Draft Report to the Washington Fish and Wildlife Commission
Washington Sea Duck Management Strategies
Washington Department of Fish and Wildlife Waterfowl Section
June 2013

Introduction

Eleven species of sea ducks commonly occur in western Washington, including scoters (surf, white-winged, black), long-tailed duck, harlequin duck, goldeneyes (common, Barrow's), bufflehead, and mergansers (common, red-breasted, hooded). Sea ducks are game species, managed under state and federal migratory waterfowl regulations cooperatively through the Pacific Flyway Council. Washington Department of Fish and Wildlife (WDFW) has improved monitoring of Puget Sound sea duck populations as part of the Puget Sound Ecosystem Monitoring Program (PSEMP) since 1991. Long-term declines in wintering numbers of scoters and limited populations of harlequin and long-tailed ducks have lead to more conservative regulations in Washington than provided by federal frameworks. In addition to improving surveys to document status and trends, WDFW has also completed specific management studies and upgraded harvest monitoring programs for these species over the past 15 years.

WDFW presented a summary of sea duck management activities to the Washington Fish and Wildlife Commission (Commission) in August 2007. At that time, the scoter population had been relatively stable for the previous 6 years, and an evaluation of scoter harvest management indicated that current overall harvest rates in Puget Sound were within sustainable levels. WDFW proposed additional banding and monitoring of scoters and other sea ducks over a three year period, with an evaluation report planned for presentation to the Commission in 2010. The findings of the three-year evaluation, including potential harvest management options, were summarized in a report presented to the Commission in August 2010 and posted online at http://wdfw.wa.gov/publications/pub.php?id=01007. At that time, WDFW selected a Puget Sound harvest strategy which treated the scoter population as independent from other regional or flyway populations, regulated harvest based on predefined action levels, and established regulation packages that were adopted by the Commission for the following three years. WDFW provided notice at subsequent Commission meetings that the harvest management strategies would be reviewed again in 2013, contained in this report.

Pacific Flyway Sea Duck Populations

Sea ducks using Washington habitats breed primarily in northern Canada and Alaska (see example in Figure 1), although some species (e.g. harlequin, goldeneye) also breed in Washington and surrounding states/provinces.

Figure 1. Surf scoter range

Table 1 shows population estimates for Pacific Flyway sea duck populations developed by the Sea Duck Joint Venture (SDJV), a regional partnership developed to promote sea duck conservation through specific research and monitoring projects.

Table 1. Sea duck management units and population estimates (SDJV 2009).

Sea Duck Species	Management Unit	Estimate
Black Scoter	Pacific	150,000
Surf Scoter	Pacific	400,000
White-winged Scoter	Pacific	300,000
Long-tailed Duck	Pacific	500,000
Harlequin Duck	Pacific	200,000
Barrow's Goldeneye	Pacific	200,000
Common Goldeneye	N. America	1,300,000
Bufflehead	N. America	1,400,000
Common Merganser	N. America	1,200,000
Red-breasted Merganser	N. America	350,000
Hooded Merganser	Pacific	85,000

Sea Duck Population Trends

The primary survey index for consideration of sea duck status and trends for greater Puget Sound has been the December-January aerial survey, developed by the WDFW component of PSEMP. Consistent winter aerial surveys of greater Puget Sound began in 1993-94, and have been conducted each year since then (except for 2006-07, due to funding limitations). Survey methods have been peer reviewed by a science panel as part of PSEMP. These surveys sample the entire marine shoreline and open water areas using six depth strata. The transects annually cover 7% to 8% of the marine waters in Puget Sound and the Strait of Juan de Fuca, totaling between 6,400-7,100 km of transects. Population estimates from these surveys represent minimum estimates. Observers are not able to detect all birds present within the transect strip, due to environmental conditions (e.g. glare, waves) and reactions of some species to aircraft (e.g

diving, flight). WDFW is completing a project funded by SDJV to develop visibility correction factors to apply to past survey data, based on estimates of detection rates.

Annual index data are used to characterize and interpret spatial and temporal population trends for marine birds and waterfowl. Indices were refined during 2012-13 to exclude Canadian areas and correct errors in data processing software, which resulted in slightly decreased estimates for all years. Based on these surveys, the total scoter population index (3-year average) in Puget Sound has declined from 107,214 to 50,075 (-53%) since 1994-96, and may have declined as much as 78% since 1978-79, based on a past study (MESA 1979). These estimates represent combined indices for the three scoter species: surf, white-winged, and black, which have been estimated independently since 1999. In general, population trends for sea duck species other than scoters have been relatively stable or slightly declining during the past 10 years. Figure 2 and Appendix 1 show trends for scoters and other species monitored during the survey.

Based on the results of a WDFW satellite telemetry project in 2003-06, most of the scoters wintering in Puget Sound had breeding locations in the northern boreal forest of Canada. In contrast to the wintering index trends documented by WDFW in Figure 2, data from USFWS May Breeding Population index surveys (2012) within the Canadian survey strata important to Puget Sound scoters has almost doubled since 1994 (see Figure 3). These trends mirror results from all survey strata. However, breeding indices have undergone a long-term decline since 1955, and should be interpreted with caution because breeding surveys are not designed to monitor scoters (Savard 1998). Breeding scoter trends are similar to breeding scaup trends in the northern boreal forest breeding areas of Canada, supporting a hypothesis that these populations are limited by similar factors on the breeding grounds (Slattery et al 2002). Reasons for these trends are not well understood, but long-term declines may be related to lower productivity associated with habitat changes in the boreal forest.

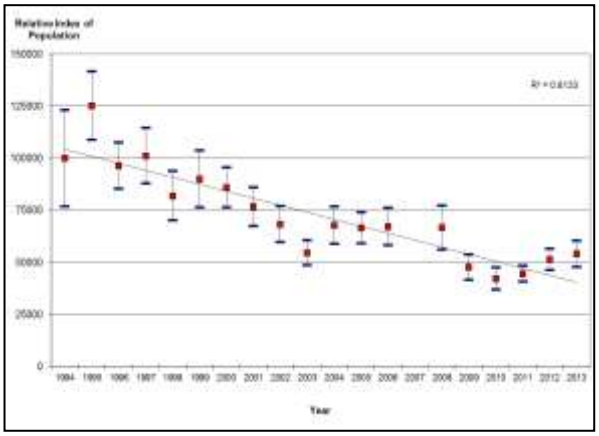

Figure 2. Annual winter scoter trends in the inner marine waters of Washington State, 1994-2013.

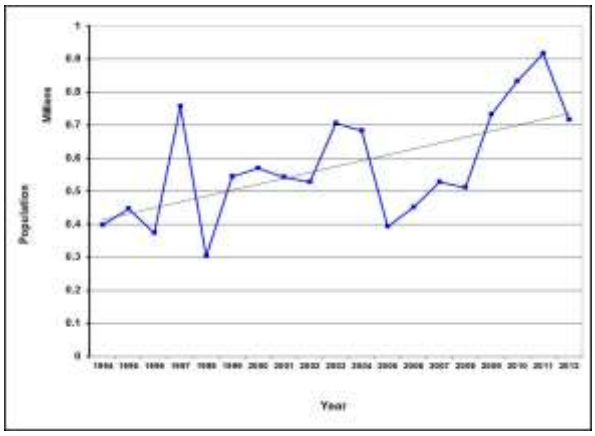

Figure 3. Annual breeding scoter trends in Canada, 1994-2012.

During 2003-2009, the Canadian Wildlife Service (CWS) funded WDFW to assess winter waterfowl population status and trends in lower British Columbia, from the U.S. border to the Fraser River Delta. Approximately 20,000-40,000 scoters were estimated on these surveys, but no trend was apparent due to the high variance associated with the estimates. Data from 1999-

2011 from the British Columbia Coastal Waterbird Survey (http://www.bsc-eoc.org/library/bccwsnews.pdf) did not indicate a trend for surf scoters, but white-winged scoters and black scoters declined -7.6% and -19.2% respectively during the period. WDFW crews surveyed inner marine waters of the Strait of Georgia to the northwest tip of Vancouver Island in 2012-13, and results will be available in fall 2013.

Winter scoter numbers are documented annually during the Midwinter Waterfowl Survey (MWS) in Pacific Flyway states (Olson and Trost 2012). February 2011 surveys of Washington and Oregon outer coast areas by WDFW recorded 21,536 scoters (SE=5,893). Scoter numbers in Grays Harbor and Willapa Bays currently average about 250 birds (1990-2013). MWS scoter trends for California and Oregon estuaries (most birds in San Francisco Bay) averaged 11,893 for 2010-12, a 60% decline since 1994.

Hunting Seasons

Sea ducks are game species, managed under state and federal migratory waterfowl regulations cooperatively through the Pacific Flyway Council. Long-term declines in wintering numbers of scoters and limited populations of harlequin and long-tailed ducks have lead to more conservative hunting seasons in Washington than provided by federal frameworks. Past restrictions have also resulted from qualitative assessments that sea duck hunting on Puget Sound was becoming more popular, with birds more accessible to harvest than other wintering areas. Daily bag limits were reduced to 4 for scoter, long-tailed duck, and harlequin in 1998, and further restricted in 2004 to allow only one harlequin duck per season. Daily bag limits were reduced to 2 for scoter, long-tailed duck, and goldeneye in 2010. Seasons in other Pacific Flyway wintering areas are shown in Table 2:

Table 2: 2012-13 Hunting season regulations in other Pacific Flyway sea duck wintering areas

State / Province	Season length	Sea duck daily bag	Other daily bag restrictions
Alaska	107	10	6 harlequin, 6 long-tailed
British Columbia	107	8	2 harlequin, 2 goldeneye
Oregon	107	7	none
California	107	7	none

Harvest Estimates and Hunting Activity

State and federal harvest surveys are not designed to provide accurate harvest estimates of sea ducks and other lightly hunted species. To obtain better harvest information, WDFW initiated a mandatory hunting authorization and harvest report for sea duck hunters in 2004. Prior to the 2009-10 season, authorizations and harvest reports were issued from the WDFW Olympia office; but in 2009-10, authorizations and harvest record cards (and reporting) were included as part of the WDFW licensing system. Harvest reported to WDFW is extrapolated to account for hunters who do not return reports, and increased by 30% to account for wounding loss. Although harvest of scoters and goldeneyes is reported by species, only total harvest is summarized in this report because of concerns about accuracy of species identification. USFWS and WDFW cooperated on a special survey of Washington sea duck hunters using wing envelopes in 2011-12, which found that 18.4% (n=38) of sea ducks reported on harvest report cards were misclassified. Estimates of sea duck hunter effort and harvest from report cards are presented in Figures 4-5:

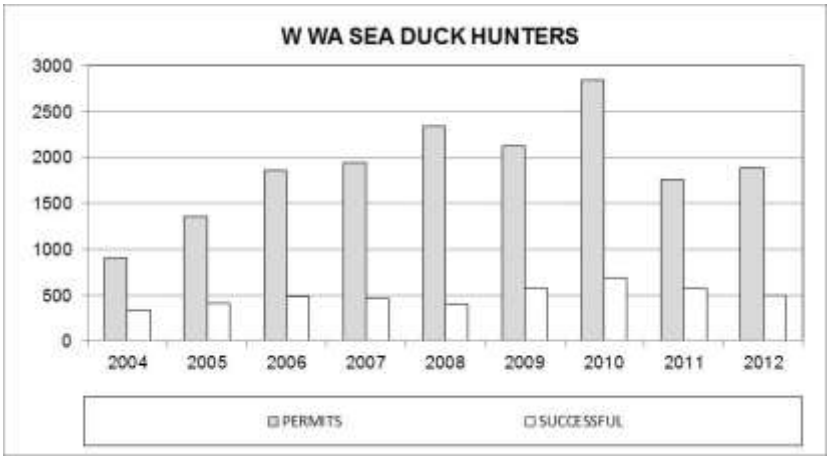

Figure 4. Authorizations and successful hunters.

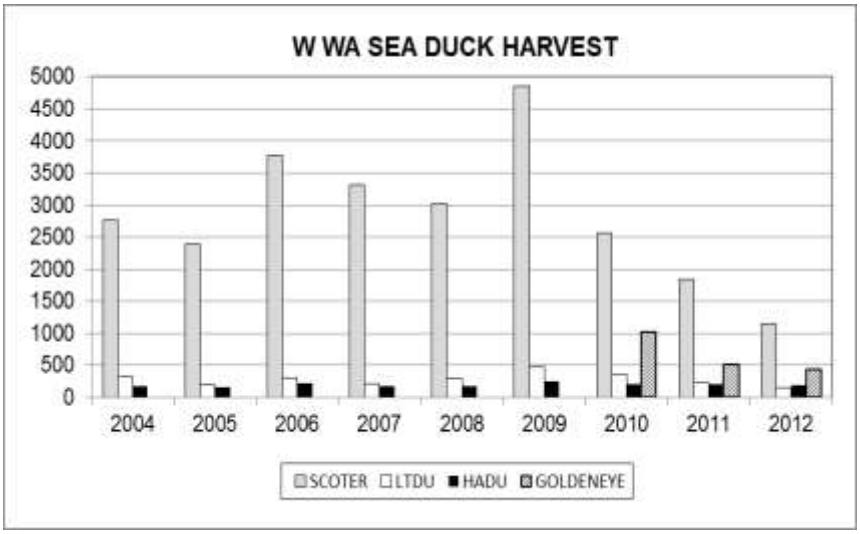

Figure 5. Sea duck harvest estimates.

Results of sea duck report card analyses presented in Figures 4 and 5 showed an increase in authorizations issued (+1%) and number of successful hunters (+23%), but a decrease in scoter harvest (-51%) between 2007-09 and 2010-12. Lower bag limits implemented starting in 2010 and a $13.20 fee for migratory bird hunting authorizations implemented starting in 2011, could have reduced participation in 2011 and 2012. The 2010-12 mean harvest estimate of 1,848 scoters represented 3.7% of the scoter population index for that period, down from 7.1% in 2007-09. Results for all sea duck species are shown in Table 3.

Table 3: Comparison of harvest, population, harvest rate estimates: 2007-09 vs. 2010-12

Parameter	Period	Scoter	LTDU	HADU	Goldeneye
Harvest	2007-09	3,735	327	197	n/a
	2010-12	1,848	243	194	650
Population	2007-09	52,264	4,542	2,839	24,853
	2010-12	50,075	4,795	2,691	22,706
Harvest % of Population	2007-09	7.1%	7.2%	6.9%	n/a
	2010-12	3.7%	5.1%	7.2%	2.9%

Based on hunter forums, sports shows, and sporting magazines / other publicity, it appears that sea duck hunting has generally become more popular in Washington over the past 20 years. Sea duck guides commonly advertise and have clients from across the country. Reduced quality hunting access for other waterfowl species, due to development and restriction of inland hunting sites around Puget Sound, may also be responsible for some of the increased interest, especially given that some species (e.g. scoters) are easily decoyed at traditional use sites.

Recruitment Estimates

Estimates of the number of young birds added into the population each year are required to understand population dynamics and reproductive potential. Unfortunately, limited data exist to document recruitment rates of sea ducks. To address this data gap, WDFW implemented boat surveys to estimate age, sex, and species ratios of scoters and harlequin ducks during each February of 2008-10. This period was chosen because during February, young harlequin duck and surf scoter males are easy to distinguish from their adult male and female counterparts. Results from our scoter telemetry work indicated that both surf and white-winged scoters maintained their winter home ranges throughout February; thus, we assumed that birds present during the boat surveys were representative of the wintering population estimated by our aerial surveys. In 2010, we also estimated juvenile percentages and species ratios for Barrow's and common goldeneye.

In 2008-10, we surveyed over 180 harlequin duck transects and more than 300 scoter transects each year, each 1 km in length. Over 25,000 surf scoters were classified during the three years of the study. Results of age ratio surveys for surf scoters indicated an average juvenile percentage of 8.3% for 2008-10. This compares to an estimate of 14.1% for British Columbia in 2000-02 (Iverson 2004). Over 5,000 harlequin ducks were observed during the WDFW surveys, with an average juvenile percentage of 9.7%. This compares to a rate of 7.9% estimated for harlequin ducks in British Columbia in 1996-99 (Smith et al. 2001). Common goldeneye and Barrow's goldeneye both had juvenile percentages of 9.7% in 2010. As a species group, sea ducks are relatively long-lived and have a lower reproductive rate compared to other waterfowl (i.e. according to Patterson [1979] they are "K-strategists"). Barrow's was found to comprise 21.8% of the entire goldeneye population in 2010.

Survival Estimates, Band Recoveries, and Movement Information

Other important components for understanding population dynamics of Puget Sound sea ducks are estimates of annual survival and movement of birds throughout the year. We studied these components for scoters through several banding, marking, and telemetry studies. The studies offered some of the best information available to understand sea duck mortality and movements throughout the Pacific Flyway.

To assess scoter survival, WDFW began banding efforts in 2007 during the period of wing molt in late summer. Molting sites utilized by scoters that winter in Washington were identified from telemetry work done during previous years. The molting population in Washington is not completely representative of the wintering population using Puget Sound. Telemetry studies of molting locations for Puget Sound wintering scoters ranged from the Canadian interior, to coastal northern Alaska, to northern California. In addition, telemetry studies of wintering scoters from other Pacific Flyway areas documented similar molting locations as the wintering Puget Sound

scoters, including locations within Washington. The project was partially intended to determine the feasibility of marking large numbers of scoters, for possible implementation on a flyway scale.

Captures were conducted by driving flocks of scoters towards gill nets specifically designed for at-sea captures of marine birds. Capture sites included Oak Harbor / Crescent Bay, Padilla Bay, Boundary Bay, and the Fraser River Delta. During 2007-09, a total of 3,062 scoters were marked, making this effort the largest banding project for scoters in the Pacific Flyway. Recovery rates were relatively low, with only 33 birds taken by hunters during the three years of the project (see recovery map in Appendix 2), representing a 1.1% recovery rate. Banded birds were almost all recovered within Puget Sound.

Survival was modeled using a Program MARK multi-strata model with live and dead encounters. Strata were defined from molting areas, and the model assumed sex-specific variation in survival, a constant recapture rate, a constant transition rate, and a time-specific recovery parameter. Utilizing these methods, we estimated mean annual survival (SE) for surf scoter females at 0.93 (0.08) and for males at 0.75 (0.30). Due to low sample size, the estimates for males and for white-winged scoters are not usable for evaluation of population dynamics. The survival rate of 0.93 for surf scoter females is consistent with the high survival rate estimates documented for sea ducks, as compared to many other waterfowl species (USFWS 2000). As noted previously, this survival rate may not be representative of Puget Sound wintering scoters due to mixing of birds destined for other wintering areas in molting flocks.

As noted previously, WDFW marked scoters with satellite transmitters throughout Puget Sound in 2003-2006. This project was funded by the Sea Duck Joint Venture. In addition to documentation of breeding areas, the telemetry project provided the first information available for migration and wintering area use throughout the year. The study found high site fidelity of adult breeding age birds to breeding, migration, and wintering areas. Of the 41 adult birds (> 3 years old) that had functioning transmitters the next year after banding, 40 returned to winter within 45 miles of their original banding sites (one white-winged scoter marked in the South Sound wintered in Bellingham Bay the subsequent year). Appendix 3 provides a few examples showing use of the same wintering areas each year. Year-to-year site fidelity among experienced adult waterfowl is not unusual and offers advantages to survival. We did not mark subadult or juvenile scoters with satellite transmitters; but based on patterns in other species these cohorts are less likely to exhibit site fidelity.

Harvest Management Options

When evaluating management options for Washington sea duck populations, there are several factors to consider regarding this species group. In general, information about basic biology, delineation, estimation of breeding and wintering populations, and harvest (particularly subsistence harvest) lags far behind that of other duck species (USFWS 2013). The limited studies that have been completed indicate that the group is characterized by relatively high survival and low productivity, and strong fidelity of breeding adults to use areas (Eadie et al. 1988, Savard et al. 1998). Our studies confirmed these factors influencing population dynamics of Puget Sound scoters. USFWS (2000) notes that sea ducks have limited capability to compensate for hunting mortality through increased recruitment or increased survival outside of

the hunting season, and that harvest mortality should be considered completely additive to natural mortality.

Management options developed in this review are primarily focused on Puget Sound scoters because this group has had long-term declines, while other species have been relatively stable. SDJV is in the process compiling survey and demographic information for use in assessment of harvest potential for five sea duck species, including scoters. SDJV will compare the results of the assessment for each species and geographic area with existing harvest information to determine whether current harvest levels are likely to be above, below, or near sustainable levels, and identify priority gaps in our understanding of harvest potential.

Scoters in Puget Sound have been declining at a greater rate than can be explained from current harvest, and it is not possible to explain the 28% population decline (~19,000 scoters) experienced from January 2008 to January 2009 on the basis of harvest. Our preliminary modeling of the Puget Sound scoter population also indicates that other factors are responsible for the population trend, but that harvest does have a role in influencing the long-term rate of decline. Given the long-term declines in the scoter population, harvest may now be having a more significant influence on population dynamics than in past years.

In contrast to wintering trends, breeding populations in areas important to Puget Sound scoters have been increasing recently (see Figures 2 and 3). The differences between our wintering index trend and the breeding index trend indicate that there may be additional limiting factors affecting our wintering population. Potential influences that may be important contributors to observed scoter trends on Puget Sound include the following:

- In Washington, two thirds of the state's 6 million people are concentrated along Puget Sound shorelines utilized by sea ducks. The region's population continues to grow steadily at about 20% each decade. Some of the fastest growth is occurring in Puget Sound's rural counties (OFM 2002); greatly increasing disturbance, pollution, and degradation of foraging areas used by sea ducks.
- Shellfish and invertebrates are important parts of the diet of many sea ducks, including scoters. Information is not available to determine shellfish trends in Puget Sound (Dethier 2006), or invertebrate trends. Commercial shellfish growers now commonly use nets to exclude shellfish predators, including sea ducks. Acidification of marine areas may also be affecting shellfish abundance.
- In addition to human disturbance, studies in lower British Columbia found high winter disturbance rates on brant by increasing numbers of bald eagles (Boyd and Hagmeier 2002). The bald eagle population in Washington has been increasing significantly over the last 30 years (Stinson et al. 2007), which could contribute to distribution shifts of sea ducks.
- Large concentrations of scoters occur along the Pacific Coast from California to Alaska, and most of these areas are not surveyed during winter. Despite the strong site fidelity found in our work, we also know that the Puget Sound wintering population breeds and migrates with other birds from the larger regional and flyway population. Wintering areas of waterfowl occasionally undergo major changes in distribution; for example, almost the entire cackling Canada goose population (over 150,000) that used to winter in California now winter 1,000 miles north in Oregon and Washington. WDFW has been

working in collaboration with the SDJV to implement a pilot study to estimate winter trends for the entire Pacific Flyway, and surveyed important areas of the BC coast in 2013. Until trend information is available from other wintering areas, we are unable to determine the role of any distribution shifts on our short and long-term trends.

In consideration of our findings, the state of our knowledge, and range of management directions discussed from the flyway to the local level, we believe that there are three general approaches to managing scoter harvest in Washington.

1. Consider Puget Sound scoter populations as part of a larger regional or flyway population and follow Pacific Flyway season frameworks.
   This approach is based on the fact that the larger Pacific Flyway population of scoters is estimated at approximately 850,000, and USFWS does not currently recognize subpopulations for harvest management. Based on breeding trends, the population outside of Alaska has undergone long-term declines but is currently increasing. This approach would result in liberalization of the current hunting season structure.

2. Continue a Puget Sound harvest strategy which treats the scoter population as independent from other regional or flyway populations, and regulate harvest based on predefined action levels.
   This approach recognizes a more specific Puget Sound wintering population. It regulates harvest opportunity based on population threshold levels, and is similar to the harvest strategies followed for most other waterfowl species (brant, snow geese, etc.) as presented in the 2009-2015 WDFW Game Management Plan, Strategy 79a (pp. 103-104). This approach utilizes action levels with specific daily bag limits based on three-year averages of the winter index for scoters, with harvest rate targets of 5% or less of the winter index in each package:

Regulation Package	Winter Index (3-yr)*	Bag Limit
Closure	<45,000	0
Restrictive	45,000-67,500	2
Moderate	67,500-135,000	4
Liberal	>135,000	7

*note that these objectives have been adjusted from the 2010 version of this review, because of refinements to winter survey methods and analyses

Population trends would continue to determine the need for additional conservation measures of other sea duck species. Table 3 indicates that winter estimates for these species have been relatively stable in Puget Sound between 2007-09 and 2010-12. Small populations (<5,000) of harlequin duck, long-tailed duck, and Barrow's goldeneye in Puget Sound warrant continuation of conservative regulations for these species. Additional restrictions will be considered for harlequin duck, long-tailed duck, and goldeneye if significant declines occur (i.e. 3-year average <70% of 2007-09 average), also based on evaluation of harvest rates. Goudie et al. (1994) estimated sustainable harvest of harlequin ducks at 3-5% of the adult population, but these estimates were based on modeling simulations using broad assumptions due to lack of

data. The SDJV review of sea duck harvest potential will hopefully provide better guidance to inform harvest management.

3. Eliminate scoter hunting throughout Puget Sound or in regional or local areas
This approach is the most risk aversive. Taken to the extreme, a broad decision to stop hunting scoters without a management strategy would include them on the list of game species that are not hunted (e.g. trumpeter swans). Advocates of this approach would argue that the hunting interest and harvest potential for these species is relatively small and not worth the risk of overharvest. Regional or local closures would eliminate harvest in specific areas where higher harvest occurs.

Preferred Harvest Management Strategy

Unfortunately, there is limited information about scoter population trends from other parts of the range to evaluate if winter distribution shifts may have occurred, or the potential for immigration from adjacent areas. All available trend information from other wintering areas shows stable or declining populations, but current information is not available from most areas. Without more definitive information, we must assume that the Puget Sound wintering population has declined rather than emigrated outside of Puget Sound.

Elimination of scoter hunting would abandon traditional harvest management strategies. In addition, as non-hunted game species, scoters would likely receive a lower priority in the future for monitoring programs funded by hunter-generated revenue. Regional or local closures would be difficult to justify based on current monitoring information, more problematic to enforce, and would likely result in shifts of hunting pressure to remaining open areas.

This harvest strategy recognizes the limitations in our knowledge of scoter population dynamics and reasons for declines, as well as what we do know about potential impacts of harvest on this species group. At the same time, it seeks to maintain hunter support for management and habitat programs. This approach is consistent with the 2009-2015 Game Management Plan, which states that WDFW should "maintain a diversity of recreational hunting and viewing opportunities". The closure threshold of 45,000 represents approximately one-third of the winter index from when our surveys began, and it would assist in maintaining current scoter distribution in Puget Sound. Thresholds at other population levels seek to restrict harvest to 5% or less of the winter index based on past harvest levels with higher bag limits. For these reasons the Department plans to continue recommendations for sea duck bag limits consistent with the strategy outlined in the second approach above.

Future Management and Research Needs

1. Continue efforts to obtain additional status and trend information on wintering sea duck population status and trends in other parts of the flyway.
2. Continue annual population and harvest monitoring surveys.
3. Complete project to determine visibility correction factors and apply results to population survey results.
4. Repeat the cooperative USFWS-WDFW sea duck wing survey to refine harvest estimates.

5. Develop better information on species specific population status and harvest rates of goldeneyes (Barrow's and common).
6. Refine population models and analysis of existing age/sex ratio information.
7. Develop annual operational banding programs for scoters, harlequin ducks, and possibly long-tailed ducks.
8. Expand evaluation of forage trends based on available information and develop habitat enhancement options.
9. Publish findings in peer-reviewed journals and public information outlets.

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Appendix 1. Winter sea duck trends from the inner marine waters of Washington State.

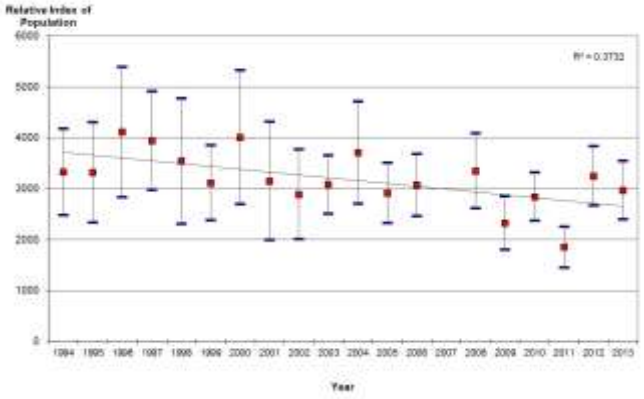


Figure A1. Harlequin Duck

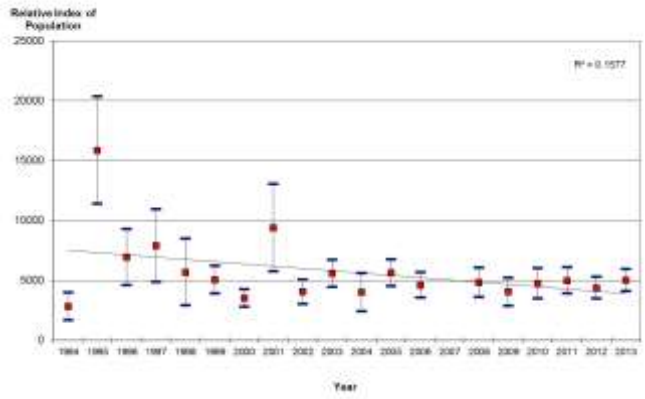


Figure A2. Long-tailed Duck

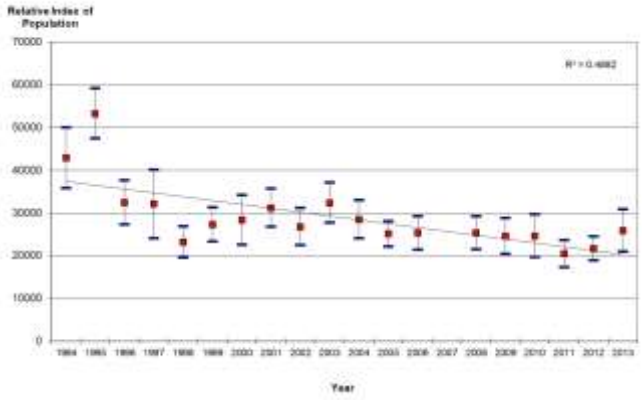


Figure A3. Goldeneye species

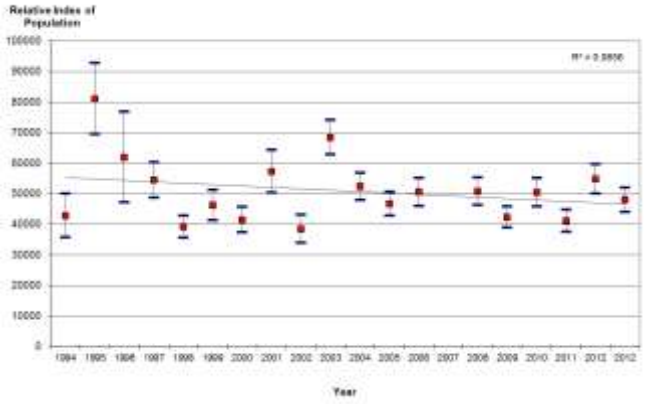
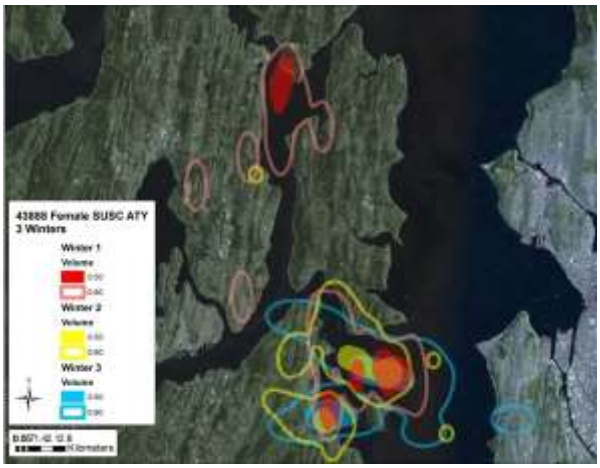
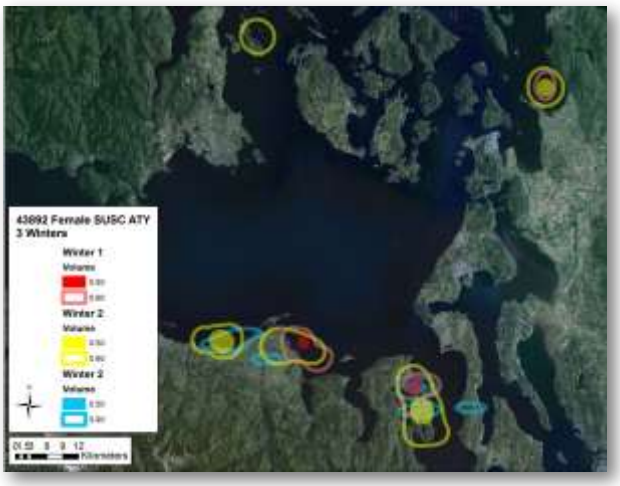


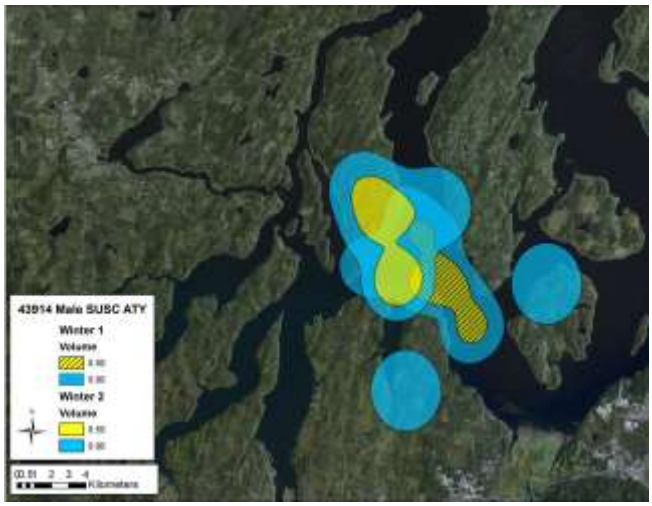
Figure A4. Bufflehead

APPENDIX 2. Scoter molt banding and recovery locations from WDFW bandings.

Appendix 3. Examples of winter use areas of scoters marked with satellite transmitters.







Winter utilization distributions (50% and 90% probability displayed) of three surf scoters, showing winter site fidelity from year to year. Data are from PTT transmitted wintering scoters from 2002-03 through 2005-06.

APPENDIX 4. Scoter harvest strategy thresholds based on 3-yr. average winter indices.