the Wells Project under FERC's regulations governing the ILP.

On May 16, 2007, Douglas PUD submitted a Proposed Study Plan (PSP) Document. The PSP Document consisted of the Applicant's Proposed Study Plans, Responses to Stakeholder Study Requests and a schedule for conducting the Study Plan Meeting. The ILP required Study Plan Meeting was conducted on June 14, 2007. The purpose of the Study Plan Meeting was to provide stakeholders with an opportunity to review and comment on Douglas PUD's PSP Document, to review and answer questions related to stakeholder study requests and to attempt to resolve any outstanding issues with respect to the PSP Document.

On September 14, 2007, Douglas PUD submitted a Revised Study Plan (RSP) Document. The RSP Document consisted of a summary of each of Douglas PUD's revised study plans and a response to stakeholder PSP Document comments.

On October 11, 2007, FERC issued its Study Plan Determination based on its review of the RSP Document and comments from stakeholders. FERC's Study Plan Determination required Douglas PUD to complete 10 of the 12 studies included in its RSP Document. Douglas PUD has opted to complete all 12 studies to better prepare for the 401 Water Quality Certification process conducted by the Washington State Department of Ecology and to fulfill its commitment to the RWGs who collaboratively developed the 12 Agreed-Upon Study Plans with Douglas PUD.

These study plans have been implemented during the designated ILP study period. The results from the study plans have been developed into 12 Study Reports. Each report is included in Douglas PUD's Initial Study Report (ISR) Document, which is scheduled for filing with FERC on October 15, 2008.

This report completes the Piscivorous Wildlife Control Study.

## **2.0 GOALS AND OBJECTIVES**

The goals of this study were to evaluate existing practices and alternatives, and inform future management decisions related to piscivorous wildlife control measures at the Wells Project and associated hatchery rearing facilities.

Specifically, the primary objectives of this study are:

- Identify and count the current and historic numbers and species of birds and mammals feeding on fish at the Project hatcheries and in the Wells tailrace;
- Assess the potential impacts of mortality caused by piscivorous birds and mammals to ESA listed, sensitive and recreationally important species;
- Describe each of the existing piscivorous wildlife control measures, including species targeted, reasons for control, frequency of control and effectiveness of the control method;
- Evaluate alternatives, including the costs and benefits of each measure recommended. The study will provide alternative methods of preventing predation of fish at the Wells Project and in hatchery rearing ponds.

## **3.0 STUDY AREA**

The study area includes the Wells Reservoir and tailrace and adjacent Project related lands; the approximately 15-acre Wells Hatchery in Chelan County (Figure 3.0-1); and the 19-acre Methow Hatchery, including the Twisp (2.6 acres) and Chewuch (0.7 acre) acclimation pond sites, located in Okanogan County (Figure 3.0-2). The Wells Hatchery is located on the west bank of the Columbia River immediately downstream of the Wells Dam. The Carlton Acclimation Pond was not included in this study because it is operated by Chelan PUD toward fulfilling a joint summer Chinook mitigation responsibility for Chelan and Douglas PUDs.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at the normal maximum water surface elevation of 781 above msl.



**Figure 3.0-1** Aerial image of the Wells Hatchery.





**Figure 3.0-2 Methow hatchery and associated off-site acclimation ponds.**

## **4.0 BACKGROUND AND EXISTING INFORMATION**

The Wells and Methow hatcheries raise steelhead (*Oncorhynchus mykiss*) and spring Chinook (*Oncorhynchus tshawytscha*), respectively, that are listed as endangered under the federal Endangered Species Act (ESA). The Washington Department of Fish and Wildlife (WDFW) estimated that 7 to 14 percent of the steelhead and summer Chinook reared in each rearing pond at the Wells Hatchery in 2005 were eaten by birds and mammals. The hatcheries have a goal for the number of yearling steelhead and Chinook smolts released each spring. To reach these goals, additional brood stock must be trapped to compensate for mortality, thereby impacting the number of ESA listed fish left to spawn naturally.

Methods of controlling avian predation at the Wells Hatchery have changed over the years. Until the mid-1980s, Washington State hatchery policy encouraged hatchery employees to kill piscivorous birds feeding on fish reared in its hatcheries along with hazing to reduce fish mortality. More recently, hatchery staff has relied solely on hazing, pyrotechnic shotgun shells (cracker shells) and exploding rockets along with propane cannons, to reduce bird predation. Hazing efforts in this period were only marginally successful.

In 1993, Douglas PUD hired the U. S. Department of Agriculture (USDA) Wildlife Services to reduce the bird predation at the Wells tailrace. The USDA installed bird exclusion wires to reduce access by flying birds in the tailrace. In 1994, USDA installed bird exclusion wires over the hatchery rearing ponds. They also used hazing methods listed above and lethal take of a few birds as a dispersal technique to reduce bird densities and reinforce hazing effects.

WDFW has information that estimates the number of fish consumed by piscivorous birds and mammals at each of the hatcheries. USDA has information on the number of birds hazed and/or shot at Wells Hatchery and in the Wells tailrace.

### **4.1 Terrestrial Resource Work Group**

As part of the relicensing process for the Wells Project, Douglas PUD established a Terrestrial Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD )(DCPUD, 2006)

Through a series of meetings, the Terrestrial RWG cooperatively identified a list of Issue Statements, Issue Determination Statements and Agreed-Upon Study Plans. An Issue Statement is an agreed-upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWG's efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria (see Section 1.2) and would be useful in making future relicensing decisions. Agreed-Upon Study Plans are the finished products of the informal RWG process.

Based upon these meetings and discussions, the Terrestrial RWG proposed a study to evaluate the effects of and alternatives to the piscivorous bird and mammal control programs (PAD Section 6.2.3.1). The need for this study was agreed to by all of the members of the Terrestrial RWG, including Douglas PUD. This study will help inform future relicensing, wildlife and fisheries management decisions and will fill data gaps that have been identified by the Terrestrial RWG.

The Issue Statement and Issue Determination Statement listed below were included in the PAD (section number included) filed with FERC on December 1, 2006:

**4.1.1 Issue Statement (PAD Section 6.2.3.1)**

Ongoing control of piscivorous wildlife may influence wildlife species abundance and diversity.

**4.1.2 Issue Determination Statement (PAD Section 6.2.3.1)**

Douglas PUD conducts a piscivorous wildlife control program to reduce predation on fish. The effect of this program on wildlife populations found within the Wells Project is unknown.

Removal of bird and mammal predators is an important part of reducing predation on ESA listed steelhead and spring Chinook at the Wells Project and associated hatchery facilities. In 2005, WDFW estimated loss due to predation at the Wells Hatchery at 7-14 percent. Douglas PUD, through the U.S. Department of Agriculture's piscivorous species hazing program, has developed and continues to employ many alternatives to lethal removal and only uses removal actions when non-lethal measures have failed. Hazing consists of noise makers, propane cannons, decoy predators, electric fence, tailrace and hatchery wires, fencing, hatchery covers and the hiring of hazing personnel. As a last resort, lethal removal techniques, including the use of traps and shot guns, are utilized.

Project operations related to wildlife control, specifically lethal removal, may have an effect on terrestrial resources and additional information is needed to determine which species may be significantly affected under this program and if there is a significant impact on sensitive or recreationally important species.

The resource work group agrees that a study is needed during the two-year ILP study period to evaluate existing practices, evaluate alternatives and inform future management decisions.

**4.2 Project Nexus**

Douglas PUD owns and pays for the operation of the Wells and Methow hatcheries and acclimation ponds as mitigation for unavoidable losses of juvenile anadromous salmonids resulting from the existence and operation of the Wells Hydroelectric Project. Fish raised at these facilities are an important component in meeting the No Net Impact (NNI) survival requirements contained within the Wells HCP. The hatcheries raise spring Chinook, summer/fall Chinook, steelhead, and rainbow trout. Spring Chinook and steelhead are listed as endangered under the federal Endangered Species Act.



Section 4.3.3 of the Wells HCP includes the requirement that Douglas PUD implement a control program to reduce the level of predation at Douglas PUD's two salmon hatcheries and in the tailrace and reservoir surrounding Wells Dam. Douglas PUD hires a contractor to employ various techniques to harass piscivorous birds at hatcheries and in the tailrace below Wells Dam. In the past, a contractor, USDA, has also conducted limited control activities on the Wells Reservoir.

## **5.0 METHODOLOGY**

Study methods were designed to describe the piscivorous bird community utilizing the Wells Project and its potential impacts on salmonid species. Results of fish-eating bird distributions, foraging behavior, and response to control methods will be applied to improve Douglas PUD's avian predator control program for future years. The current mammal control program, mammal observations made during bird surveys and recommendations for improvement also are described.

### **5.1 Identification and Enumeration of Predators**

Records of Wildlife Services management activities conducted from October 1996-May 2007 were used as a baseline to identify the species of birds and mammals attempting to use Wells Hatchery. For this study, bird use of Wells Hatchery (ponds, spawning channel, and fish ladder) and the immediate surrounding area (forebay, tailrace, and boat launch) was quantified using an approach which combined systematic and stratified random sampling. First, a systematic approach was used to quantify the number and species of birds attempting to use the study area during weekday operations. During weekdays from approximately 1 hour before sunrise to generally 1300 hours (1 p.m.), Wildlife Services employees recorded each bird or group of birds by species, number, time of observation, and response to hazing (i.e., dispersed or habituated). Thus, observations were intended to document 100% of active hazing. Second, a stratified random approach was used to sample the same area during periods when hazing did not occur. These periods consisted of 8 hour blocks between 1900-0500 hours on weekdays and weekends. Birds were again enumerated by species and time of observation; however, there were no hazing responses to measure. Instead, ten-minute focal observations were conducted on individual birds to document foraging behavior. During focal observations, observers recorded the number of foraging attempts and the number of successful attempts. When possible, the observer documented fish captures; otherwise successful attempts were coded as unknown. Observations during hazing began on November 26, 2007 and ended on April 18, 2008. Observations during non-hazing periods started one week prior and lasted 4 weeks longer than hazing, November 19, 2007-May 23, 2008. All hazing and bird observation data were compiled in a database. During bird observations, incidental observations of all piscivorous mammals also were recorded. Simultaneous to this study, a nuisance wildlife control specialist was contracted by Douglas PUD to identify and remove mammals from the hatchery site that were potentially taking fish.

## **5.2 Assess Potential Impacts to Salmon and Steelhead**

This study focused only on the potential impact of predation on salmon and steelhead. Moreover, assessment was limited to potential effects of avian predators on juvenile salmonids in the hatchery during the winter rearing stage, and in the forebay and tailrace during the spring migration stage. This study did not consider other causes of mortality; thus, all fish in the hatchery were assumed to be equally susceptible to predation. With these assumptions the study will estimate the number of fish consumed by birds at Wells Hatchery.

Simultaneous to this study, Douglas PUD contracted with a nuisance wildlife control specialist for removal of piscivorous mammals near Wells Hatchery. Number of mammals removed and observations of piscivorous mammals recorded during bird observations are discussed.

Fish consumption rates at Wells Hatchery were determined by observing bird behavior. The observer counted the number of prey caught by individual birds during ten-minute focal observation periods. Great blue heron and belted kingfisher can be observed swallowing the prey they catch; for the purpose of this estimate it was assumed that all prey items captured were fish. Common and hooded mergansers, and double-crested cormorants swallow small fish underwater and their success capturing fish could not be directly observed. The rate of consumption by the mergansers and cormorants was estimated at three fish per hour.

To estimate the number of fish consumed at Wells Hatchery from November 2007 through May 2008 it was assumed that: 1) the birds observed at the hatchery are only feeding at the hatchery, and only during non-hazing periods; and 2) observed feeding rates are representative of feeding rates for all birds of that species using the hatchery during the non-hazing period. Average bird abundance per species and capture rates for each species were extrapolated to cover all non-hazing periods during the study. However, complete enclosure can negatively affect normal hatchery operations (e.g., feeding, water measurements, pond/raceway maintenance).

## **5.3 Description of Existing Control Activities**

There are currently limited passive protection measures implemented (i.e., physical barriers) in the raceways and dirt ponds at Wells Hatchery. Bird wires and electric fencing provide physical barriers to deter bird and mammal use of rearing ponds. Gull wires are also maintained by Wildlife Services personnel in the Wells Dam tailwater area. These grids of wire are intended to deter piscivorous birds from landing, swimming, or wading in the tailrace.

USDA Wildlife Services specialists have used active non-lethal control measures to deter bird use of Wells Hatchery during winter growing periods (October-May) since 1994. Specialists are stationed at the dam during daylight hours 5 days a week, Monday-Friday. Control sessions begin approximately 1 hour before sunrise to generally 1300 hours (1 p.m.) or until bird use of the hatchery ceases. Hazing methods include the use of pyrotechnics, vehicle patrols, and strobe lights.

Estimates of birds observed versus birds dispersed were used to evaluate control efficacy during normal operating hours from November 26, 2007 through April 18, 2008 at the Wells Hatchery.

Numbers of birds observed during hazing versus those observed in the absence of hazing also were compared to detect differences in frequency and abundance of species with respect to timing of hazing. Weekly means were used for all hazing versus non-hazing comparisons. Observed foraging behavior also was quantified to estimate the potential loss of fish to avian predators in the absence of hazing. Physical control such as gull wires and fencing were fixed effects and were considered uniform across all sampling periods. Procedures in SAS® (Version 9.1, SAS institute Inc., Cary, N.C.) were used for statistical analyses. Because observational data were not normally distributed (PROC UNIVARIATE, SAS® Version 9.1, SAS Institute Inc., Cary, N.C.), Kruskal-Wallis tests were used (PROC NPAR1WAY, SAS® Version 9.1, SAS Institute Inc., Cary, N.C.) for mean comparisons.

Methow Hatchery utilizes pond covers to cover the entire raceways, while their acclimation ponds are protected by bird wires, fencing, and overhead netting. Observations conducted at Methow Hatchery from November 21, 2007 through March 31, 2008 are discussed.

## **5.4 Evaluation of Alternative Control Measures**

An integrated predator control program is necessary to effectively manage piscivorous birds and mammals at the Wells Hatchery. Alternative control methods to reduce fish predation at the Wells Hatchery include additional aversion-provoking stimuli, diversion, additional exclusion devices, habitat modification, and lethal control. Passive additions including additional netting, fencing, and wiring were evaluated. Additional active harassment patrols also were considered to reduce bird use of Wells Hatchery.

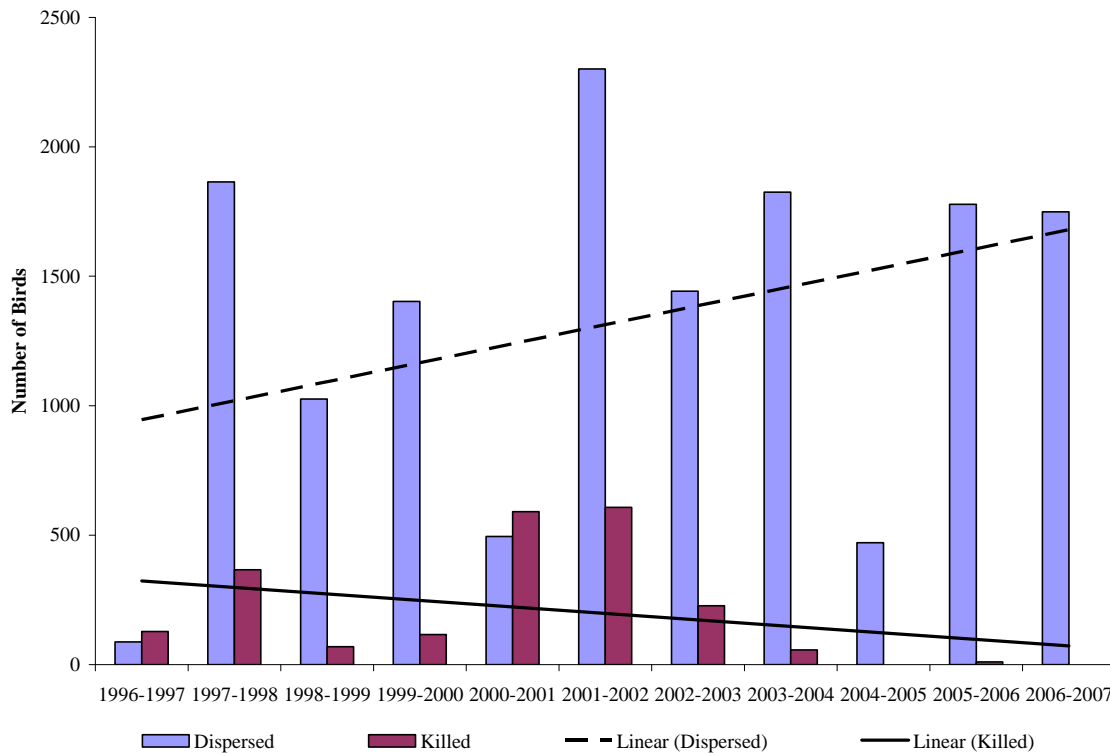
## **6.0 RESULTS**

### **6.1 Identification and Enumeration of Predators**

Since 1996, Wildlife Services has recorded the number of birds harassed and killed during management activities at Wells Hatchery. Because this program has been adaptive, few comparisons can be made among years; nevertheless, there has been a general trend toward using more non-lethal and less lethal control to reduce fish predation by birds (Figure 6.1-1). From October-May, commonly observed species recorded among years have included belted kingfisher (*Ceryle torquata*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*), California gull (*Larus californicus*), ring-billed gull (*Larus delawarensis*), mallard (*Anas platyrhynchos*), and common merganser (*Mergus merganser*). Other birds observed infrequently or in relatively small numbers included hooded merganser (*Lophodytes cucullatus*), red-breasted merganser (*Mergus serrator*), horned grebe (*Podiceps auritus*), black-billed magpie (*Pica pica*), herring gull (*Larus argentatus*), Caspian tern (*Hydroprogne caspia*), black-crowned night heron (*Nycticorax nycticorax*), bufflehead (*Bucephala albeola*), and other unidentified dabbling and diving ducks. Most of these species are piscivorous or are capable of foraging on salmonids in the hatchery. During this same period, 2000 to 2003, Wildlife Services removed two river otters (*Lutra canadensis*) and two raccoons (*Procyon lotor*) from Wells Hatchery. After 2003, a licensed Nuisance Wildlife Control Operator (NWCO) was hired by Douglas PUD to trap furbearers at Wells and Methow hatcheries. The NWCO removed seven otter between 2004 and 2008 and five raccoon during

the same time period from Wells Hatchery. Raccoons are not a likely threat to salmonids in the hatchery but may take dead or moribund fish, while river otter are a potential threat to healthy fish.

From November 2007-March 2008, the number and species of birds attempting to use Methow Hatchery was recorded. Passive measures such as pond covers, bird wires, fencing and overhead netting were effective at reducing predation by birds as most bird observations were outside ponds and raceways. Only birds that entered ponds through open doors were observed foraging (one kingfisher and one great blue heron). Mink tracks were observed outside fencing although no mammals were documented in ponds or raceways.



**Figure 6.1-1 Numbers of dispersals and birds killed during management activities at Wells Hatchery October-May, 1996-2007.**

## 6.2 Assess Potential Impacts to Salmon and Steelhead

Left uncontrolled, piscivorous birds and mammals could have a detrimental effect on salmonid production at Wells Hatchery. Many of the same bird species present at Wells Hatchery have been documented foraging in the Wells tailrace and the reservoir, and tailraces of other dams in the Columbia River Basin (Thompson and Tabor, 1981; Jones et al., 1999; Ruggerone, 1986; Roby et al., 1998). Many also are successful predators in raceways and ponds as documented in aquaculture settings (Parkhurst et al., 1992; Pitt and Conover, 1996; Glahn et al., 1999).

### 6.3 Description of Existing Control Activities

Passive control measures (e.g., wire, fencing) were in place but not evaluated individually during periods when the hazer was on site. Rather, specialists used active control measures to disperse birds as soon as birds entered the hatchery area. Some were dispersed in flight while others were dispersed from the water or land near the waters' edge. From November 26, 2007- April 18, 2008, hazers observed 2,288 bird attempts to use the Wells Hatchery (Table 6.3-1). A total of 2,274 bird dispersals (99.4% of attempts) from the Wells Hatchery resulted from 810 hazing events (324 vehicle patrols and 486 pyrotechnics) and a mean of 2.8 birds dispersed per event. Only 14 birds, mainly American coot (*Fulica americana*), did not disperse in response to hazing (Table 6.3-1). During the same period, Douglas PUD employees observed 6,839 birds utilizing Wells Hatchery during periods when hazing did not occur (Table 6.3-2). Mean number of birds observed was highest during the non-hazing periods ( $H = 28.3, 1 \text{ df}, P < 0.001$ ).

In the absence of hazing, the three most frequently observed species were great blue heron, mallard, and common goldeneye (*Bucephala clangula*), whereas the three most abundant species overall were mallard, American coot, and lesser scaup (*Aythya affinis*) (Table 6.3-2). The three most frequently observed species during hazing were common merganser, bufflehead, and great blue heron (Table 6.3-3). In contrast, the three most abundant species observed during hazing were common merganser, bufflehead, and mallard (Table 6.3-3).

**Table 6.3-1 Number of bird observations and number of bird hazing dispersals at Wells Hatchery in Chelan County, Washington, November 26, 2007- April 18, 2008.**

<b>Species</b>	<b>Observations</b>	<b>Hazing Dispersals</b>
Common Merganser	640	638
Bufflehead	457	456
Great Blue Heron	134	134
Mallard	447	447
Belted Kingfisher	87	87
Double-crested Cormorant	64	64
Lesser Scaup	341	340
American Dipper	22	22
Ring-necked Duck	37	37
Unknown Gull	10	10
American Coot	15	5
Hooded Merganser	12	12
American Wigeon	4	4
Green-winged Teal	15	15
Ring-billed Gull	2	2
Common Loon	1	1
<b>Total</b>	<b>2288</b>	<b>2274</b>

**Table 6.3-2 Frequency of occurrence and relative abundance of all birds observed during non-hazing periods (nighttime) at Wells Hatchery in Chelan County, Washington, November 2007 through April 2008.**

<b>Species</b>	<b>Frequency of Occurrence</b>	<b>Relative Abundance</b>
Great Blue Heron	347	376
Mallard	334	3325
Common Goldeneye	59	256
Lesser Scaup	39	777
American Wigeon	33	127
Double-crested Cormorant	26	47
Common Merganser	23	132
Bufflehead	21	72
Belted Kingfisher	17	19
American Coot	17	1323
Canvasback	14	49
Pied-billed Grebe	9	15
Gadwall	8	33
Unknown Duck	6	88
Ring-necked Duck	6	25
Common Loon	5	5
Greater Scaup	4	20
Redhead	4	18
Hooded Merganser	4	14
Osprey	4	4
Unknown Gull	3	80
Canada Goose	3	9
Great Horned Owl	2	2
Ring-billed Gull	1	20
Northern Pintail	1	2
California Gull	1	1

**Table 6.3-3 Frequency of occurrence and relative abundance of all birds observed during hazing (daytime) at Wells Hatchery in Chelan County, Washington, November 2007 through April 2008.**

<b>Species</b>	<b>Frequency of Occurrence</b>	<b>Relative Abundance</b>
Common Merganser	214	640
Bufflehead	113	457
Great Blue Heron	108	134
Mallard	97	447
Belted Kingfisher	86	87
Double-crested Cormorant	49	64
Lesser Scaup	34	341
American Dipper	21	22
Ring-necked Duck	11	37
Unknown Gull	10	10
American Coot	7	15
Hooded Merganser	6	12
American Wigeon	3	4
Green-winged Teal	3	15
Ring-billed Gull	2	2
Common Loon	1	1

Avian species richness was greater during non-hazing periods (Table 6.3-4) than hazing periods (Table 6.3-5). Pond 1 had the highest recorded bird abundance during hazing and non-hazing observations (Figure 6.3-1). Proportional use was generally similar between hazing and non-hazing periods except birds used the boat launch more and the forebay less during hazing periods (Tables 6.3-4 and 6-3.5). Three peaks in mean bird abundance were observed during non-hazing observations: in late December 2007, mid-February 2008, and early April 2008 (Figure 6.3-2). The first peak was attributed to a large number of American coots using the forebay area in the evenings. The second was due to a large number of mallards roosting in Pond 2. The third peak was due to a large number of lesser scaup using the forebay.

Through focal observations, we documented 781 individual foraging attempts by 11 species of birds, including 67 fish captures and 436 unknown captures during non-hazing periods (Table 6.3-6). Great blue herons made 67% of the foraging attempts, capturing 16 fish and 329 unknown prey. Osprey were the most efficient avian predator observed, capturing 26 fish in 27 foraging attempts. Over half (51%) of all observed foraging attempts were made in the four hatchery ponds. Of the remaining foraging attempts, 36% and 10% occurred in the raceways next to the office and the boat launch, respectively. The remaining 3% of attempts occurred in the forebay, the middle raceway, the lower spawn channel, and Columbia River adjacent to Carpenter Island.

**Table 6.3-4 Numbers of birds observed at Wells Hatchery in Chelan County, Washington, November 2007-April 2008 during non- hazing periods.**

Species	Locations <sup>1</sup>													
	BL	CI	FB	FL	LSC	MR	MSC	OR	P1	P2	P3	P4	TR	USC
Great Blue Heron	17	14	1	19	16	20	19	60	76	15	49	24	0	10
Mallard	0	0	92	0	33	0	91	0	1806	750	332	118	0	97
Unknown Duck	0	0	0	0	0	0	0	0	84	1	1	0	0	0
Kingfisher	0	0	0	0	0	0	1	0	3	1	8	6	0	0
Bufflehead	0	0	2	0	0	0	0	0	45	8	15	2	0	0
Common Goldeneye	4	0	12	0	0	0	0	0	153	55	20	12	0	0
Lesser Scaup	0	0	482	0	0	0	0	0	250	32	11	0	0	2
Greater Scaup	0	0	0	0	0	0	0	0	4	8	0	0	0	8
American Coot	0	0	1318	0	0	0	0	0	2	3	0	0	0	0
American Wigeon	0	0	31	0	0	0	0	0	54	32	4	6	0	0
Redhead	0	0	14	0	0	0	0	0	4	0	0	0	0	0
Gadwall	0	0	14	0	0	0	0	0	18	0	1	0	0	0
Common Merganser	34	0	26	0	0	0	0	0	0	0	42	6	0	0
Common Loon	2	0	3	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0	1	0	13	0	0	0
Great Horned Owl	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Canvasback	0	0	4	0	0	0	0	0	30	5	5	0	0	5
Ring-necked Duck	0	0	25	0	0	0	0	0	0	0	0	0	0	0
California Gull	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pied-billed Grebe	0	0	15	0	0	0	0	0	0	0	0	0	0	0
Double-crested Cormorant	0	0	37	0	0	0	0	0	0	3	6	1	0	0
Northern Pintail	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Canada Goose	0	0	2	0	0	0	0	0	0	0	0	0	0	1
Osprey	0	0	0	0	0	0	0	0	2	2	0	0	0	0

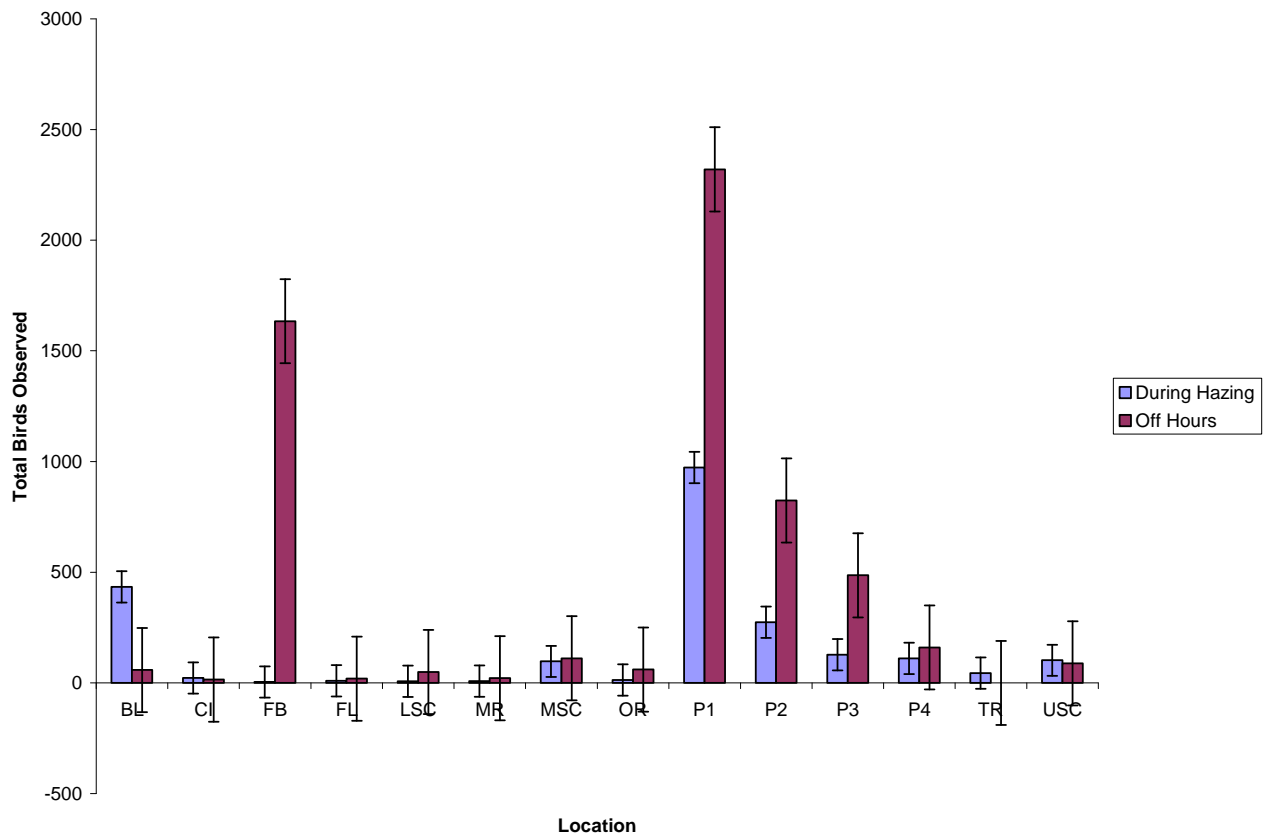
<sup>1</sup>BL = boat launch; CI = Carpenter Island; FB = forebay; FL = fish ladder; LSC = lower spawn channel; MR = middle raceways; MSC = middle spawn channel; OR = office raceways; P1 = dirt pond 1; P2 = dirt pond 2; P3 = dirt pond 3; P4 = dirt pond 4; TR = tailrace; USC = upper spawn channel



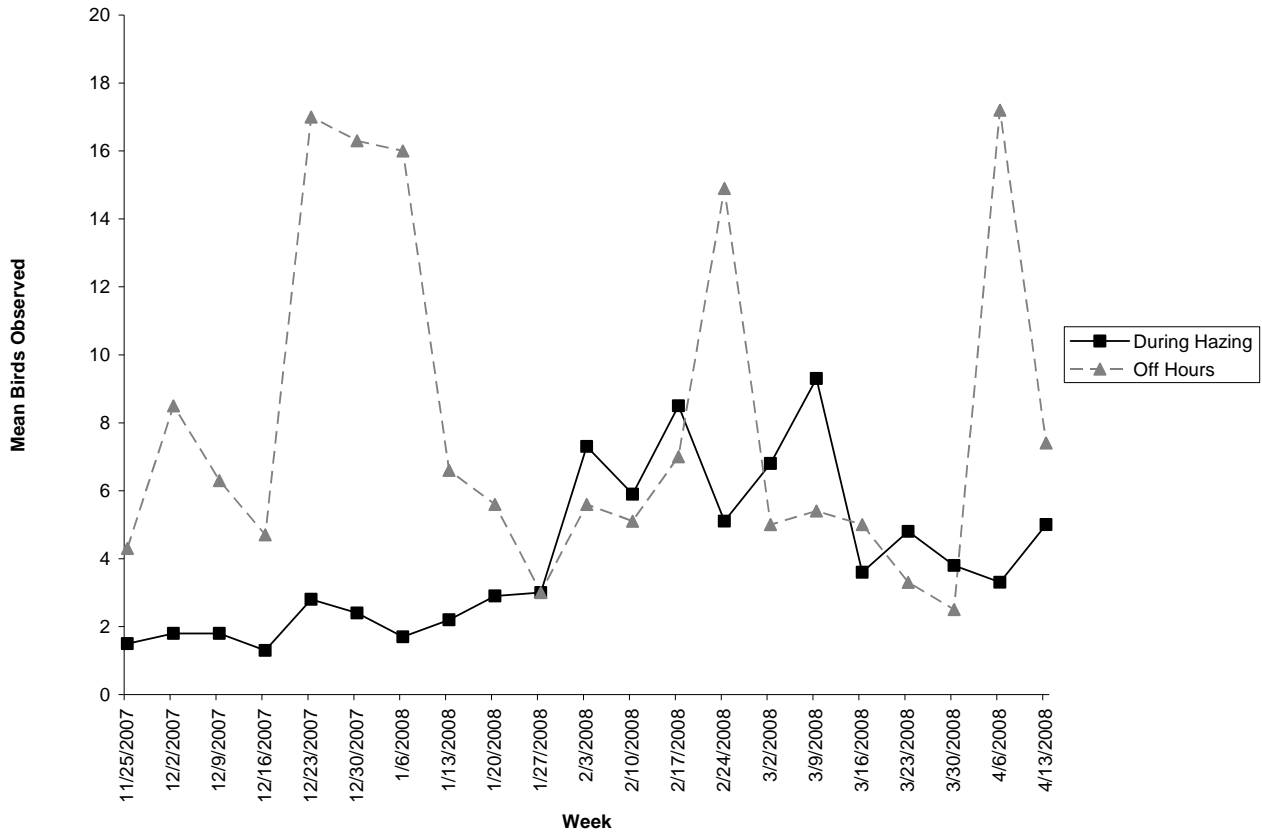
**Table 6.3-5 Numbers of birds observed at Wells Hatchery while conducting non-lethal hazing at Wells Dam in Chelan County, Washington, November 2007-April 2008.**

Species	Locations <sup>1</sup>													
	BL	CI	FB	FL	LSC	MR	MSC	OR	P1	P2	P3	P4	TR	USC
Great Blue Heron	40	15	0	5	2	2	8	8	1	1	12	10	24	5
Mallard	1	0	0	0	2	2	69	0	226	42	20	26	0	51
Kingfisher	12	0	0	1	1	4	5	3	9	3	25	20	0	3
Bufflehead	4	0	0	0	0	0	0	0	350	65	9	25	0	4
Lesser Scaup	1	0	0	0	0	0	0	0	205	110	18	0	0	7
American Coot	0	0	0	0	0	0	0	0	15	0	0	0	0	0
American Wigeon	0	0	0	0	0	0	0	0	2	1	0	1	0	0
Common Merganser	35	6	0	0	2	0	8	0	146	28	37	23	10	3
Common Loon	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	2	0	0	0	0	0	0	0	6	0	3	1	0	0
Ring-necked Duck	0	0	0	0	0	0	0	0	2	7	0	0	0	28
Double-crested Cormorant	11	1	4	3	0	0	0	0	6	2	0	2	9	0
Unknown Gull	3	0	0	0	0	0	1	0	4	0	1	0	1	0
American Dipper	7	0	0	0	0	0	6	2	1	3	2	0	0	1
Green-winged Teal	0	0	0	0	0	0	0	0	0	12	0	3	0	0

<sup>1</sup> BL = boat launch; CI = Carpenter Island; FB = forebay; FL = fish ladder; LSC = lower spawn channel; MR = middle raceways; MSC = middle spawn channel; OR = office raceways; P1 = dirt pond 1; P2 = dirt pond 2; P3 = dirt pond 3; P4 = dirt pond 4; TR = tailrace; USC = upper spawn channel



**Figure 6.3-1** Total birds observed at all Wells Hatchery locations during hazing and non-hazing periods, November 2007-April 2008.



**Figure 6.3-2 Mean numbers of birds observed weekly at all Wells Hatchery locations during hazing and non-hazing periods, November 2007-April 2008.**

**Table 6.3-6 Observations of bird foraging behavior recorded during non-hazing periods at Wells Hatchery, Chelan County, Washington, November 2007-May 2008.**

Species	Foraging attempts	Fish caught	Unknown caught
Great Blue Heron	522	16	329
Common Merganser	87	0	51
Hooded Merganser	53	0	27
Double-crested Cormorant	34	23	8
Osprey	27	26	0
Belted Kingfisher	26	1	14
Bufflehead	10	0	0
Pied-billed Grebe	9	0	2
Mallard	6	1	0
Common Loon	6	0	3
Common Goldeneye	2	0	2
<b>Total</b>	<b>782</b>	<b>67</b>	<b>436</b>

Based on the fish consumption calculations, 27,767 fish were consumed by birds foraging in the dirt rearing ponds at Wells Hatchery from November 2007 to May 2008 (Table 6.3-7). Great blue heron accounted for 79.2 percent of the estimated fish consumption. Common mergansers consumed 10.3 percent of the total. Hooded mergansers, belted kingfishers and double-crested cormorants consumed 6.3, 3.5, and 0.7 percent, respectively. Hatchery personnel calculated the total fish loss in Pond 3 to be 12.4 percent, well within the seven to fourteen percent loss documented in past years (Table 6.3-8). Estimated consumption of fish in Pond 3 accounts for only 26 percent of the total fish loss (Table 6.3-8). However, estimated consumption of fish in Pond 4 was 4.5 times greater than the total loss calculated when fish were released from the pond, suggesting that WDFW loss estimates are too low.

**Table 6.3-7 Number of fish consumed in Wells Hatchery Ponds, Chelan County, Washington, November 2007-May 2008, as estimated by foraging rates and species abundance.**

Species	Pond 1	Pond 2	Pond 3	Pond 4	Total
Great Blue Heron	10,929	2,704	5,555	2,791	21,979
Double-crested Cormorant*	0	98	98	11	207
Belted Kingfisher	178	16	435	341	970
Common Merganser*	0	0	2,648	223	2,871
Hooded Merganser*	153	0	1,587	0	1,740
<b>Total</b>	<b>11,260</b>	<b>2,818</b>	<b>10,323</b>	<b>3,366</b>	<b>27,767</b>

\* Common merganser, hooded merganser and double-crested cormorant fish consumption at Wells Hatchery was estimated at 3 fish per bird.

**Table 6.3-8 WDFW estimates of fish loss from Ponds 3 and 4 at Wells Hatchery, Douglas County, Washington, November 2007-May 2008.**

Pond	Fish in	Fish out	Fish missing	Loss rate
Pond 3	333,908	292,597	41,311	0.124
Pond 4	148,525	147,782	743	0.005

Few birds were documented in the tailrace during November-April observations when hazing occurred (24 great blue heron, 10 common merganser, 9 double-crested cormorant, and 1 unknown gull). During the same period when hazing did not occur, no birds were observed. However, after hazing ended in mid-April observers witnessed unknown gulls (range 1-50) using the tailrace. The timing of gull observations coincided with migration of smolts through the Wells Dam and the release of salmonids from the Wells Hatchery.

Minimal use of Wells Hatchery by aquatic mammals was observed during this study. Observations of 1-4 raccoons were recorded 15 times during focal runs, but none were observed catching fish. River otter were observed four times during evening focal runs and were documented capturing fish on two occasions. A nuisance wildlife control specialist contracted to trap furbearers at Wells Hatchery removed three raccoons during 11 trap nights throughout this study period.

## 6.4 Evaluation of Alternative Control Measures

The current non-lethal hazing measures implemented at Wells Hatchery appear to effectively deter potential avian and mammalian predators during daylight hours. Hazing at Wells Hatchery is conducted for six hours after daylight. Modifying the hazing schedule or hiring additional hazers to cover both daytime and evening or nighttime periods, including weekends, could further reduce bird predation.

Non-lethal hazing loses its effectiveness over time without the reinforcement of periodic lethal control. Lethal control should be considered an option in adaptive management plans; however, it should be used timely and prudently. Fish-eating birds in North America are considered migratory and are protected by the Migratory Bird Treaty Act. Thus, take of birds at the Wells Hatchery outside designated hunting seasons requires permits from U.S. Fish and Wildlife Service and coordination with the Washington Department of Fish and Wildlife. Nonetheless, lethal control should be available to managers at Wells Hatchery when fish-eating birds habituate to non-lethal control measures.

A variety of additional aversion-provoking stimuli are available to support use of vehicle patrols and pyrotechnics including propane cannons, scarecrows, and lasers. Because birds are known to habituate to these devices, use should be alternated with other techniques and reinforced with lethal control when appropriate.

Diversion is a non-lethal control measure that has been used with aquaculture, whereby alternate prey is made available to predators to reduce loss of preferred fish. Start-up and maintenance cost of this approach is variable and site specific. However, this technique would not likely be a cost effective approach for Wells Hatchery.

Complete enclosure of ponds and raceways denies birds and mammals access to fish. Implementation of complete enclosure would make active hazing unnecessary at ponds and raceways. However, complete enclosure can negatively affect normal hatchery operations (e.g., feeding, water measurements, pond/raceway maintenance). Modification or supplementation of partial enclosure measures currently in place could reduce bird use. Replacing the existing bird exclusion wires on the ponds with a finer scale grid (1 to 2 feet between wires) would further reduce aerial predators such as heron, kingfisher, and osprey (Conover 2002). In addition, replacing the electric fence along the sides of the ponds with wire mesh fencing would guard against wading birds such as great blue heron, and fencing around the hatchery perimeter could exclude aquatic mammals such as river otter.

Habitat modification also is an important component of predator control. Vegetation should be maintained so as to minimize cover for predators near fish ponds and raceways. Perching or landing sites can be covered with spines, wire, or sharp objects to prevent birds from using those areas (Conover, 1992).

## 7.0 DISCUSSION

Integrated approaches, which may include aversion-provoking stimuli, diversion, exclusion, habitat modification, and lethal control, are necessary to reduce bird predation (Conover 2002). Non-lethal hazing with pyrotechnics and vehicle patrols (aversion-provoking stimuli) in conjunction with bird wire and fencing (habitat modification) was efficacious during daylight hours at the Wells Hatchery as bird hazing events resulted in 99.4% of birds moving away from the study area. Without monitoring movement of individual birds it is extremely difficult to know if hazing has lasting or only temporary effects on individuals. Observations conducted during non-hazing periods suggest that local populations of birds may have altered their daily patterns to use hatchery ponds when hazers and hatchery staff were not present. This was particularly true of great blue heron, which exhibited a much higher frequency of occurrence and relative abundance in the absence of hazing. Bird presence, however, does not necessarily equate to loss of fish. Although great blue herons are efficient visual predators capable of taking hatchery salmonids, they have a flexible, diverse diet including amphibians, birds, crustaceans, insects, mammals, reptiles, and fishes (Palmer, 1962; Kushlan, 1978; Peifer, 1979; Verbeek and Butler, 1989). Additional active hazing may continue to reduce bird presence and opportunities for foraging; however, more information is needed to determine levels of fish loss to predators.

Total fish losses at Ponds 1 and 2 are unknown (WDFW personnel estimate the number of fish released from these ponds into the Columbia River). Calculated losses of steelhead smolts from Pond 3 (41,311) and 4 (743) are difficult to interpret relative to the documented foraging and estimated predation determined at these ponds in this study. Clearly, the calculated loss at Pond 4 is too low. However, the calculated loss at Pond 3 is almost certainly too high. Bird foraging pressure accounts for only 25 percent of the fish loss from Pond 3. Documented foraging attempts were slightly higher in Pond 3 compared to the other three ponds, but cannot account for loss of over 41,000 fish. That amount of loss would equate to the loss of approximately 220 fish every day of the study, which is not supported by the bird counts or behavioral observations. When the predation estimates from this study for Ponds 3 and 4 are combined, birds consumed less than 14,000 fish, compared to the WDFW combined estimated losses of over 42,000 fish. Assuming both combined estimates are accurate, avian predation accounted for one-third of the total hatchery steelhead losses from Ponds 3 and 4.

An unexpected finding was the absence of observations of black-crowned night herons (*Nycticorax nycticorax*) during crepuscular and nocturnal surveys. Night herons have been documented at Wells Hatchery during past management activities by Wildlife Services and exist in the general area. Resumption of use of Wells Hatchery by night herons could result in a significant increase in fish predation.

Mammalian predators also may have contributed to the historical rates of loss reported at the Wells Hatchery; however, based upon this year's study, their impacts were likely negligible. River otter were present and seen foraging for fish on two occasions in Pond 3. Because their presence and sign (e.g., tracks and slides) were not continuous, it is unlikely they actively foraged regularly in the hatchery.

## 8.0 STUDY VARIANCE

Variances in the FERC approved study plan for the Piscivorous Wildlife Control Study include the following:

- No bird counts were collected for the Wells tailrace. Activity in the tailrace was very low for most of the study and so study resources were focused on predation at the Methow and Wells fish hatcheries.
- No cost estimates were developed for the measures recommended. The effectiveness of the current hazing program can be increased without additional cost.

## 9.0 RECOMMENDATIONS

Current methods in place to deter potential avian predators from Wells Hatchery are effective; however, adaptations could further reduce fish predation. Consideration should be given to modifying the hazing schedule to include evening or nighttime hours. The hazing period should be extended until all fish are moved from the hatchery ponds. As this coincides with movement of migrating smolts through the Wells Dam and arrival of gulls, additional resources (e.g., personnel and equipment) may be required.

Replacing the electric fencing around ponds at Wells Hatchery with woven field fence would deter wading birds (e.g., great blue herons) from walking under gull wire. Constructed properly, these fences also would deter use by aquatic mammals (e.g., river otter).

Managers should continue to monitor bird and mammal use of Wells Hatchery and refine techniques to quantify fish survival in ponds and raceways. Better fish counts into and out of rearing ponds are necessary to assess potential impacts by predators. Managers also should consider screening birds as potential vectors of fish diseases. If future monitoring indicates consistent excessive losses (>5%) from Pond 3 or other rearing ponds, cause-specific mortality investigations may be necessary to identify corrective measures. If pond use by aerial predators increases or if birds are shown to be disease vectors, decreasing the spacing between gull wires may further reduce pond use.

Passive measures appear to effectively dissuade bird and mammal use at Methow Hatchery, making active measures unnecessary. Managers can further reduce predation by ensuring that pond covers are closed and kept secured. Managers should consider a future study to determine if waterfowl attracted to the hatchery ponds are a vector for the Ich protozoan disease (*Ichthyophthirius multifiliis*) outbreaks each fall.

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## **Appendix A**

### **Non-Hazing (Nighttime) Bird Count and Fish Consumption Data**

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
11/19/07	2315	P2	2	GBHE			
11/19/07	0318	P3	1	GBHE			
11/19/07	0600	P4	1	GBHE	1		
11/19/07	2327	P2	38	MALL			
11/19/07	2342	P2	1	Unknown Duck			
11/20/07	2234	P1	1	GBHE			
11/20/07	2138	P2	23	MALL			
11/20/07	2331	P4	4	MALL			
11/21/07	0348	P1	1	GBHE			
11/21/07	0106	P3	1	GBHE			
11/24/07	1314	P4	1	GBHE			
11/24/07	0714	P3	2	KIFI	1		1
11/24/07	1002	P3	1	KIFI	1		1
11/24/07	1437	P3	1	KIFI	1		1
11/24/07	1101	P3	1	KIFI	2		1
11/24/07	1027	P4	2	KIFI	1	0	0
11/24/07	1235	P4	1	KIFI	1		1
11/24/07	0821	P1	1	MALL			
11/24/07	0806	P3	1	MALL			
11/25/07	0704	P4	2	Bufflehead	10		
11/25/07	0857	P4	1	KIFI	1		1
11/25/07	0825	P4	1	KIFI	3	1	
11/28/07	2008	P1	1	GBHE	2	0	0
11/28/07	2034	P4	1	GBHE			
11/28/07	2317	P4	1	GBHE			
11/28/07	2144	P1	2	MALL			
11/28/07	0131	P3	1	Unknown Duck			
11/29/07	0149	P3	1	GBHE	7		4
11/29/07	0241	P3	1	GBHE			
11/29/07	2114	P1	3	MALL			
11/29/07	2232	P1	8	MALL			
11/29/07	2311	P1	28	MALL			
11/29/07	2345	P1	17	MALL			
11/29/07	0318	P2	6	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
11/29/07	0406	P3	1	MALL			
11/30/07	2314	P1	1	GBHE			
11/30/07	2333	P1	17	MALL			
11/30/07	2450	P2	5	MALL			
11/30/07	2404	P3	3	MALL			
12/01/07	2124	P3	1	GBHE	3		2
12/01/07	0238	P4	1	GBHE			
12/01/07	2245	P1	6	MALL			
12/01/07	2020	P1	2	MALL			
12/01/07	1921	P2	3	MALL			
12/01/07	2003	P2	7	MALL			
12/01/07	0216	P3	4	MALL			
12/04/07	2440	P1	1	GBHE	2		1
12/04/07	1954	P1	1	GBHE			
12/04/07	2104	P3	1	GBHE			
12/04/07	1906	P1	22	MALL			
12/04/07	2345	P1	52	MALL			
12/04/07	1920	P2	44	MALL			
12/04/07	2120	P3	4	MALL			
12/05/07	0115	P1	1	GBHE			
12/05/07	2123	P1	1	GBHE			
12/05/07	2321	P4	1	GBHE			
12/05/07	2109	P1	6	MALL			
12/05/07	0319	P2	43	MALL			
12/05/07	2216	P2	17	MALL			
12/05/07	0424	P4	2	MALL			
12/05/07	2246	P4	2	MALL			
12/06/07	2322	P1	4	MALL			
12/06/07	0334	P1	4	MALL			
12/06/07	0556	P1	13	MALL			
12/06/07	0321	P2	10	MALL			
12/08/07	2406	P3	1	GBHE			
12/08/07	2023	P1	2	MALL			
12/08/07	2237	P1	2	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
12/08/07	2253	P2	1	MALL			
12/08/07	2316	P4	6	MALL			
12/08/07	2210	P1					
12/09/07	0144	P1	1	GBHE			
12/09/07	2137	P3	1	GBHE			
12/09/07	1914	P2	8	MALL			
12/09/07	2207	P3	2	MALL			
12/09/07	2250	P4	6	MALL			
12/09/07	2306	P3					
12/10/07	0114	P1	4	Bufflehead			
12/10/07	0248	P3	1	GBHE			
12/10/07	2110	P1	6	MALL			
12/10/07	0406	P1	2	MALL			
12/10/07	2131	P3	15	MALL			
12/10/07	2320	P3	8				
12/10/07	2441	P3	1				
12/13/07	1906	P1	1	GBHE			
12/13/07	0210	P1	1	GBHE			
12/13/07	2100	P3	1	GBHE			
12/13/07	1917	P1	70	MALL			
12/13/07	2125	P1	13	MALL			
12/13/07	2439	P1	9	MALL			
12/13/07	2046	P3	1	MALL			
12/13/07	0145	P3	32	MALL			
12/14/07	0116	Pond	1	GBHE			
12/15/07	0115	P1	6	Common Goldeneye			
12/15/07	2148	P1		GBHE			
12/15/07	2159	P3	1	GBHE			
12/15/07	2170	P3	1	GBHE			
12/15/07	2110	P1	24	MALL			
12/15/07	2122	P2	12	MALL			
12/15/07	2241	P3	2	MALL			
12/16/07	2210	P1	1	GBHE			
12/16/07	1933	P3	1	GBHE			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
12/16/07	1908	P1	14	MALL			
12/16/07	2333	P2	11	MALL			
12/16/07	2057	P3	2	MALL			
12/19/07	0141	P1	12	Common Goldeneye			
12/19/07	2349	P1	1	GBHE			
12/19/07	0155	P1	1	GBHE			
12/19/07	0315	P4	1	GBHE			
12/19/07	2308	P1	2	MALL			
12/19/07	2319	P2	16	MALL			
12/19/07	0449	P3	2	MALL			
12/20/07	0145	OR	1	GBHE	1		1
12/20/07	2108	P1	1	GBHE			
12/20/07	0218	P1	1	GBHE			
12/20/07	2412	P3	1	GBHE			
12/20/07	2120	P1	4	MALL			
12/20/07	0418	P1	8	MALL			
12/20/07	2458	P2	8	MALL			
12/20/07	0320	P3	4	MALL			
12/21/07	2120	P1	2	MALL			
12/21/07	2120	P1	6	Unknown Duck			
12/21/07	1951	OR	1	GBHE	3		2
12/21/07	2020	P3	1	GBHE			
12/21/07	2004	USC	1	GBHE			
12/21/07	2145	FB	6	Lesser Scaup			
12/21/07	1940	P1	16	MALL			
12/21/07	2235	P1	28	MALL			
12/21/07	2103	P2	5	MALL			
12/23/07	0850	P1	1	GBHE			
12/27/07	2304	P1	20	MALL			
12/27/07	2304	P1	8	Unknown Duck			
12/27/07	2141	OR	1	GBHE	2		1
12/27/07	2120	P1	1	GBHE			
12/27/07	2105	P1	16	MALL			
12/27/07	2234	P3	2	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
12/28/07	0152	FB	400-500	Coot			
12/28/07	2249	FB	4	Gadwall			
12/28/07	2210	BL	1	GBHE			
12/28/07	1904	LSC	1	GBHE			
12/28/07	0218	MSC	1	GBHE			
12/28/07	2316	MSC	1	GBHE			
12/28/07	2015	OR	1	GBHE	1		1
12/28/07	2415	OR	1	GBHE			
12/28/07	2002	P1	1	GBHE	2		1
12/28/07	0403	P1	1	GBHE			
12/28/07	0316	MSC	2	MALL			
12/28/07	2350	MSC	8	MALL			
12/28/07	1926	P1	7	MALL			
12/28/07	2232	FB	4	Redheads			
12/29/07	2132	FB	5	American Wigeon			
12/29/07	1918	P1	8	American Wigeon			
12/29/07	2126	FB	1	COME			
12/29/07	0218	FB	1	GBHE			
12/29/07	2316	LSC	1	GBHE			
12/29/07	2133	MSC	1	GBHE			
12/29/07	2143	OR	1	GBHE	7		3
12/29/07	2114	OR	1	GBHE			
12/29/07	2034	P1	1	GBHE	2		2
12/29/07	0101	P3	1	GBHE	2		2
12/29/07	2221	P3	1	GBHE			
12/29/07	1904	P1	56	MALL			
12/29/07	0141	P4	2	MALL			
12/30/07	2108	FB	4	American Wigeon			
12/30/07	0148	OR	1	GBHE			
12/30/07	0212	P3	1	GBHE	3		1
12/30/07	2341	P3	1	GBHE	3		2
12/30/07	2120	P1	8	MALL			
12/30/07	2257	P1	24	MALL			
12/30/07	2204	P4	2	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
12/31/07	0120	FB	3	American Wigeon			
12/31/07	0348	P3	2	Bufflehead			
12/31/07	0132	FB	400-500	Coot			
12/31/07	0238	P1	1	GBHE	2		2
12/31/07	0103	MSC	14	MALL			
01/02/08	1946	MSC	1	GBHE			
01/02/08	1930	OR	1	GBHE			
01/02/08	2145	OR	1	GBHE			
01/02/08	2220	USC	1	GBHE			
01/02/08	1913	P1	9	MALL			
01/02/08	2351	P3	2	MALL			
01/03/08	0103	P3	1	GBHE			
01/03/08	0218	Pond	1	GBHE			
01/05/08	0825	FB	2	American Wigeon			
01/05/08	0800	BL	4	COME	2		1
01/05/08	0958	BL	4	COME	52		19
01/05/08	1415	P1	3	Common Goldeneye	2		2
01/05/08	0851	P3	1	Common Goldeneye			
01/05/08	1228	P3	3	Common Goldeneye			
01/05/08	1051	BL	1	Common Loon	6		3
01/05/08	0728	FB	4	Coot			
01/05/08	1341	CI	1	GBHE	1	0	0
01/05/08	0812	CI	1	GBHE			
01/05/08	1114	P1	1	HOME	2		2
01/05/08	0740	P1	1	KIFI	1		1
01/05/08	1138	P1	1	KIFI	1		1
01/05/08	1438	P3	1	KIFI			
01/05/08	0704	P1	64	MALL			
01/07/08	1920	OR	1	GBHE			
01/07/08	2111	P1	1	GBHE	3		1
01/07/08	2001	P4	1	GBHE			
01/07/08	1904	P1	11	MALL			
01/07/08	2050	P1	28	MALL			
01/07/08	2245	P3	4	MALL			



Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
01/08/08	2201	FB	2	Canvasback			
01/08/08	2301	FB	1	Common Loon			
01/08/08	0218	OR	1	GBHE	3		3
01/08/08	2119	P1	1	GBHE	1		1
01/08/08	2420	P4	1	GBHE			
01/08/08	2141	MR	1	Great Horned Owl			
01/08/08	2106	P1	8	MALL			
01/08/08	2224	P1	64	MALL			
01/09/08	2417	FB	400-500	Coot			
01/09/08	0308	OR	1	GBHE	1		1
01/09/08	0421	OR	1	GBHE			
01/09/08	2330	OR	1	GBHE			
01/09/08	2310	P1	1	GBHE	2		1
01/09/08	0146	P3	1	GBHE			
01/09/08	0216	P4	2	MALL			
01/10/08	0223	P1	32	MALL			
01/10/08	0223	P1	4	Canvasback			
01/10/08	0554	BL	1	GBHE			
01/10/08	0351	MSC	1	GBHE			
01/10/08	0239	P1	2	GBHE			
01/10/08	0148	BL	1	Great Horned Owl			
01/10/08	0316	MSC	4	MALL			
01/10/08	0411	MSC	6	MALL			
01/10/08	2408	P1	6	MALL			
01/11/08	2001	LSC	1	GBHE			
01/11/08	2342	MSC	1	GBHE			
01/11/08	1941	P1	1	GBHE	1		1
01/11/08	1940	P1	1	GBHE			
01/11/08	2137	USC	1	GBHE			
01/11/08	2024	MSC	4	MALL			
01/11/08	2012	P1	6	MALL			
01/11/08	2253	P1	18	MALL			
01/12/08	0141	BL	1	GBHE	1		1
01/12/08	0218	OR	1	GBHE	11		8

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
01/13/08	2258	FL	1	GBHE			
01/13/08	1916	LSC	1	GBHE	1		1
01/13/08	2323	OR	1	GBHE			
01/13/08	1904	P1	88	MALL			
01/13/08	2040	P3	8	MALL			
01/13/08	2003	FB	6	Ring-Necked Duck			
01/14/08	2410	BL	1	GBHE			
01/14/08	2354	MR	1	GBHE	2		2
01/14/08	0251	MSC	1	GBHE			
01/14/08	2340	MSC	1	GBHE			
01/14/08	0235	OR	1	GBHE	4		3
01/14/08	0213	OR	1	GBHE			
01/14/08	0100	P1	1	GBHE			
01/14/08	2307	P1	16	MALL			
01/15/08	0225	P3	4	Common Goldeneye			
01/15/08	2416	FB	8	Gadwall			
01/15/08	0102	LSC	1	GBHE	3		1
01/15/08	0447	OR	1	GBHE	1		1
01/15/08	2437	P1	28	MALL			
01/15/08	2437	P1	39	MALL			
01/16/08	2115	P1	4	American Wigeon			
01/16/08	2251	P4	3	Common Goldeneye			
01/16/08	2314	BL	1	GBHE			
01/16/08	2329	MR	1	GBHE			
01/16/08	2147	P1	1	GBHE	1		1
01/16/08	2240	P3	1	GBHE			
01/16/08	2106	P1	8	MALL			
01/17/08	0205	FB	2	American Wigeon			
01/17/08	0258	MSC	1	GBHE			
01/17/08	0118	OR	1	GBHE			
01/17/08	0351	MSC	3	MALL			
01/18/08	2356	OR	1	GBHE	2		2
01/18/08	2313	P1	1	GBHE	1		1
01/18/08	0419	P1	1	GBHE	1		1

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
01/19/08	2415	FB	5	American Wigeon			
01/19/08	0618	OR	1	GBHE			
01/19/08	0116	P4	1	GBHE	2		1
01/19/08	0201	P4	1	GBHE			
01/19/08	0334	P4	1	GBHE			
01/19/08	0250	P1	14	MALL			
01/19/08	2456	P3	12	MALL			
01/19/08	0429	P3	4	MALL			
01/22/08	1940	FB	4	American Wigeon			
01/22/08	2106	MR	1	GBHE			
01/22/08	1903	P1	1	GBHE	2		2
01/22/08	2334	P4	1	GBHE			
01/22/08	2251	USC	1	GBHE			
01/22/08	1921	P1	9	MALL			
01/22/08	2004	P3	2	MALL			
01/22/08	2041	P4	4	MALL			
01/22/08	2119	FB	4	Ring-Necked Ducks			
01/23/08	0131	P1	7	MALL			
01/23/08	0131	P1	4	American Wigeon			
01/23/08	2416	P1	9	American Wigeon			
01/23/08	2320	P1	3	Common Goldeneye			
01/23/08	0224	OR	1	GBHE	4		3
01/23/08	2345	P1	1	GBHE			
01/23/08	2302	P1	22	MALL			
01/24/08	2437	FB	2	Gadwall			
01/24/08	0129	BL	1	GBHE			
01/24/08	2237	CI	1	GBHE			
01/24/08	0602	FL	1	GBHE			
01/24/08	0248	OR	1	GBHE	3		1
01/24/08	0152	OR	1	GBHE			
01/24/08	0321	P1	1	GBHE	1		1
01/24/08	2350	P1	1	GBHE	1		1
01/24/08	2119	P1	1	GBHE			
01/24/08	2403	LSC	5	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
01/24/08	0410	MSC	24	MALL			
01/24/08	2102	P1	14	MALL			
01/24/08	0228	P3	8	MALL			
01/24/08	2331	P1	6	MALL			
01/24/08	2331	P1	4	Redheads			
01/24/08	2430	FB	8	Ring-Necked Ducks			
01/25/08	0230	P3	1	GBHE			
01/25/08	0413	USC	1	GBHE			
01/25/08	0114	P4	4	MALL			
01/26/08	0133	P1	3	Common Goldeneyes			
01/26/08	0133	P1	3	Canvasback			
01/26/08	1130	P3	4	MALL			
01/26/08	1130	P3	1	Gadwall			
01/26/08	1039	CI	1	CAGU			
01/26/08	0815	BL	4	COME			
01/26/08	0914	BL	5	COME			
01/26/08	0831	BL	4	Common Goldeneye			
01/26/08	0720	P1	2	Common Goldeneye			
01/26/08	0756	FB	6	Coot			
01/26/08	0952	P1	4	Gadwall			
01/26/08	0850	CI	1	GBHE			
01/26/08	1025	CI	2	GBHE			
01/26/08	0701	P1	1	GBHE			
01/26/08	0239	USC	1	GBHE			
01/26/08	0929	MSC	1	KIFI			
01/26/08	0228	P3	1	KIFI	3		1
01/26/08	1143	P4	1	KIFI	4		1
01/26/08	0216	BL	1	Common Loon			
01/26/08	0709	P1	33	MALL			
01/26/08	1118	P1	12	MALL			
01/26/08	0745	P3	26	MALL			
01/26/08	0145	P3	9	MALL			
01/26/08	0731	P4	18	MALL			
01/26/08	0204	P4	24	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
01/26/08	1106	FB	4	PBGR			
01/27/08	2113	P1	4	Common Goldeneye			
01/27/08	2008	BL	1	GBHE	1		1
01/27/08	1940	MR	1	GBHE			
01/27/08	2048	OR	1	GBHE			
01/27/08	2444	OR	1	GBHE			
01/27/08	2135	P1	1	GBHE	2		1
01/27/08	1914	P1	1	GBHE	9		1
01/27/08	1936	P3	1	GBHE			
01/27/08	1954	P4	1	GBHE			
01/27/08	2408	P4	1	GBHE			
01/27/08	1902	P1	20	MALL			
01/27/08	2245	P3	4	MALL			
01/28/08	2127	P1	6	Canvasback			
01/28/08	2115	P1	2	Common Goldeneye			
01/28/08	0157	P4	2	Common Goldeneye			
01/28/08	2246	BL	1	GBHE	2		1
01/28/08	0120	LSC	1	GBHE			
01/28/08	0244	MR	1	GBHE			
01/28/08	2202	MSC	2	GBHE			
01/28/08	2103	P1	14	MALL			
01/28/08	0212	USC	4	MALL			
01/29/08	0141	P3	3	Common Goldeneye			
01/29/08	0228	BL	1	GBHE	1	0	0
01/29/08	0422	FL	1	GBHE			
01/29/08	2403	LSC	1	GBHE			
01/29/08	0305	P1	1	GBHE			
01/29/08	0435	P3	3	MALL			
02/04/08	0135	P3	1	DCCO			
02/04/08	0135	P3	3	MALL			
02/04/08	1940	P3	3	MALL			
02/04/08	0940	P3	2	American Wigeon			
02/04/08	2250	P3	3	MALL			
02/04/08	2250	P3	2	American Wigeon			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
02/04/08	2015	P1	1	MALL			
02/04/08	2315	P1	1	MALL			
02/04/08	0215	P1	1	MALL			
02/04/08	1910	P4	4	MALL			
02/04/08	2220	P4	4	MALL			
02/04/08	0040	P4	3	MALL			
02/04/08	2155	USB	0				
02/05/08	2220	P1	2	MALL			
02/05/08	2320	P1	2	MALL			
02/05/08	0140	P1	2	MALL			
02/08/08	2247	P1	4	Common Goldeneye			
02/08/08	2316	MSC	1	GBHE			
02/08/08	1943	OR	1	GBHE			
02/08/08	2210	OR	1	GBHE			
02/08/08	1926	P1	1	GBHE	1		1
02/08/08	1915	P1	1	GBHE			
02/08/08	2006	P2	1	GBHE			
02/08/08	1902	P1	34	MALL			
02/08/08	2104	P3	2	MALL			
02/09/08	2219	P1	62	MALL			
02/09/08	2219	P1	8	Common Goldeneye			
02/09/08	2219	P1	2	Coot			
02/09/08	2117	P1	3	Common Goldeneye			
02/09/08	2349	MR	1	GBHE			
02/09/08	0103	P1	1	GBHE			
02/09/08	2523	P2	1	GBHE			
02/09/08	0244	MSC	4	MALL			
02/09/08	2143	MSC	2	MALL			
02/09/08	2104	P1	6	MALL			
02/09/08	2130	P3	14	MALL			
02/09/08	2157	P4	5	MALL			
02/10/08	0412	P4	3	Common Goldeneye			
02/10/08	0436	MSC	1	GBHE			
02/10/08	0448	OR	1	GBHE	15		9

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
02/10/08	2436	P1	1	GBHE			
02/10/08	0321	P2	1	GBHE			
02/10/08	0158	P3	1	GBHE			
02/10/08	0116	USC	2	MALL			
02/11/08	2331	OR	1	GBHE			
02/11/08	2302	P1	57	MALL			
02/11/08	2313	P2	4	MALL			
02/12/08	0101	P1	3	Common Goldeneye			
02/12/08	0541	BL	1	GBHE	1		1
02/12/08	2341	MR	1	GBHE			
02/12/08	0256	MSC	1	GBHE			
02/12/08	0409	OR	1	GBHE	6		5
02/12/08	2207	OR	1	GBHE	29		13
02/12/08	0149	OR	1	GBHE			
02/12/08	2153	OR	1	GBHE			
02/12/08	2120	P2	1	GBHE			
02/12/08	0224	LSC	2	MALL			
02/12/08	2106	P1	12	MALL			
02/12/08	2140	P1	38	MALL			
02/12/08	2422	P3	2	MALL			
02/12/08	0507	P3	8	MALL			
02/12/08	2246	P3	3	MALL			
02/12/08	2259	P4	8	MALL			
02/12/08	0633	USC	4	MALL			
02/13/08	0303	P2	4	American Wigeon			
02/13/08	0340	OR	1	GBHE			
02/13/08	0149	P1	1	GBHE			
02/13/08	0110	USC	2	MALL			
02/14/08	2120	P1	3	American Wigeon			
02/14/08	2136	FL	1	GBHE			
02/14/08	2350	OR	1	GBHE	9		6
02/14/08	2237	OR	1	GBHE	61		43
02/14/08	2341	FB	14	MALL			
02/14/08	2107	P1	8	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
02/14/08	2150	P2	6	MALL			
02/15/08	0138	P1	3	Common Goldeneye			
02/15/08	1918	P1	2	Common Goldeneye			
02/15/08	2117	MSC	1	GBHE			
02/15/08	2031	OR	1	GBHE	7		6
02/15/08	0436	OR	1	GBHE			
02/15/08	1947	P1	1	GBHE	2		2
02/15/08	2418	P4	1	GBHE			
02/15/08	0354	USC	1	GBHE			
02/15/08	1901	P1	8	MALL			
02/15/08	0225	P2	2	MALL			
02/15/08	2100	P3	13	MALL			
02/15/08	2304	USC	2	MALL			
02/16/08	0114	P1	28	MALL			
02/16/08	0114	P1	4	American Wigeon			
02/16/08	0214	OR	1	GBHE	17		16
02/16/08	0132	P1	1	GBHE			
02/19/08	2130	P1	38	MALL			
02/19/08	2130	P1	13	Common Goldeneye			
02/19/08	1905	P1	8	MALL			
02/19/08	1905	P1	7	Common Goldeneye			
02/19/08	2247	P4	2	American Wigeon			
02/19/08	2056	BL	1	GBHE			
02/19/08	1920	LSC	1	GBHE	1		1
02/19/08	1950	MR	1	GBHE			
02/19/08	2206	OR	1	GBHE			
02/19/08	1934	LSC	4	MALL			
02/19/08	2004	P1	30	MALL			
02/19/08	2020	P3	2	MALL			
02/20/08	2334	P1	4	American Wigeon			
02/20/08	2334	P1	2	Common Goldeneye			
02/20/08	2421	FL	1	GBHE			
02/20/08	2355	P1	1	GBHE			
02/20/08	0255	P2	1	GBHE			



Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
02/20/08	0119	P4	1	GBHE			
02/20/08	2304	LSC	4	MALL			
02/20/08	2320	P1	22	MALL			
02/20/08	0240	USC	8	MALL			
02/21/08	2145	P2	3	MALL			
02/21/08	2145	P2	2	Common Goldeneye			
02/21/08	2450	P2	4	MALL			
02/21/08	2450	P2	1	Common Goldeneye			
02/21/08	0124	P4	4	American Wigeon			
02/21/08	2110	P1	4	Bufflehead			
02/21/08	2121	P1	6	Common Goldeneye			
02/21/08	2408	MR	1	GBHE			
02/21/08	2215	MR	1	GBHE			
02/21/08	2436	MSC	1	GBHE			
02/21/08	2200	MSC	1	GBHE			
02/21/08	0334	OR	1	GBHE	24		21
02/21/08	0512	P1	1	GBHE	3		2
02/21/08	0316	P3	1	GBHE			
02/21/08	2345	P3	4	Common Goldeneye			
02/21/08	2105	P1	26	MALL			
02/21/08	0258	P3	45	MALL			
02/21/08	2224	P3	2	MALL			
02/21/08	0424	USC	2	MALL			
02/22/08	0404	BL	1	GBHE			
02/22/08	2429	FL	1	GBHE			
02/22/08	0314	P3	1	GBHE			
02/26/08	2320	P2	118	MALL			
02/26/08	2320	P2	6	American Wigeon			
02/26/08	2320	P2	8	Common Goldeneye			
02/26/08	2140	LSC	1	GBHE			
02/26/08	2111	P1	1	GBHE	1		1
02/26/08	2124	P2	41	MALL			
02/27/08	1920	P1	4	MALL			
02/27/08	1920	P1	4	Common Goldeneye			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
02/27/08	1945	P2	86	MALL			
02/27/08	1945	P2	5	Common Goldeneye			
02/27/08	1945	P2	8	American Wigeon			
02/27/08	2015	LSC	1	GBHE			
02/27/08	0434	OR	1	GBHE	27		22
02/27/08	0300	OR	1	GBHE			
02/27/08	1901	P1	1	GBHE	4		4
02/27/08	0114	P3	1	GBHE			
02/27/08	2338	P3	3	Common Goldeneye			
02/27/08	2449	P1	4	MALL			
02/27/08	2301	P4	6	MALL			
02/28/08	0112	USC	2	MALL			
02/29/08	2306	P2	38	MALL			
02/29/08	2306	P2	4	American Wigeon			
02/29/08	2148	P3	3	Canvasback			
02/29/08	2351	LSC	1	GBHE			
02/29/08	0228	OR	1	GBHE			
02/29/08	2224	OR	1	GBHE			
02/29/08	2102	P2	6	MALL			
02/29/08	2116	P4	2	MALL			
03/01/08	2342	P2	45	MALL			
03/01/08	2342	P2	4	Common Goldeneye			
03/01/08	2342	P2	6	American Wigeon			
03/01/08	2342	P2	2	Coot			
03/01/08	2319	P1	6	MALL			
03/01/08	2319	P1	2	Common Goldeneye			
03/01/08	0137	P1	4	Common Goldeneye			
03/01/08	0144	BL	1	GBHE			
03/01/08	0108	MR	1	GBHE			
03/01/08	2503	P1	1	GBHE	5		5
03/01/08	0208	USC	3	MALL			
03/02/08	0402	P1	8	American Wigeon			
03/02/08	0604	P1	8	Bufflehead			
03/02/08	0639	FB	1	COME			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/02/08	0114	FL	1	GBHE			
03/02/08	0441	FL	2	GBHE			
03/02/08	0319	MR	1	GBHE			
03/02/08	2422	OR	1	GBHE			
03/02/08	0231	P1	1	GBHE	6		3
03/02/08	2402	P1	1	GBHE			
03/02/08	0651	FB	2	Horned Grebe	9		2
03/02/08	0627	P3	1	KIFI	3		2
03/02/08	0136	P3	2	MALL			
03/02/08	0618	P3	2	Northern Pintail			
03/02/08	0214	FB	2	Ring-Necked Ducks			
03/04/08	2330	P2	14	MALL			
03/04/08	2330	P2	2	Bufflehead			
03/04/08	2301	P1	1	GBHE	2		2
03/04/08	2318	P1	12	MALL			
03/04/08	2351	P3	7	MALL			
03/05/08	0255	FB	2	American Wigeon			
03/05/08	0611	P1	9	Bufflehead			
03/05/08	0633	USC	3	Canvasback			
03/05/08	0648	BL	17	COME			
03/05/08	0547	BL	1	GBHE			
03/05/08	2406	LSC	1	GBHE			
03/05/08	0134	P3	1	GBHE			
03/05/08	0418	P2	8	Common Goldeneye			
03/05/08	0621	P1	1	KIFI	3		2
03/05/08	0103	MSC	4	MALL			
03/05/08	0230	USC	6	MALL			
03/06/08	2141	P3	4	MALL			
03/06/08	2141	P3	2	Canvasback			
03/06/08	2116	P1	4	American Wigeon			
03/06/08	2343	LSC	1	GBHE			
03/06/08	2237	MSC	1	GBHE			
03/06/08	2215	OR	1	GBHE	16		13
03/06/08	2129	P1	2	Common Goldeneye			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/06/08	2104	P1	7	MALL			
03/06/08	2251	P3	10	MALL			
03/07/08	2122	P1	5	MALL			
03/07/08	2122	P1	1	Common Goldeneye			
03/07/08	1932	P1	6	MALL			
03/07/08	1932	P1	2	American Wigeon			
03/07/08	0121	P1	4	Bufflehead			
03/07/08	2416	FL	1	GBHE			
03/07/08	2145	LSC	1	GBHE			
03/07/08	2005	MR	1	GBHE			
03/07/08	2321	OR	1	GBHE	7		6
03/07/08	2101	P1	1	GBHE	2		2
03/07/08	2437	P1	1	GBHE	6		3
03/07/08	1914	P1	1	GBHE			
03/07/08	0210	USC	2	MALL			
03/07/08	0403	FB	3	Ring-Necked Duck			
03/08/08	2205	P2	2	MALL			
03/08/08	2205	P2	3	Canvasback			
03/08/08	0114	P3	2	MALL			
03/08/08	0114	P3	4	Bufflehead			
03/08/08	2248	P3	6	MALL			
03/08/08	2248	P3	2	Bufflehead			
03/08/08	2318	FB	63	Coot			
03/08/08	2338	LSC	1	GBHE			
03/08/08	2103	P1	1	GBHE	2		1
03/08/08	2120	P1	6	Common Goldeneye			
03/08/08	0435	P1	5	Common Goldeneye			
03/08/08	2139	P1	12	MALL			
03/09/08	0114	OR	1	GBHE			
03/09/08	0145	P4	1	GBHE			
03/09/08	0239	P3	2	Common Goldeneye			
03/09/08	0212	MSC	2	MALL			
03/09/08	0318	OR					
03/10/08	2153	P2	2	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/10/08	2153	P2	1	Coot			
03/10/08	2131	P1	6	Canvasback			
03/10/08	2318	OR	1	GBHE			
03/10/08	2210	P1	1	GBHE	3		3
03/10/08	2117	P1	16	Common Goldeneye			
03/10/08	2245	P3	3	HOME	22		14
03/10/08	2104	P1	41	MALL			
03/11/08	0134	FB	11	Coot			
03/11/08	0134	FB	1	Common Goldeneye			
03/11/08	0332	P1	8	MALL			
03/11/08	0332	P1	2	Common Goldeneye			
03/11/08	0217	BL	1	GBHE	3		1
03/11/08	0409	MR	1	GBHE			
03/11/08	0111	P1	1	GBHE			
03/11/08	0440	P2	1	GBHE			
03/11/08	1915	?	1	GBHE	3	3	
03/11/08	1903	?	1	GBHE	6		6
03/11/08	1848	?	1	GBHE			
03/11/08	2217	?	1	GBHE			
03/11/08	0147	USC	4	MALL			
03/12/08	1841	P3	1	DCCO			
03/12/08	1841	P3	11	MALL			
03/12/08	1814	P1	6	Lesser Scaup			
03/12/08	1814	P1	2	Bufflehead			
03/12/08	1814	P1	8	Common Goldeneye			
03/12/08	1814	P1	1	American Wigeon			
03/12/08	1900	P3	7	COME	19		18
03/12/08	1920	P3	1	DCCO	8		8
03/12/08	1827	P1	4	Gadwall			
03/12/08	2121	FL	1	GBHE			
03/12/08	2357	MR	1	GBHE			
03/12/08	2018	P1	1	GBHE	2		2
03/12/08	1850	USC	1	GBHE			
03/12/08	2309	P4	4	Common Goldeneye			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/12/08	2201	LSC	2	MALL			
03/12/08	2042	MSC	2	MALL			
03/12/08	1802	P1	27	MALL			
03/12/08	1926	P2	4	MALL			
03/13/08	0104	FB	2	MALL			
03/13/08	0104	FB	17	Coot			
03/13/08	2123	P1	4	MALL			
03/13/08	2123	P1	2	American Wigeon			
03/13/08	2242	P2	2	Canvasback			
03/13/08	2355	FL	1	GBHE			
03/13/08	0133	P1	1	GBHE	1		1
03/13/08	2105	P1	1	GBHE	3		1
03/13/08	2209	P2	3	Common Goldeneye			
03/13/08	2321	LSC	2	MALL			
03/14/08	0150	P1	6	MALL			
03/14/08	0150	P1	4	Bufflehead			
03/14/08	0150	P1	5	Common Goldeneye			
03/14/08	1852	P1	4	Bufflehead			
03/14/08	1924	P2	6	Bufflehead			
03/14/08	1956	P3	3	Bufflehead			
03/14/08	2012	P3	2	COME	11		10
03/14/08	2037	FB	5	Coot			
03/14/08	1939	P3	2	DCCO	19	16	
03/14/08	1838	P1	6	Gadwall			
03/14/08	2307	LSC	1	GBHE			
03/14/08	0120	OR	1	GBHE			
03/14/08	2341	OR	1	GBHE			
03/14/08	2122	P1	1	GBHE	1		1
03/14/08	0318	P2	1	GBHE			
03/14/08	1812	P1	10	Common Goldeneye			
03/14/08	1823	P1	10	Lesser Scaup			
03/14/08	1911	P2	4	Lesser Scaup			
03/14/08	0431	LSC	14	MALL			
03/14/08	2330	MSC	4	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/14/08	1802	P1	30	MALL			
03/14/08	0230	P3	2	MALL			
03/14/08	2102	USC	2	MALL			
03/15/08	0116	BL	1	GBHE	2		1
03/15/08	0147	MR	1	GBHE			
03/15/08	0132	FB	4	MALL			
03/16/08	2328	P2	2	MALL			
03/16/08	2328	P2	4	Common Goldeneye			
03/16/08	2302	FL	1	GBHE			
03/16/08	2359	OR	1	GBHE			
03/16/08	2346	P3	1	GBHE			
03/16/08	2314	P1	6	MALL			
03/17/08	0106	P2	12	MALL			
03/17/08	0106	P2	4	Common Goldeneye			
03/17/08	0106	P2	2	American Wigeon			
03/17/08	2417	P1	2	Bufflehead			
03/17/08	2417	P1	4	Gadwall			
03/17/08	0613	P3	2	MALL			
03/17/08	0613	P3	2	Bufflehead			
03/17/08	2133	P2	2	MALL			
03/17/08	2133	P2	4	Common Goldeneye			
03/17/08	0345	P2	4	MALL			
03/17/08	0345	P2	2	American Wigeon			
03/17/08	2105	FB	2	Bufflehead			
03/17/08	2237	FB	1	Eared Grebe			
03/17/08	2349	FL	1	GBHE			
03/17/08	0132	P1	1	GBHE	6		4
03/17/08	0442	FB	5	Common Goldeneye			
03/17/08	0247	P1	3	MALL			
03/17/08	0503	P1	5	MALL			
03/17/08	2117	P1	4	MALL			
03/17/08	0647	P2	2	MALL			
03/18/08	1850	P3	1	COME	20		16
03/18/08	1850	P3	2	HOME			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/18/08	1827	P2	34	MALL			
03/18/08	1827	P2	8	Greater Scaup			
03/18/08	1827	P2	6	Common Goldeneye			
03/18/08	1802	P1	6	MALL			
03/18/08	1802	P1	2	Bufflehead			
03/18/08	2218	P2	8	MALL			
03/18/08	2218	P2	4	Common Goldeneye			
03/18/08	2239	P3	2	Bufflehead			
03/18/08	1813	P1	9	Canvasback			
03/18/08	0303	USC	2	Canvasback			
03/18/08	1947	CI	8	GBHE			
03/18/08	0836	FL	1	GBHE			
03/18/08	0140	MR	1	GBHE			
03/18/08	2130	OR	1	GBHE			
03/18/08	0425	P1	1	GBHE	1		1
03/18/08	0103	P1	1	GBHE	2		2
03/18/08	2021	USC	2	Lesser Scaup			
03/18/08	2340	FB	3	MALL			
03/18/08	0413	MSC	4	MALL			
03/18/08	2324	MSC	4	MALL			
03/18/08	2410	P1	6	MALL			
03/18/08	1916	P4	2	MALL			
03/18/08	1932	P2	2	DCCO			
03/19/08	0103	FL	1	GBHE			
03/19/08	0152	P1	1	GBHE	1		1
03/21/08	2139	P2	4	MALL			
03/21/08	2139	P2	2	Common Goldeneye			
03/21/08	2216	OR	1	GBHE			
03/21/08	2248	USC	1	GBHE			
03/21/08	2118	P1	3	MALL			
03/21/08	2231	P1	12	MALL			
03/21/08	2320	P2	1	MALL			
03/22/08	148	P1	18	MALL			
03/22/08	417	USC	2	MALL			



Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/24/08	2210	BL	1	GBHE			
03/24/08	2130	OR	1	GBHE			
03/24/08	2104	P1	1	GBHE	4		2
03/24/08	2143	P1	6	MALL			
03/24/08	2236	P2	2	MALL			
03/25/08	2139	FL	1	GBHE			
03/25/08	2212	MSC	1	GBHE			
03/25/08	2421	P1	1	GBHE	1		1
03/25/08	2101	P1	1	GBHE	3		3
03/25/08	0218	P2	1	GBHE			
03/25/08	0156	P2	2	Lesser Scaup			
03/25/08	0306	P3	2	MALL			
03/26/08	2422	P1	4	MALL			
03/26/08	2422	P1	2	Lesser Scaup			
03/26/08	0140	FB	8	Coot			
03/26/08	0204	MR	2	GBHE	7		4
03/26/08	0221	P3	1	GBHE			
03/26/08	0431	P1	2	MALL			
03/28/08	2328	FL	1	GBHE			
03/28/08	0151	P3	1	GBHE			
03/28/08	0107	P1	2	MALL			
03/28/08	2421	P2	2	MALL			
03/29/08	1802	P1	22	Lesser Scaup			
03/29/08	1802	P1	4	Greater Scaup			
03/29/08	1815	P1	2	Bufflehead			
03/29/08	1827	P1	2	Canvasback			
03/29/08	2341	MR	1	GBHE			
03/29/08	0404	OR	1	GBHE			
03/29/08	2141	P1	1	GBHE	1		1
03/29/08	0240	P1	1	GBHE	7		3
03/29/08	0209	P2	1	GBHE			
03/29/08	1917	P3	1	GBHE	1		1
03/29/08	1845	P3	2	GBHE	2		2
03/29/08	1858	P4	1	GBHE	3		3

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
03/29/08	2001	USC	1	GBHE			
03/29/08	2208	P1	2	Common Goldeneye			
03/29/08	0610	USC	4	Greater Scaup			
03/29/08	1928	USC	4	Greater Scaup			
03/29/08	1840	P3	8	HOME	12		8
03/29/08	0639	P1	12	Lesser Scaup			
03/29/08	0650	P3	5	Lesser Scaup			
03/29/08	2239	P2	4	MALL			
03/29/08	0623	FB	2	PBGR			
03/30/08	0143	FL	1	GBHE			
03/30/08	0114	FB	4	Lesser Scaup			
04/08/08	0100	P2	2	MALL	6	1	
04/08/08	2240	P2	2	MALL			
04/10/08	1900	FB	1	MALL			
04/10/08	1900	FB	25	Lesser Scaup			
04/10/08	1922	P2	2	GBHE			
04/10/08	1922	P2	10	MALL			
04/10/08	1922	P2	12	Lesser Scaup			
04/10/08	1920	P1	6	MALL			
04/10/08	1920	P1	5	Lesser Scaup			
04/10/08	1930	P3	10	COME			
04/10/08	1945	P4	4	COME			
04/10/08	2135	P2	3	MALL			
04/10/08	1915	USC	1	MALL			
04/11/08	1922	P4	1	GBHE	3		2
04/11/08	1922	P4	6	MALL			
04/11/08	1910	P2	2	MALL			
04/11/08	1910	P2	10	Lesser Scaup			
04/11/08	1905	P1	20	MALL			
04/11/08	1905	P1	25	Lesser Scaup			
04/11/08	1920	P3	3	Lesser Scaup			
04/11/08	1920	P3	9	GBHE			
04/11/08	1930	USC	4	MALL			
04/11/08	1930	USC	1	Canadian Goose			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
04/11/08	2030	P3	2	GBHE	4	2	
04/11/08	1900	FB	10	Lesser Scaup			
04/11/08	2105	P3	1	MALL			
04/12/08	1900	FB	150	Lesser Scaup			
04/12/08	1900	FB	6	Common Goldeneye			
04/12/08	1900	FB	1	DCCO			
04/12/08	1910	P1	25	Lesser Scaup			
04/12/08	1910	P1	10	MALL			
04/12/08	1920	P3	3	COME			
04/12/08	1920	P3	5	MALL			
04/12/08	1915	P2	1	MALL			
04/12/08	1930	UC	2	MALL			
04/13/08	0530	P2	1	DCCO			
04/13/08	0540	P1	8	MALL			
04/15/08	1900	P1	10	MALL			
04/15/08	1900	P1	20	Lesser Scaup			
04/15/08	1900	P3	11	COME			
04/15/08	1900	P4	1	DCCO			
04/15/08	1235	P1	2	Lesser Scaup			
04/16/08	1850	FB	1	DCCO			
04/16/08	1850	FB	1	PBGR			
04/16/08	1850	P2	1	GBHE			
04/16/08	1850	P2	2	MALL			
04/16/08	1850	P1	16	Lesser Scaup			
04/16/08	1850	P1	8	MALL			
04/16/08	1850	P3	5	COME			
04/18/08	1900	P3	1	COME			
04/18/08	1900	P3	5	MALL			
04/18/08	1900	P1	6	MALL			
04/18/08	1900	P1	22	MALL			
04/18/08	1850	P4	2	COME			
04/18/08	1900	FB	1	DCCO			
04/18/08	1935	USC	4	MALL			
04/18/08	1900	USC	4	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
04/19/08	2400	P1	2	MALL			
04/19/08	0515	P1	5	MALL			
04/19/08	4400	USC	2	MALL			
04/21/08	1855	P3	1	GBHE	2	1	
04/21/08	1855	P3	2	COME			
04/21/08	1855	P3	6	MALL			
04/21/08	1855	P1	15	Lesser Scaup			
04/21/08	1855	P1	6	MALL			
04/21/08	1850	FB	150	Lesser Scaup			
04/21/08	1850	FB	2	DCCO			
04/21/08	1905	P4	2	GBHE	4	1	
04/22/08	1900	P3	1	GBHE	4		1
04/22/08	1900	P3	3	MALL			
04/22/08	1900	P1	12	Lesser Scaup			
04/22/08	1900	P1	7	MALL			
04/22/08	1900	FB	1	DCCO			
04/24/08	0530	P2	2	Lesser Scaup			
04/25/08	1900	P1	12	Lesser Scaup			
04/25/08	1900	P1	8	MALL			
04/25/08	1855	FB	1	DCCO			
04/25/08	1855	FB	6	PBGR			
04/25/08	1905	P4	1	GBHE	3	2	
04/25/08	1905	P2	4	MALL			
04/26/08	1900	P1	10	Lesser Scaup			
04/26/08	1900	P1	9	Mallard			
04/26/08	1853	FB	130	Lesser Scaup			
04/26/08	1853	FB	20	COME			
04/26/08	1853	FB	1	Eared Grebe			
04/26/08	1853	FB	4	Canadian Geese			
04/26/08	1853	FB	2	DCCO			
04/26/08	1920	USC	1	MALL			
04/27/08	2400	P1	1	MALL			
04/28/08	2400	P2	2	Lesser Scaup			
04/28/08	0540	USC	4	MALL			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
04/29/08	1900	P1	1	MALL			
04/29/08	1900	P1	10	Lesser Scaup			
04/29/08	1905	FB	3	DCCO			
04/29/08	1900	P2	2	MALL			
04/29/08	1900	P3	2	MALL			
04/29/08	1910	USC	2	MALL			
04/30/08	1840	FB	1	Common Loon			
04/30/08	1840	FB	2	DCCO			
04/30/08	1850	P1	4	MALL			
04/30/08	1850	P1	10	Lesser Scaup			
05/01/08	1900	FB	2	DCCO			
05/03/08	1900	P1	7	MALL	4	4	
05/03/08	1900	P1	4	Lesser Scaup			
05/03/08	1900	P1	1	Osprey			
05/04/08	1900	FB	2	DCCO			
05/04/08	1900	FB	1	PBGR			
05/04/08	1900	P1	6	MALL			
05/04/08	1900	P1	4	Lesser Scaup			
05/05/08	2400	P2	1	GBHE			
05/05/08	2400	P3	1	GBHE	16	2	
05/05/08	2400	P1	6	Lesser Scaup			
05/05/08	2400	P4	1	MALL			
05/07/08	1900	P1	20	MALL	11	9	
05/07/08	1900	P1	1	OSPREY			
05/07/08	1900	P2	1	MALL			
05/07/08	1900	P4	1	MALL			
05/07/08	1900	USC	2	MALL			
05/08/08	1900	FB	4	COME			
05/08/08	1900	FB	3	MALL			
05/08/08	1900	P3	1	GBHE			
05/08/08	1900	P1	17	MALL			
05/08/08	1900	P2	4	MALL			
05/08/08	1900	USC	2	MALL			
05/10/08	1845	FB	1	Common Loon			

Date	Time (24hr)	Location	Number of birds	Species	Foraging attempts	Fish caught	Unknown caught
05/10/08	1845	FB	2	Canvasback			
05/10/08	1845	FB	3	Lesser Scaup			
05/10/08	1845	P3	3	GBHE	5	3	
05/10/08	1957	P4	1	GBHE			
05/10/08	1845	P1	23	MALL			
05/10/08	1900	USC	5	MALL			
05/10/08	1845	P2	1	Osprey	1	1	
05/11/08	1900	P2	2	MALL	11	11	
05/11/08	1900	P2	1	KIFI			
05/11/08	1900	P2	1	Osprey			
05/11/08	1900	FB	2	DCCO			
05/11/08	1900	P1	12	MALL			
05/11/08	1900	USC	2	MALL			
05/13/08	0530	USC	7	MALL			
05/14/08	1900	FB	2	DCCO			
05/14/08	1900	P1	2	MALL			
05/14/08	1900	USC	2	MALL			
05/15/08	1900	P1	2	MALL			
05/15/08	1900	P3	1	MALL			
05/15/08	1900	USC	1	MALL			
05/17/08	0530	FB	1	DCCO			
05/17/08	0530	FB	1	PBGR			
05/17/08	0530	FB	2	MALL			
05/18/08	1900	P2	4	MALL			
05/19/08	1900	FB	3	DCCO			
05/19/08	1900	FB	20	MALL			
05/19/08	1900	FB	6	Redhead			
05/19/08	1900	FB	4	American Wigeon,			
05/19/08	1900	FB	4	Lesser Scaup			
05/19/08	1900	P2	2	MALL			
05/21/08	2400	FB	1	DCCO			
05/21/08	2400	FB	8	MALL			
05/22/08	1845	FB	2	DCCO			
05/22/08	1845	FB	15	MALL			

<b>Date</b>	<b>Time (24hr)</b>	<b>Location</b>	<b>Number of birds</b>	<b>Species</b>	<b>Foraging attempts</b>	<b>Fish caught</b>	<b>Unknown caught</b>
05/22/08	1845	FB	4	Redhead			
05/22/08	1845	FB	2	Ring-Neck Duck			
05/22/08	1925	P3	1	GBHE	2	2	
05/22/08	1845	USC	7	MALL			
05/23/08	1845	FB	2	DCCO			
05/23/08	1845	FB	20	MALL			
05/23/08	1935	P3	1	GBHE	1	1	