CHAPTER TWELVE

Harvest of Sea Ducks in North America*

A CONTEMPORARY SUMMARY

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Abstract. Sea ducks present unique challenges to waterfowl harvest management because the species have relatively low intrinsic population growth rates and varied population structure and harvest occurs under a diversity of rangewide hunting traditions. Sea duck harvest occurs throughout North America, ranging from inland harvest of widely distributed species, such as goldeneyes and mergansers, to specialized harvest of eiders and scoters in coastal and northern regions. Harvest of widely distributed species is well represented in continental waterfowl harvest monitoring programs. More localized harvests, such as those in coastal and remote areas, have proven challenging to monitor, and some special surveys have been implemented. Sea duck harvest regulations have evolved over the decades according to changes in population levels, management philosophies, and improvements in harvest information. Hunting of goldeneyes and Buffleheads has usually been regulated within general bag limits for ducks. Regulations for large mergansers have been liberal, but limits for Hooded Mergansers have remained conservative. Harvest regulations for eiders, scoters, Long-tailed Ducks, and Harlequin Ducks have recently become more restrictive, subject to special seasons and bag limits in primary coastal hunting areas. With a few exceptions, harvest of widely distributed species and most species along the Pacific Coast is considered sustainable. Common Eider harvest in the Atlantic Flyway is a management concern given fluctuations in eider populations, high harvest pressure, and the presence of two subspecies. Sea ducks are important subsistence resources in the North; eiders are harvested by coastal communities and scoters by inland communities. Harvest estimates are now available for most northern jurisdictions, and management is undertaken in cooperation with First Nations and Inuit organizations in Canada and subsistence management bodies in Alaska. Additional information on the delineation and demography of sea duck populations is essential, along with improved harvest estimation techniques, to inform collaborative harvest management and to ensure sustainable harvest.

Key Words: age ratio, bag limit, eiders, egg collecting, ethnotaxonomy, harvest management, harvest surveys, HIP surveys, hunting seasons, regulations, scoters, sex ratio, subsistence harvest, wing survey, wounding losses.

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Harvest management of sea duck populations has focused on concerns that sea duck recruitment is lower than in other taxa of ducks and that the effects of harvest may be largely additive and density independent (Goudie et al. 1994). Since harvest can be regulated, bag limits and seasons should be conservative as a primary means of sustaining populations (Chapter 3, this volume). In contrast, the tone of popular sporting literature often emphasizes opportunities to harvest exotic species of sea ducks during late seasons, under relatively liberal bag limits, and that sea ducks are an underutilized resource (Gillilan 1988). The divergent viewpoints highlight the need for research into the role of harvest in population dynamics so managers can develop appropriate harvest strategies.

Ideally, the influence of harvest on sea duck populations ought to be assessed in the context of comprehensive population models driven by reliable parameter datasets. Recent attention to declines in sea ducks has stimulated the development of models for some populations (Krementz et al. 1997, Gilliland et al. 2009, Schamber et al. 2009, Iverson and Esler 2010, Bentzen and Powell 2012, Wilson et al. 2012). However, most sea duck populations are poorly defined and have not been investigated with harvest models, in part because data on demographic parameters are often scarce or inadequate.

For most sea duck species, harvest assessment is constrained by the lack of critical information on (1) population structure and delineation of cohesive and manageable population units; (2) appropriate geographic management scales; (3) seasonal ranges, migration patterns, and fidelity to sites; and (4) reliable estimates of population size, productivity, and sources of nonhunting mortality (Sea Duck Joint Venture Management Board 2008, Sea Duck Joint Venture 2013). In addition, major challenges exist for documenting hunter participation and activity, the size and composition of harvest, and the rangewide distribution of harvest. In light of these uncertainties, it is challenging to design and implement appropriate harvest management actions, particularly for populations with declining or unknown trends in bird numbers. Identifying the information required to guide harvest management has been identified as a priority for the Sea Duck Joint Venture (2013), which has initiated efforts to evaluate harvest potential of several populations.

There is no question that in situations where mortality is a limiting factor for a population changes in harvest regulations, especially those affecting harvest of adult females, can provide survival benefits to improve population trajectories (Gilliland et al. 2009, Merkel 2010). However, if the limiting factors are primarily related to productivity, conventional regulatory prescriptions for managing harvest may have to be applied over many years and may have little effect on population dynamics.

Our objectives in this chapter are to provide (1) a synopsis of harvest management authorities and sources of harvest information, (2) an overview of sea duck harvesting traditions and regulation history along the Atlantic and Pacific Coasts and in the northern regions where hunting of sea ducks is most prevalent, and (3) a summary of the magnitude and composition of sea duck harvest in North America.

HARVEST MANAGEMENT AUTHORITIES

Regulation of waterfowl hunting has largely been a responsibility of the federal governments in the United States and Canada, particularly after ratification of the 1916 Migratory Bird Convention (Treaty) between the United States and Great Britain (for Canada) for the Protection of Migratory Birds. The treaty established a framework to protect shared bird populations by actions including regulation of hunting. Both the United States and Canada codified the treaty in federal laws: in the United States as the Migratory Bird Treaty Act of 1918 and in Canada as the Migratory Birds Convention Act of 1917. The concept of managing waterfowl on the basis of migratory corridors or flyways was developed in the 1940s and formally established in 1952. Since then, waterfowl hunting framework regulations in the United States have been developed annually through consultation between the U.S. Fish and Wildlife Service (USFWS) and state wildlife agencies associated with four Flyway Councils. Hunting rules are implemented through state regulations that are at least as restrictive as federal frameworks. In Canada, the Canadian Wildlife Service (CWS) consults with the provincial and territorial wildlife agencies to develop final waterfowl hunting regulations, which are then established in federal law. The federal regulatory processes in the United States and Canada remain separate, but representatives of the Canadian provinces, territories, and federal agencies collaborate with the Flyway Councils to exchange information and develop cooperative management programs.

SURVEYS TO ASSESS FALL–WINTER HARVEST

The main sources of information on hunter activity in fall and winter and sea duck harvest are national surveys that the USFWS and the CWS have conducted for decades. Sample frames, stratification, sampling procedures, data collection, and analytical methods have been described in detail elsewhere (Martin and Carney 1977, Cooch et al. 1978, Geissler 1990, Padding et al. 2006a, Johnson et al. 2012). Here, we focus on aspects of those surveys that specifically address sea ducks. Some US states have conducted other sea duck harvest surveys, and their results allow comparisons with the USFWS survey that we will examine.

Traditional surveys have not covered a large portion of North American harvest of sea ducks, namely, subsistence harvest in the north that occurs mostly from spring through early fall. Subsistence harvests have not been well documented historically; most were technically illegal but largely not enforced until relatively recent times. In this chapter, we make general distinctions between traditional *subsistence harvest*, defined by nutritional and cultural aspects, and conventional *fall and winter harvest* that includes recreation, food harvesting, and other values under more regulated conditions.

It is important to recognize, from a regulatory standpoint and for interpretation of harvest information, that coastal species such as eiders (*Polysticta* and *Somateria* spp.), scoters (*Melanitta* spp.), Harlequin Ducks (*Histrionicus histrionicus*), Long-tailed Ducks (*Clangula hyemalis*), and Barrow's Goldeneye (*Bucephala islandica*) are treated as a subset of the 15 taxonomic sea duck species (Mergini) in North America because they are subject to special hunting regulations. Widely distributed species (hereafter *ubiquitous* sea ducks) such as Common Goldeneye (*Bucephala clangula*), Bufflehead (*Bucephala albeola*), and mergansers (*Lophodytes* and *Mergus* spp.) are harvested across the continent and are usually regulated under general duck hunting seasons and bag limits.

U.S. Fish and Wildlife Service Harvest Survey: 1952–2001

From 1952 through 2001, the sample frame for the annual national survey consisted of every person who purchased a Migratory Bird Hunting and Conservation Stamp (or federal duck stamp). All waterfowl hunters 16 years of age or older are required to buy a federal duck stamp, which is valid for one year. A sample of duck stamp purchasers were asked to document their waterfowl hunting activity and harvest throughout the hunting season and report it on a survey form (Martin and Carney 1977).

Initially, hunters were asked to report duck and goose harvest by species, but it soon became apparent that some hunters were unable to identify species. To address this problem, the Waterfowl Parts Collection Survey (hereafter, wing survey) was developed to allow identification of the species, sex, and age of harvested ducks based on wing plumage (Carney 1984). A modified harvest survey form asked about hunting and harvest of general waterfowl categories (ducks, sea ducks, and geese) rather than species, and the wing survey generated data to partition harvest estimates by species, sex, and age (Martin and Carney 1977).

The harvest survey design allowed estimation of sea duck harvest separately from other species of ducks in the Atlantic Flyway, where special sea duck hunting seasons for eiders, scoters, and Long-tailed Ducks were held in all coastal states except Florida. In all other states, sea duck harvest reports and wings were combined with other duck data for harvest estimation. The Atlantic Flyway sea duck harvest analysis assumed that (1) hunters were able to identify eiders, scoters, and Long-tailed Ducks, and that (2) they knew that only those species were considered sea ducks for regulatory purposes.

The mechanism of hunter sampling from the harvest survey relied on cooperation by postal clerks and other vendors of federal duck stamps, and response rates declined in the 1980s when cooperation deteriorated (Tautin et al. 1989). In the 1990s, concerns about increasing bias from nonresponses in the waterfowl harvest survey (Barker et al. 1992) and a long-standing need to establish a national sample frame of all migratory bird hunters (Tautin et al. 1989) led the USFWS and state wildlife agencies to develop the Harvest Information Program (HIP; Elden et al. 2002). Under this program, the state agencies use their hunting license systems to provide the USFWS with an annual list of all licensed migratory bird hunters, forming the sample frame for annual harvest surveys. Before discontinuing the federal duck stamp–based waterfowl harvest survey, the USFWS conducted the duck

stamp survey and the HIP waterfowl harvest survey concurrently for a 3-year period from 1999 to 2001 (Johnson et al. 2012).

U.S. Fish and Wildlife Service Harvest Survey: 1999 to Present

The HIP survey integrates 49 state-specific sample frames, treated as strata (Padding et al. 2006b). In the United States, issuing annual hunting licenses is a state purview; each individual state determines who must obtain a license to hunt in the state and, conversely, which hunters are exempt from the hunting license requirement. Eligibility varies from state to state, but groups of hunters most commonly exempted from hunting license requirements are young hunters (typically ≤16 years of age), landowners hunting on their own property, senior hunters (typically ≥60–65 years of age), and disabled veterans (Sheriff et al. 2002). The HIP sample frame does not include most license-exempt hunters, whereas only young hunters were previously excluded from the duck stamp survey sample frame. However, this difference apparently had little effect on survey results because the annual duck stamp–based and HIP estimates of active waterfowl hunters for the 1999–2001 overlap period were nearly the same (U.S. Fish and Wildlife Service, unpubl. data).

Under HIP, state hunting license vendors are required to ask migratory bird hunters a series of questions about what species they hunted the previous year and how many birds were harvested. The answers to those questions enable the USFWS to sample primarily duck and goose hunters for the waterfowl harvest survey, woodcock hunters for the woodcock harvest survey, and so on, and to sample hunters at different rates based on their previous reported harvest. In coastal Atlantic Flyway states, license vendors also specifically ask migratory bird hunters if they hunted sea ducks (eiders, scoters, or Long-tailed Ducks) during the previous hunting season. Persons that did are considered likely sea duck hunters and constitute a separate sampling stratum. California and Alaska identify likely sea duck hunters by similar means, except that only scoters and Harlequin Ducks are considered sea ducks in California, whereas eiders, scoters, Harlequin Ducks, Long-tailed Ducks, and mergansers are included in Alaska's special sea duck bag limits. Hunters must purchase a separate permit to hunt scoters in Oregon. In Washington State, a separate permit is required for hunting Harlequin Ducks, scoters, Long-tailed Ducks, and goldeneyes. As in the duck stamp–based survey, respondents are asked to report their sea duck hunting activity and harvest separately from other duck hunting and harvest.

Like the previous system, the HIP survey system consists of a questionnaire survey that asks hunters to report their harvest of ducks, sea duck, geese, and brant. The wing survey is unchanged from the previous system and provides estimates of species, sex, and age composition for the bag. However, the HIP questionnaire asks hunters to report their harvest for each hunting trip, including the county and state in which they hunted.

Some hunters mistakenly report diving ducks or other ducks as sea ducks, so the USFWS uses the county information to determine whether the reported sea duck harvest could have occurred in special sea duck zones in the Atlantic Flyway or coastal areas of the Pacific Flyway, because nearly all of the sea duck harvest occurs in those two flyways. All sea duck harvest reported in other counties is added to other duck harvest for estimation purposes. Likewise, sea duck wings received are separated according to the counties where the birds were shot, so that wings from birds shot in coastal counties are used to estimate the species composition of the reported sea duck harvest and wings from sea ducks shot in other counties are used to estimate sea ducks as a proportion of other ducks harvested. For example, the sea duck harvest in New York is the sum of the reported sea duck harvest in the special sea duck hunting zone near Long Island, combined with sea ducks harvested in the rest of the state in areas such as the Finger Lakes and Lake Ontario. In addition to correcting some reported sea ducks harvested that were actually other diving ducks, sorting harvest and wings by county enables a better assessment of the impact of special sea duck hunting regulations.

Alaska is treated separately because sea duck hunting regulations define the group more broadly to include Common Mergansers (*Mergus merganser*), Red-breasted Mergansers (*M. serrator*), and Harlequin Ducks, in addition to eiders, scoters, and Long-tailed Ducks. Alaska has no special sea duck zones, and harvest is not necessarily restricted to the state's coastal areas because scoters, Long-tailed Ducks, and Harlequin Ducks can be found inland. Thus, sea duck harvest and

species composition is estimated statewide for Alaska. In all other states, reported sea duck harvest and sea duck wings are combined with other ducks for analyses that estimate species-specific harvest.

Strengths and Weaknesses of the U.S. Fish and Wildlife Service Harvest Surveys

Sample Frames and Sampling

The primary strength of both survey systems is their sample frames and sampling designs. Both versions of the harvest survey are based on sample frames of nearly all waterfowl hunters and provide representative samples, including sea duck hunters. The main goal of implementing HIP was to increase the accuracy of state and flyway harvest estimates, so HIP does not adequately address questions about regional and local harvest of sea ducks and other species related to management areas, habitat units, or particular seasonal aggregations of waterfowl. More detailed harvest surveys related to specific sea duck population units would require intensive and expensive efforts.

State hunting license vendors do not always ask migratory bird hunters the questions required under the HIP (Moore et al. 2002), including questions designed to identify likely sea duck hunters and create a separate sampling stratum for them. Thus, each year some sea duck hunters are assigned to the wrong stratum in the HIP sample frame. However, all strata are sampled every year, albeit at different rates, and any misclassifications result in reduced precision but do not otherwise affect sea duck hunter activity and harvest estimates. Furthermore, all state HIP sample frames include nonresident (out-of-state and alien) license holders. Assuming that response rates for resident and nonresident hunters are similar, sea duck harvest by nonresident hunters and individuals who hunt with professional guides is captured in the HIP questionnaire survey, even if those hunters are misclassified with regard to the sea duck stratum.

Harvest Estimates

The duck stamp–based survey's sampling mechanism deteriorated over time but apparently that did not affect the accuracy of duck harvest estimates. Both survey systems were used from 1999 to 2001, and the annual duck harvest estimates derived from the two separate systems were similar (Padding and Royle 2012). Padding and Royle (2012) found that the duck stamp–based survey and HIP survey overestimated goose harvest by factors of 1.50 (SE = 0.02) and 1.63 (SE = 0.04), respectively, and both surveys overestimated duck harvest by a factor of 1.37 (SE = 0.02). The authors did not investigate the accuracy of sea duck harvest estimates, but it seems likely that those values were also overestimated to a similar degree.

Wing Surveys

Wing survey participants consist of two groups: (1) hunters who participated in the wing survey the previous year, and (2) a sample of hunters who participated in the questionnaire survey the previous year and reported harvesting at least one duck or goose. Hunters in the first group are removed from the sample after three years of participation. In a typical year, 6,000–8,000 hunters participate in the wing survey (usually ≤1% of all waterfowl hunters), roughly apportioned by state of residence based on the proportion of the national waterfowl harvest that usually is taken in that state (U.S. Fish and Wildlife Service, unpubl. data). Most of the primary states for sea duck harvest account for a small proportion of the total national harvest of waterfowl so hunter sample sizes are usually small for those states. Because many individual hunters probably exhibit the same hunting patterns from year to year and the sample always includes some hunters who have participated for 1 or 2 previous years, the small sample of sea duck wings received from some states may not be representative of sea duck harvest in those states. Thus, annual estimates of species- and date-specific sea duck harvest at the state level are often imprecise and autocorrelated with previous years' estimates. We report survey results at those levels as 10-year averages.

Nonresident hunters who do not reside in the state where the harvest occurred do not pose problems in estimating sea duck harvest but do potentially affect estimates of species composition. Nonresident hunters, especially those who hunt sea ducks with professional guides, probably do not hunt sea ducks year after year. Therefore, even if they are selected for the wing survey as a result of reporting sea duck harvest on the previous year's questionnaire, they are less likely to

hunt sea ducks again while they are participants in the wing survey program. This issue would not affect the accuracy of species-specific harvest estimates if the species composition of sea ducks that resident and nonresident hunters harvest is the same, which is likely the case for the most part. However, harvest of species that nonresident hunters select for taxidermy would be underestimated if wings from those targeted species were not always submitted.

Canadian Wildlife Service Harvest Survey: 1967 to Present

The sample frame for Canada's national migratory bird harvest survey is based on a federal permit that is sold primarily at post offices and is required of all migratory bird hunters. The sample frame is stratified according to (1) which province, or zone within province, the hunter purchased the permit; (2) hunter experience, based on whether the hunter purchased a permit the previous year or the previous two years; and (3) whether or not the permit purchaser is a resident of Canada (Cooch et al. 1978). The survey began in 1967 and several refinements were made from 1967 to 1974 (Johnson et al. 2012).

Like the US system, the Canadian harvest survey system consists of a questionnaire survey that asks hunters to report their harvest of ducks, geese, and other species or species groups and a wing survey called the Species Composition Survey that provides species, sex, and age information. The questionnaire survey does not ask hunters to report sea duck hunting and harvest separately, but it does ask them to report the date and location of each of their hunts (Cooch et al. 1978, Johnson et al. 2012). Questionnaire survey results are used to estimate duck hunter activity and the total harvest of ducks, and the wing survey is used to estimate the species, sex, and age composition of the duck harvest, including species of sea ducks. The wing sample typically overrepresents the early part of the hunting season, so the date of harvest provided by both the questionnaire and wing surveys is used to estimate species composition by time period, and species-specific harvest estimates are summed across time periods (Johnson et al. 2012). This calculation ensures that harvest of species typically hunted later in the hunting season, such as sea ducks, is fully represented in estimates of total duck harvest.

Strengths and Weaknesses of the CWS Harvest Survey

The main strength of the survey system is the complete sample frame of all migratory bird hunters that the national permit provides, enabling the selection of stratified representative samples to maximize efficiency. However, the questionnaire survey response rate is typically only about 40% (Padding et al. 2006b), and nonresponse in harvest surveys is thought to result in inflated estimates (Barker 1991).

Hunters do not participate in the wing survey for more than two consecutive years, so impacts associated with multiyear participation do not affect the Canadian species composition and temporal and geographic distribution estimates as much as they do the US results. The annual sample is about 10,000 duck wings, which, like the US wing survey sample, is usually ≤1% of the total duck harvest. The proportion of the sea duck harvest that is sampled is small enough that resulting harvest estimates are imprecise; therefore, we report estimated harvest in Canada as 10-year averages.

The CWS wing survey excludes hunters who are not Canadian residents because administrative difficulties make it unreasonable to ask hunters to ship bird parts across international borders. This exclusion requires the assumption that Canadian and nonresident hunters both harvest the various species in the same proportions. However, this assumption is likely reasonable with regard to sea duck harvest. The proportion of nonresident hunters (mainly from the United States) has grown significantly since the mid-1990s in the prairie provinces of Alberta, Saskatchewan, and Manitoba (Alisauskas 2011), but nonresidents represent only <1% of the people who purchase migratory bird hunting permits in coastal provinces where most of the sea duck hunting occurs (M. Gendron, pers. comm.).

Several provinces in Atlantic Canada, including Newfoundland and Labrador, New Brunswick, and Nova Scotia, have special late sea duck hunting seasons in January and February. Harvest during those months may be underrepresented in the questionnaire survey because some hunters probably return their survey responses before that season occurs.

Wendt and Sileff (1986) documented issues with harvest estimates for sea ducks in Newfoundland, where a special survey was sent to hunters to

report the kill of sea ducks and murres during the entire hunting season (September–March) in the late 1970s. Estimates from the special survey indicated that the national survey underestimated sea duck harvest by four to seven times. The authors attributed this difference to the timing of large harvests that occur late in the season and the wing survey, which concluded by November. More efforts have been made in recent years to ensure coverage of the national harvest survey and the wing survey for the entire hunting season. Similar special surveys were conducted in the late 1990s and showed the same bias, but it was much less pronounced (special surveys were ~1.6 times higher, S. Gilliland, Environment Canada, unpubl. data). Other issues indicated by Wendt and Sileff (1986) include the low number of sea duck hunters, their low response rates in some areas, a highly clumped distribution, and a strongly skewed distribution of harvest by individual hunters. All of these factors lead to imprecise and usually underestimated harvest of sea ducks.

State Surveys

Several states conduct independent efforts to estimate sea duck harvest, including Maryland and Washington. The Maryland Department of Natural Resources (MDNR) annually surveys a random sample of 7% of the state's hunting license purchasers to estimate hunting activity and harvest of all game species in the state (W. F. Harvey, pers. comm.). The method is a mail questionnaire survey that uses the HIP sample frame for Maryland, so it is generally comparable to the HIP survey. Annual estimates from the two surveys do not always agree (especially 2010 and 2011; Table 12.1), but the average estimated annual harvest over the entire period from the HIP surveys (16,700 birds) is similar to the average from the MDNR surveys (14,200 birds, Maryland Department of Natural Resources, unpubl. data).

To gain better information about sea duck harvest and hunting activity for the state, the Washington Department of Fish and Wildlife (WDFW) began requiring all sea duck hunters hunting in western Washington to obtain a special permit and harvest card in 2004 (Washington Department of Fish and Wildlife, unpubl. report). Permittees are required to immediately record harvest in the field and provide a report of their sea duck hunting after the season. Harvest estimates are expanded to account for the total number of permittees, with a correction for nonresponse.

TABLE 12.1

Comparisons of annual state-specific sea duck harvest (scoters, Long-tailed Ducks, and Harlequin Ducks) as estimated from federal (USFWS) and state (MDNR) waterfowl harvest surveys and mandatory hunter reports (WDFW).

	Maryland		Western Washington	
Year	Federal survey	State survey	Federal survey	State survey
1999	12,000	13,600		
2000	9,900	9,800		
2001	16,900	10,500		
2002	13,100	10,100		
2003	18,700	15,900		
2004	20,400	11,600	2,433	2,275
2005	20,400	23,000	2,383	1,928
2006	27,500	13,700	2,452	3,007
2007	17,900	16,800	3,325	2,594
2008	16,600	17,300	5,055	2,447
2009	16,100	13,800	8,963	3,903
2010	9,300	19,200	1,404	2,182
2011	18,200	9,500	4,552	1,577

The mandatory reporting system yields a harvest estimate of coastal sea duck species (scoters, Long-tailed Ducks, Harlequin Ducks, and goldeneyes) that can be compared with federal survey estimates for the state. Washington's annual sea duck permittee list has not been utilized in the federal survey; consequently, the federal harvest estimates are based on reported harvest and wings received for all ducks, rather than using a separate stratum of prospective sea duck hunters. The Washington survey relies on species identification by hunters, rather than the parts collection survey, and misclassification has been documented but not accurately quantified (D. Kraege, pers. comm.).

The federal harvest estimates for sea ducks in western Washington were greater than annual estimates from WDFW's mandatory reports in 6 of 8 years from 2004 through 2011 (Table 12.1), and the average of the federal estimates (3,798) was about 50% higher than the average of the WDFW counts (2,489). The difference in estimates suggests that the federal survey overestimated Washington sea duck harvest, that some permittees did not submit the mandatory report, or both.

The 2009 federal estimate for Washington illustrates a consequence of relying solely on the wing survey to differentiate between sea duck harvest and harvest of other ducks. That year, a single avid scoter hunter selected for the wing survey submitted a large number of scoter wings, resulting in an unusually high estimate of scoter harvest. Beginning in 2013, the HIP survey corrected this problem by using Washington's sea duck permit sales information to sample sea duck hunters and estimate sea duck harvest separately, as in the Atlantic Flyway and the other coastal Pacific Flyway states.

Wounding Loss

Wounding loss occurs when birds are injured or killed but not retrieved by hunters. Losses are probably greater in sea ducks than other waterfowl because (1) sea ducks are usually shot over open water at longer ranges than decoying dabbling ducks, (2) most sea ducks are large birds with tough feathers and skin that is difficult to penetrate, and (3) they are strong swimmers and divers that have a good chance of escaping retrieval (Bellrose 1953, Hochbaum and Walters 1984). To reduce the loss of wounded sea ducks, Atlantic Flyway hunters in the United States are allowed to shoot wounded ducks from motorboats under power in designated offshore sea duck hunting zones; this method of take is prohibited elsewhere in the United States and in Canada.

In the late 1960s, the Maryland DNR conducted studies of sea duck hunters in Chesapeake Bay that yielded estimates of wounding rates (L. J. Hindman, pers. comm.). The studies consisted of (1) observations recorded by MDNR personnel during hunts in which they participated and (2) surreptitious observations of other hunting parties by trained MDNR personnel, modeled after the hunter performance studies of the 1960s and 1970s (Kimball et al. 1971). Hunters observed during these studies were unable to retrieve about 28% of downed scoters, eiders, and Long-tailed Ducks (Maryland Department of Natural Resources, unpubl. data).

The annual HIP survey asks hunters to report the number of sea ducks they wounded and lost. During the 1999–2003 hunting seasons, reports of wounding loss [birds wounded/(birds wounded + birds killed and retrieved)] averaged 0.18 for sea ducks and 0.12 for other ducks (Padding et al. 2006b, Moore et al. 2007). However, these data are difficult to interpret because (1) some wounding cannot be readily detected, (2) reactions of birds to near misses may be perceived as wounding, and (3) some hunters may be reluctant to report wounding loss. Martin and Carney (1977) concluded that although harvest surveys probably provide reliable indices of wounding loss, they likely underestimate loss rates. In harvest management and population models, wounding loss is typically considered to be 0.20 of the total duck kill (Anderson and Burnham 1976, Johnson et al. 1997). Assuming that hunter-reported sea duck wounding loss is 1.5 times greater than for other ducks, 0.30 or higher is a comparable estimate for sea ducks, depending on hunting methods. Hunter reports of wounding of ducks and geese have declined in the 1990s and 2000s (Schulz et al. 2006; U.S. Fish and Wildlife Service, unpubl. data), so perhaps actual wounding rates are lower now.

Another difficulty in assessing wounding loss is that the ultimate fate of a wounded bird is unknown; the bird could (1) die of its wounds or because of increased vulnerability to predation,

(2) recover enough to survive but not enough to reproduce as part of the breeding population, or (3) recover fully (Van Dyke 1981). Several studies have shown that substantial numbers of live ducks and geese had one or more shotgun pellets embedded in their tissue, indicating that they had survived hunting wounds (Elder 1955, Peterson and Ellarson 1975, Perry and Geissler 1980, Kirby et al. 1981, Madsen and Riget 2007). Hicklin and Barrow (2004) captured and examined 1,005 incubating female Common Eiders (*Somateria mollissima*) in eastern Canada and found that 29% of them carried at least one embedded pellet. Merkel et al. (2006) showed that embedded shots affected the body condition of juvenile Common Eiders but not that of subadults and adults. Exposure to hunting may be substantial for some species, but actual mortality due to wounding could be lower than currently accepted wounding loss estimates.

HARVEST OF UBIQUITOUS SPECIES (BUFFLEHEADS, COMMON GOLDENEYES, MERGANSERS)

Hunting Regulations: Past and Present

Migration routes and wintering areas of Buffleheads, Common Goldeneyes, and the mergansers are broadly distributed in North America, whereas eiders, scoters, Harlequin Ducks, and Long-tailed Ducks are primarily hunted in coastal areas and the Great Lakes. Consequently, harvest management of ubiquitous species has usually been implemented at national rather than regional scales. Ubiquitous species can be harvested under conventional fall and winter harvest regulations as well as by subsistence hunters.

For the most part, hunting Buffleheads and goldeneyes has only been allowed during general duck hunting seasons, and the species have been included in the aggregate daily bag limit for ducks, pooling any combination of species. However, shooting Buffleheads was prohibited in the United States from 1932 through 1937 in response to a presumed population decline. Bruette (1934) noted that Bufflehead numbers had decreased, although he characterized the species as quite abundant. In 1938, US hunters were allowed a maximum of three Buffleheads per day as part of a 10-duck daily bag limit, and in 1944, the restriction on Buffleheads was removed. Canada offered some additional hunting opportunity from Québec west to Alberta in the 1960s and early 1970s by allowing take of two bonus goldeneyes in addition to the full regular daily bag limit of ducks. Later, as concerns mounted over the status of western Barrow's Goldeneyes, the daily bag limit for goldeneyes was restricted to two birds in British Columbia in 1990 and western Washington in 2010. Concerns were raised about the status of eastern Barrow's Goldeneyes where a small breeding population was centered in Québec and wintered in the northern Atlantic states (Robert et al. 2000), which also led to harvest restrictions in the east.

Common and Red-breasted Mergansers

Anglers and fisheries managers have not held mergansers in high regard over the years. Mergansers have been viewed as major fish predators since the early 1900s (Beach 1936, White 1957, Erskine 1972, Anderson et al. 1985), and most fish and wildlife agencies supported reduction of mergansers. In general, Common Mergansers were considered more egregious fish predators than Red-breasted Mergansers; Hooded Mergansers (*Lophodytes cucullatus*) were not a concern (see Munro and Clemens 1932, 1937, 1939; Salyer and Lagler 1940). Thus, it is not surprising that hunting regulations were established that encouraged hunting of mergansers, first in Canada and later in the United States.

The bag limit for all merganser species was removed entirely in Ontario in the mid-1930s, a few years later in Prince Edward Island, and in Newfoundland in 1965. Beginning in 1950, there was no bag limit for Common and Red-breasted Mergansers in Québec. When the *no limit* policy was discontinued in 1977, extra mergansers were still allowed in addition to the general duck bag limits in Newfoundland and Québec, and mergansers were also included in the additional seasons for eiders, scoters, mergansers, and Long-tailed Ducks in the coastal waters of New Brunswick and Nova Scotia. Additional mergansers in the daily bag were allowed in Québec until 1997 and were still allowed in Newfoundland and Labrador as of 2013.

Beginning in 1944, hunters in the United States were allowed to take up to 25 Common and Red-breasted Mergansers daily in addition to the general duck bag limit. The special bag limit

for mergansers, over and above limits for other ducks, was based on the rationale of protecting economic fisheries of salmon, trout, and herring. In 1954, the additional 25-bird daily bag limit for Common and Red-breasted Mergansers was eliminated nationwide in the United States. In 1957, the separate additional bag limit for mergansers was reestablished in all four flyways with a daily bag limit of five (10 in possession), of which only one bird could be a Hooded Merganser. All merganser species have been included in the Pacific Flyway's general duck limits since 1980, but states in the other three flyways still allow the additional merganser limits under the federal frameworks. Some states have elected to forego this option: in 2012, Connecticut, Maryland, and New York in the Atlantic Flyway, Missouri in the Mississippi Flyway, and Montana and New Mexico in the Central Flyway opted to include mergansers in their general bag limits for ducks.

Hooded Merganser

Conservation concerns about Hooded Mergansers in the United States were recognized in the early 1900s based on population declines in California (Grinnell et al. 1918), the northeastern and Mid-Atlantic states (Phillips 1926), as well as other parts of their continental range. As regulation of waterfowl hunting evolved, the sparseness of Hooded Mergansers compared to the *Mergus* species led to protective measures nationwide in the United States when the bag limit for Hooded Mergansers was reduced to one bird per day and one in possession from 1953 through 1962, and one bird per day and two in possession through 1978. The restriction on Hooded Mergansers in Pacific Flyway states was lifted in 1979, and harvested birds have been included in the general duck limits since 1980. Low levels of harvest in the Pacific Flyway since the 1960s, typically ≤5,000 of about three million ducks harvested annually (S. M. Olson and R. E. Trost, U.S. Fish and Wildlife Service, unpubl. report; R. E. Trost and M. S. Drut, U.S. Fish and Wildlife Service, unpubl. report), suggest there is low interest in merganser hunting there and hunters probably take most Hooded Mergansers incidentally while hunting other ducks. In the other three flyways, however, the restriction remains in place, although the daily bag and possession limits were raised to two and four birds, respectively, in 2006 in the Mississippi and Central Flyways and 2007 in the Atlantic Flyway.

Canada did not impose similar limitations on harvest of Hooded Mergansers, and the species was included under regulations for other species of mergansers or as part of the general duck bag limit (Québec, Manitoba, and the Central and Pacific Flyway provinces). No bag limit was set for Hooded Mergansers in Ontario until 1971, and in Newfoundland and Prince Edward Island until 1974, at which time the species was included as part of the general duck bag limits in those provinces.

Harvest

As expected from their broad distribution during hunting seasons, Buffleheads, Common Goldeneyes, and Hooded Mergansers are harvested throughout the continent (Figures 12.1 and 12.2). The Great Lakes region is a particularly important harvest area for these species, due to both bird abundance and large numbers of waterfowl hunters. The most commonly harvested sea ducks in North America (excluding subsistence harvest) are Buffleheads with annual continental harvest averaging about 211,000 birds, Common Goldeneyes averaging 103,000 birds, and Hooded Mergansers averaging 102,000 birds/year during the decade from 2002 to 2011.

The three species are all considered late migrants, but Buffleheads undertake fall migration earlier than the rest (Bellrose 1980). The difference in timing is reflected in the seasonal harvest in the United States, where about half of the Bufflehead harvest occurs before December compared with the other species (Figure 12.3). These duck species are not highly sought after by hunters, but goldeneye and Bufflehead decoys are fairly common in some regions, and wing survey receipts indicate that at least a few hunters specifically target mergansers (U.S. Fish and Wildlife Service, Branch of Harvest Surveys, unpubl. data). Overall, annual harvest of these species appears to track annual estimates of total duck harvest closely in both Canada and the United States (Figures 12.4 and 12.5), suggesting that most of the birds are taken opportunistically during hunts primarily targeting diving (*Aythya* spp.) or dabbling ducks (*Anas* spp.).

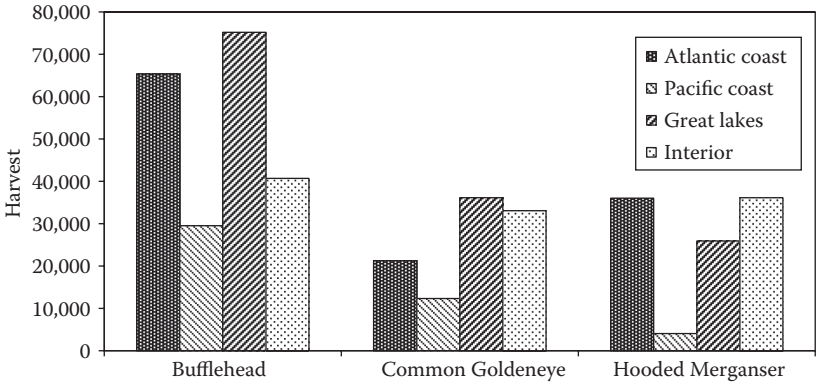

Figure 12.1. Regional distribution of the estimated average annual harvest of Buffleheads, Common Goldeneyes, and Hooded Mergansers in the United States and Canada from 2002 through 2011.

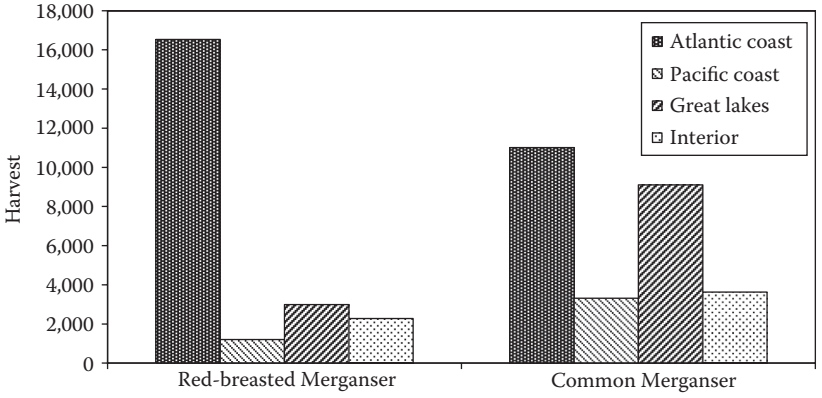

Figure 12.2. Regional distribution of the estimated average annual harvest of Red-breasted and Common Mergansers in the United States and Canada from 2002 through 2011.

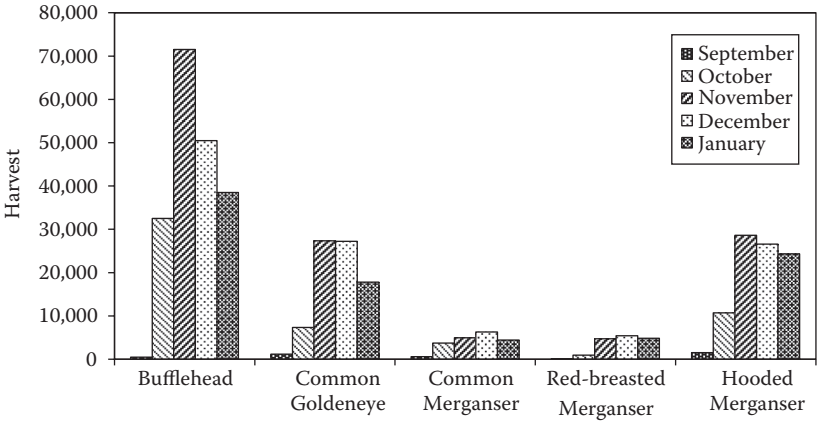

Figure 12.3. Seasonal distribution of the estimated average annual harvest of Buffleheads, Common Goldeneyes, and mergansers in the United States from 2002 through 2011.

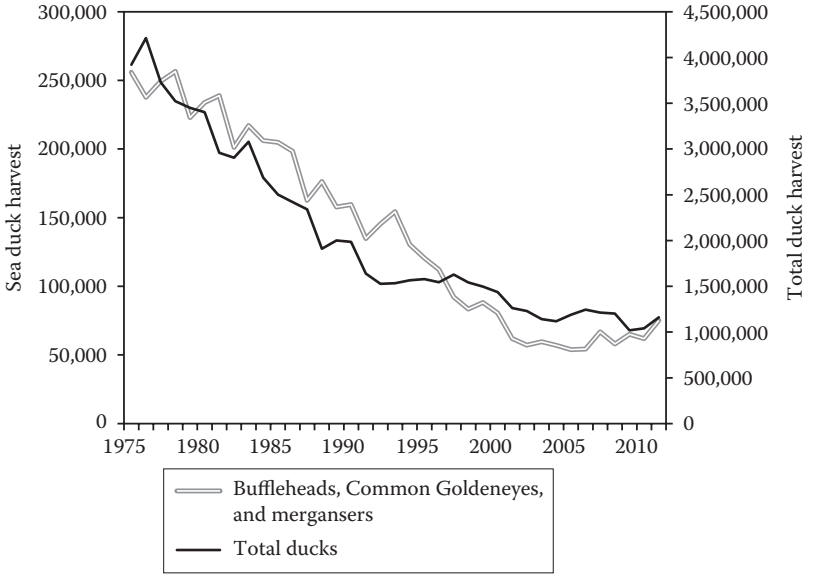

Figure 12.4. Estimated annual combined harvest of Buffleheads, Common Goldeneyes, and mergansers compared to total duck harvest in Canada from 1975 through 2011.

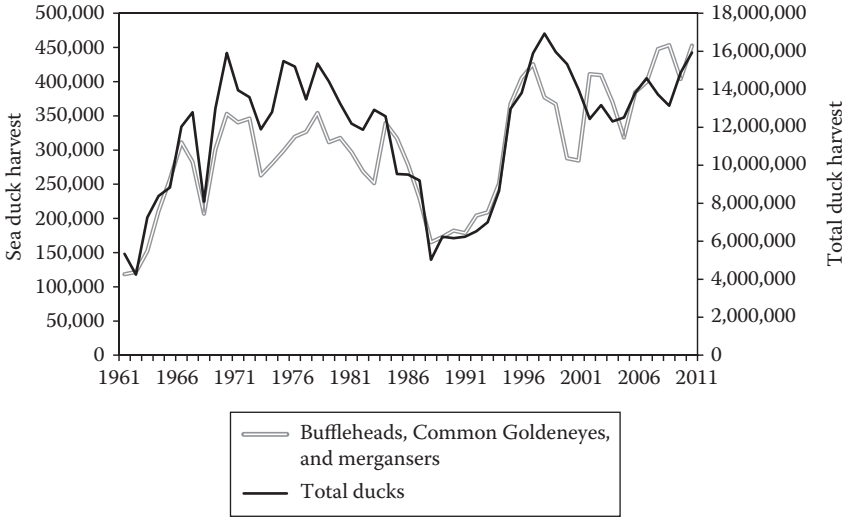

Figure 12.5. Estimated annual combined harvest of Buffleheads, Common Goldeneyes, and mergansers compared to total duck harvest in the United States from 1961 through 2011.

Sex and Age Composition

Fall and winter plumages of most adult male sea ducks are striking compared to immature birds and adult females, and many US hunters likely target adult males as a result. Thus, sex ratios of harvested birds are influenced by hunter selectivity and do not necessarily reflect the standing sex ratio of wild populations. Nonetheless, adult males outnumber females in populations of goldeneyes, Buffleheads, and most mergansers with the exception of the Common Merganser (Table 12.2). The female-biased sex ratio of Common Merganser may reflect the continental population's sex composition but could also be the result of different migration patterns among the different age and sex classes (Anderson and Timken 1972), which may make adult males less vulnerable to hunting.

TABLE 12.2

Adult sex ratios (males–females) and age ratios (immature birds of both sexes–adult females) of goldeneyes, Buffleheads, and mergansers harvested in Canada and the United States from 2002 through 2011.

	Adult sex ratio		Age ratio		Wings examined	
Species	Canada	United States	Canada	United States	Canada	United States
Common Goldeneye	2.34	2.10	4.00	2.75	2,698	7,236
Barrow's Goldeneye	1.03	2.64	1.41	2.36	106	588
Bufflehead	2.79	2.95	4.85	3.65	1,801	15,197
Common Merganser	0.82	0.97	3.28	2.06	759	2,019
Red-breasted Merganser	2.71	1.41	6.05	2.17	579	1,795
Hooded Merganser	2.44	2.34	3.40	3.22	1,343	6,103

Harvest age ratios of most species have a higher ratio of immature birds in Canada than the United States (Table 12.2), suggesting that immature birds of these species become more wary after their initial exposure to hunting in Canada. Age ratios of birds harvested in the United States imply that recent annual production rates are relatively high for Common Goldeneyes, Buffleheads, and Hooded Mergansers but are less robust for Barrow's Goldeneyes and Common and Red-breasted Mergansers, suggesting lower harvest potential for the latter group of species.

ATLANTIC COAST FALL–WINTER TRADITIONS

The Atlantic coast of North America has a rich sea duck hunting tradition, from subsistence hunting by aboriginal peoples, to market hunting in the 1800s and early 1900s, to sport hunting. Commercial waterfowl hunting was still an accepted practice on the Atlantic coast until the late 1930s (Smith 1985), and sea ducks were hunted despite their less favorable reputation among gourmands. Market prices for Buffleheads and goldeneyes ($0.30–$0.50 per pair), scoters ($0.50), and Long-tailed Ducks ($0.70–$0.90) were much lower than the $5–$7 per pair that Canvasback (*Aythya valisineria*) commanded as a highly regarded species but were similar to prices for Northern Pintails (*Anas acuta*) and American Wigeon (*A. americana*, Walsh 1971). Even as market hunting faded into history, traditional fall and winter sea duck concentration areas remained the favored haunts of hunters.

Bays, sounds, inlets, river mouths, and other Atlantic coastal waters are the primary wintering grounds for several sea duck populations, and over the years, decades, and even centuries, those areas have provided ample opportunity for the hardy hunters who pursued these birds. The 1909 painting of Winslow Homer, *Right and Left*, depicts two goldeneyes falling to the gun and is an iconic image of Atlantic coast sea duck hunting on a rough day. Similar scenes still occur in hundreds of locales in the Gulf of St. Lawrence and the Bay of Fundy, along the coasts of Maine and Cape Cod, and in Long Island Sound, Chesapeake Bay, and Pamlico Sound. In 2013, more than 70 guide services from Maine to North Carolina offered specialized sea duck hunts, indicating that interest in hunting sea ducks along the Atlantic coast remains high to this day.

Further north, sea duck hunting is the main waterfowl harvest; when hunters in Newfoundland *are going at the ducks*, the main quarry is Common Eiders and not American Black Ducks (*Anas rubripes*) or Mallards (*A. platyrhynchos*). Attitudes of many hunters in Newfoundland and Labrador toward sea duck hunting are more similar to those of northerners than recreational hunters. The hunt is largely considered a subsistence harvest and has long traditions and cultural value. Hunting is often a community-based activity, and hunters and nonhunters alike participate in cleaning and processing sea ducks for consumption. Unfortunately, the perception of a traditional right to hunt sea ducks and other birds has been taken to extreme levels by a few individuals, and large-scale illegal harvest and selling of sea ducks still occurs despite considerable effort of enforcement officials (Chardine et al. 2008).

Harvest of sea ducks also continues with a relatively small but passionate group of sea duck hunters in the islands of St. Pierre and Miquelon,

a small overseas collectivity of France located off the south coast of Newfoundland. The Migratory Bird Treaty/Convention between Canada and the United States does not apply in this area; hunting regulations have been set by local authorities, and they have traditionally allowed relatively liberal access to sea ducks and seasons extending into April. These late seasons have been challenged recently to align with European Union regulations on hunting birds.

Hunting Regulations: Past and Present

Eiders, Scoters, and Long-tailed Ducks

Market hunting had nearly extirpated American Common Eiders (*S. m. dresseri*) by the end of the 1800s (Goudie et al. 2000), and the Migratory Bird Treaty Act of 1916 stipulated that the United States and Canada would both prohibit eider hunting entirely. However, the Migratory Bird Convention Act (MBCA) did not apply in Newfoundland and Labrador because the region was a British colony that did not join confederation with Canada until 1949. Eider hunting, largely for subsistence purposes, continued in coastal waters. Likewise, subsistence hunters in the Canadian North continued taking eiders, as the MBCA was generally not enforced in the north. The ban on eider hunting in the rest of Canada and the United States remained until 1932, when eiders were included as part of the daily bag limit during the regular duck season.

Special seasons to provide additional sea duck hunting opportunity were first implemented in 1938, in Maine, New Hampshire, Connecticut, Massachusetts, and Rhode Island. Hunters there were allowed to take 10 scoters/day in open coastal waters from September 15 until the beginning of the general duck hunting season, at which point scoters were included along with other ducks as part of the duck bag limit. After expanding to include Long Island in 1940, the additional scoter season was replaced with a separate 92-day sea duck season in 1949, with a daily bag limit of seven eiders and scoters in any combination; Long-tailed Ducks were added the following year. In 1963, the season was increased to 107 days, the maximum season allowed under the 1916 Migratory Bird Treaty Act, and by 1971, all Atlantic coast states except Florida had special sea duck seasons. For more information, Caithamer et al. (2000) provide a detailed description of the evolution of sea duck hunting regulations in Atlantic coast states.

In Canada, an additional 30-day season for eiders and scoters was allowed in the coastal waters of New Brunswick and Nova Scotia beginning in 1948 and the following year in Newfoundland when it became a province. In 1950, Long-tailed Ducks were added to the list of species that could be taken during the additional sea duck seasons, and beginning in 1952, the additional season was also provided in the coastal waters of Québec. The additional seasons were retained in New Brunswick and Nova Scotia but were replaced with separate seasons for eider, scoter, and Long-tailed Duck hunting that were independent of general duck hunting seasons in Newfoundland (1958) and Québec (1963). The seasons provided hunting opportunity late in the winter, when most other ducks have long since migrated south but many sea ducks remain along Canada's east coast. Daily bag limits during both additional and separate seasons were the same as they were during general duck hunting seasons except in Labrador, where hunters could take 25 eiders, scoters, and Long-tailed Ducks daily in any combination. In 1967, separate bag limits of 10 birds in any combination were established for the additional seasons in New Brunswick and Nova Scotia, and Québec hunters were allowed two eiders, scoters, or Long-tailed Ducks in addition to the general daily duck bag limit. The daily bag limit for the separate season on the island of Newfoundland was increased to 12 birds in 1969.

The special sea duck seasons remained unchanged in most of the Atlantic coastal states and provinces during the 1970s and most of the 1980s. When regular duck hunting season lengths and daily bag limits were significantly reduced in the late 1980s, hunters in prime sea duck areas such as Chesapeake Bay increasingly turned to the special sea duck season for more hunting opportunity. Concerned about the possible impacts of this increased hunting pressure on scoters and Long-tailed Ducks, the state of Maryland reduced the daily bag limit to five sea ducks in 1989, and in 1993, the USFWS reduced the daily bag limit to four scoters in all Atlantic Flyway states. Similarly, concerns about the status of Common Eiders and scoters led CWS to reduce New Brunswick's additional-season daily bag limit in 1990 to six birds, of which no more than four could be eiders or scoters. That year, eider harvest was also limited

to six birds daily in Newfoundland and seven birds daily in Labrador. The 10-bird limit was maintained in Nova Scotia, but in 1994, a restriction on scoter harvest was implemented with limits of no more than 4 birds/day, and a few years later, Nova Scotia's sea duck bag limit was reduced from 10 to 5 birds.

By 1997, eider harvest in Newfoundland had declined by 55% below the levels taken in the mid-1980s, and examination of females for embedded shot indicated that eiders migrating through or wintering around Newfoundland were exposed to high levels of hunting pressure (Hicklin and Barrow 2004). Confronted with declining harvest, evidence of heavy hunting pressure, and widespread expressions of public concern for eider populations, the CWS implemented harvest restrictions in 1998. The bag limit for eiders, scoters, and Long-tailed Ducks combined was reduced from 12 to 6 birds throughout the province, only three eiders could be taken daily in February, and the season was closed for the first 10 days of March. Subsequently, a survey that covered the wintering range of northern Common Eiders estimated that over 200,000 northern eiders wintered in Canada. The harvest assessment developed using this new information suggested the population in Canada could sustain additional harvest and the February restriction was lifted (Gilliland et al. 2009).

In the United States, as sea duck hunting continued to gain popularity, additional states restricted bag limits more than federal frameworks required. Maine maintained the aggregate seven-bird daily bag limit but restricted eider harvest to five birds daily in 1999, and further reduced the limit to four birds in 2009. In Massachusetts in 1999 and New Hampshire in 2000, the two states reduced the eider and Long-tailed Duck limit to four birds. Further, hunters in Massachusetts were allowed to take only one female eider per day. In 2004, Connecticut reduced the aggregate sea duck bag limit to five birds, of which no more than four birds could be Long-tailed Ducks, and Rhode Island also reduced the aggregate bag limit to five birds in 2008.

Barrow's Goldeneye

Uncertainty about the status of Barrow's Goldeneyes in British Columbia and interest in understanding the impacts of harvest on the western population of this species led to investigations of the ecology of the species in the 1980s (Savard 1987, Savard and Eadie 1989). The research led to increased scrutiny of the small eastern population and concern for its well-being (Savard and Dupuis 1999). The first harvest restrictions for eastern Barrow's Goldeneye, including closures and reduced bag limits, were established in Québec in 1995. The eastern birds were listed as a population of special concern in Canada (Committee on the Status of Endangered Wildlife in Canada 2000). Subsequently, the bag limit for Barrow's Goldeneye was reduced to one bird daily and two in possession in 2007 in Newfoundland and Labrador, New Brunswick, Nova Scotia, Ontario, and Prince Edward Island and in Québec the following year. A complete ban on harvest of Barrow's Goldeneyes was considered, but given the difficulty in identifying goldeneye species under typical hunting conditions, a one-bird daily limit was put in place. In 2012, the possession limit was reduced to one bird in those provinces. The US federal frameworks for the Atlantic Flyway have no specific restrictions on goldeneyes, but the state of Maine elected to close the season on this species in 2008.

Harlequin Duck

The species has probably never been numerous in eastern North America (Vickery 1988) but likely has declined since the early 1900s (Goudie 1989). As it became apparent that the eastern population numbered <1,000 birds (Goudie 1989), Canada closed the hunting season on Harlequin Ducks in Newfoundland and Labrador and Prince Edward Island in 1987, Nova Scotia in 1988, New Brunswick in 1989, and Ontario and Québec in 1990. That year, the eastern population of Harlequin Ducks was also listed as endangered in Canada. The United States closed the season in the Atlantic Flyway in 1989. The population has rebounded through the 2000s but remains relatively small at ≤2,000 birds (Mittelhauser 2008, Thomas 2008). Hunting of Harlequin Ducks is still prohibited in eastern North America.

Hunting Activity

The number of active waterfowl hunters in eastern Canada (the Atlantic Provinces and Quebec) declined steadily from the mid-1970s to the 2000s and has apparently stabilized at about 38,000 hunters

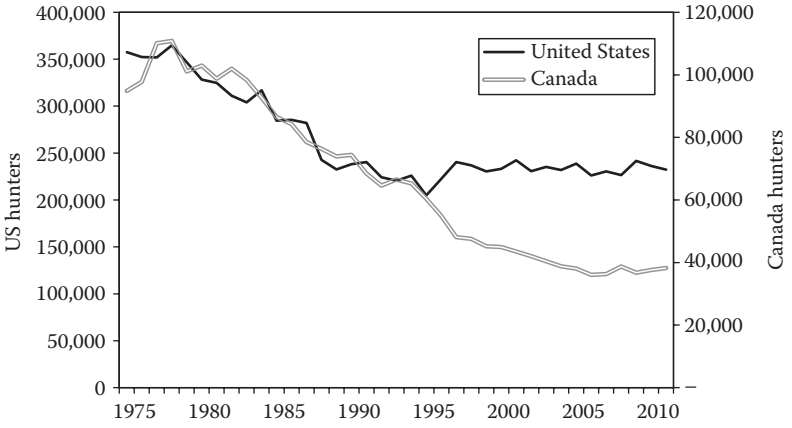

Figure 12.6. Number of active waterfowl hunters in Atlantic coastal states and provinces of the United States and Canada from 1975 through 2011.

per year in recent years (Figure 12.6). In contrast, although waterfowl hunters in Atlantic coast states have also declined since the 1970s, they stabilized about a decade earlier, in the mid-1990s (Figure 12.6). Estimates of sea duck hunter numbers are not available for the same time period, but harvest estimates suggest that they tracked waterfowl hunter numbers in Canada. In the 1980s, when regular duck hunting seasons were shortened, bag limits were reduced, and additional restrictions were imposed on harvest of American Black Ducks, the attention of waterfowl hunters turned to sea ducks in some areas. In Maine, for example, many guide services for sea duck hunting were established at this time (B. Allen, pers. comm.). The number of sea duck hunting guide services in Maine has declined since the 1990s (B. Allen, pers. comm.), indicating that interest in sea duck hunting there has waned recently. Estimates of active sea duck hunters (people who hunted eiders, scoters, and Long-tailed Ducks) are only available for Atlantic coast states for 1999 onward, and the estimates for that period are fairly stable, averaging about 11,500 hunters annually (range 9,800–13,700) in 1999–2011.

Fall and Winter Harvest

Fall and winter harvest of Common Eiders is about evenly split between Canada and the United States, but scoters and Long-tailed Ducks are taken primarily in the United States (Figure 12.7). Harvest of Common Eiders is about the same in both countries, but Canada mostly takes northern Common Eiders, whereas US harvest is focused almost exclusively on American Common Eiders (Reed and Erskine 1986). Most of the eider, scoter, and Long-tailed Duck fall and winter harvest in both countries occurs along the Atlantic coast, although the Great Lakes region (>20% of the average annual harvest of Long-tailed Ducks) and the Pacific coast (>10% of the average annual harvest of Surf Scoters [*Melanitta perspicillata*]) are also significant harvest areas (Figure 12.8). A few King Eiders (*Somateria spectabilis*) are taken in either country in the sport harvest; from 2000 through 2011, the estimated mean annual harvest was 124 birds in Canada (all in eastern Canada) and 135 in the United States (85 on the Atlantic coast and 50 in Alaska). Estimated harvest may be biased low because Gilliland and Robertson (2009) reported that about 10% of the thousands of eiders harvested in northern Newfoundland were King Eiders and mainly juveniles. However, even taking into account a potential bias, harvest of King Eiders likely amounts to no more than a few hundred birds annually in each country.

Harvest of scoters and Long-tailed Ducks in eastern Canada dropped precipitously from the 1970s to the 2000s (Figure 12.9). Despite a similar decrease in hunter numbers (Figure 12.6), the decline in Common Eider harvest was much less pronounced. In Atlantic Canada, eiders are the targeted species in coastal sea duck hunts, with other species being taken somewhat opportunistically. The steepest declines in Long-tailed Duck harvest were in Ontario and Québec, suggesting shifts in the species distribution or changing

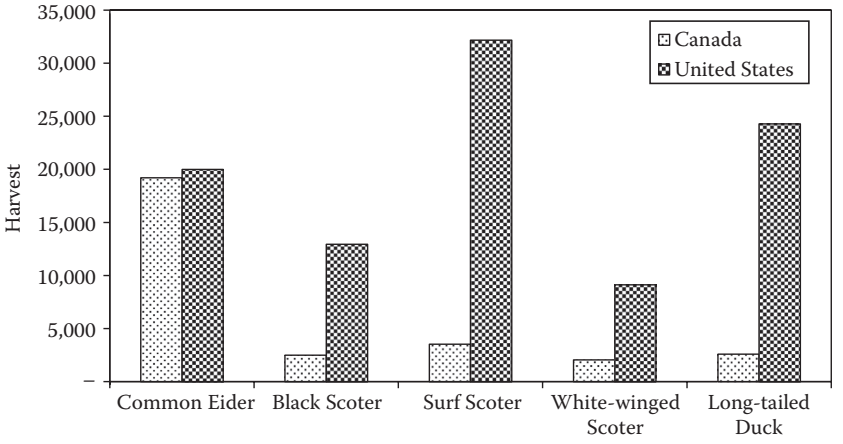

Figure 12.7. Estimated average annual harvest of Common Eiders, Black Scoters, White-winged Scoters, Surf Scoters, and Long-tailed Ducks in the United States and Canada from 2002 through 2011.

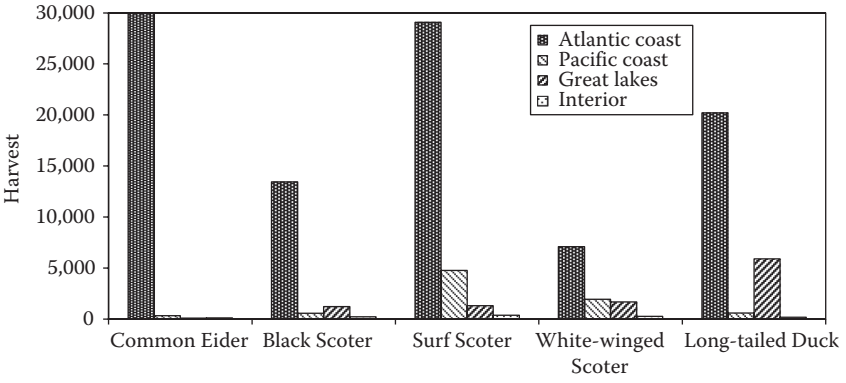

Figure 12.8. Regional distribution of the estimated average annual harvest of Common Eiders, Black Scoters, White-winged Scoters, Surf Scoters, and Long-tailed Ducks in the United States and Canada from 2002 through 2011.

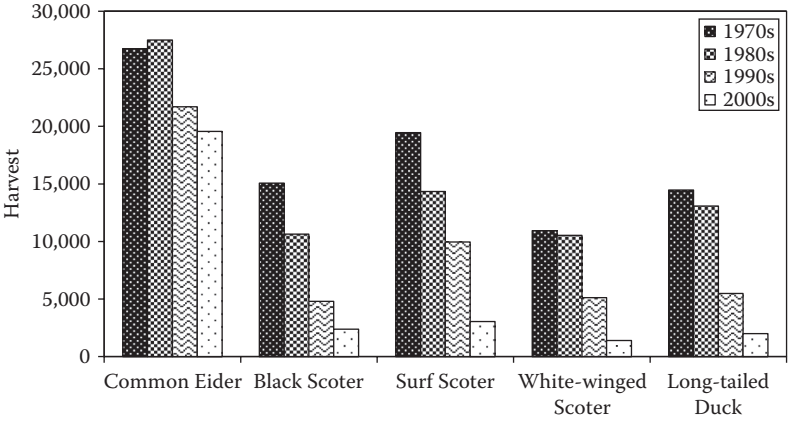

Figure 12.9. Estimated average annual harvest of several sea duck species in eastern Canada by decade from the 1970s through the 2000s.

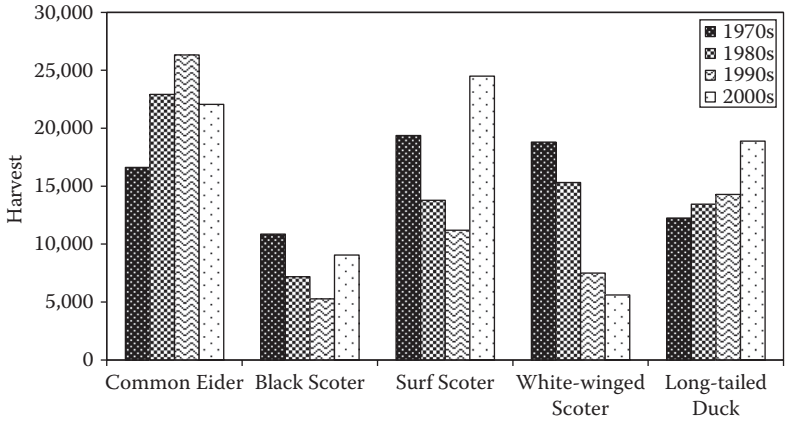

Figure 12.10. Estimated average annual harvest of several sea duck species in Atlantic coast states of the United States by decade from the 1970s through the 2000s.

hunting traditions in these provinces. Temporal patterns were different in the United States during the same period and varied more among species (Figure 12.10). Long-tailed Duck harvest increased steadily from the 1970s to the 2000s, whereas the declining harvest of White-winged Scoters (*Melanitta fusca*) was similar to the decline that Canada experienced. White-winged Scoter harvest on the Atlantic coast has decreased from an average of >25,000 birds/year in the 1970–1980s to about 7,000 birds/year in the 2000s, suggesting that this species is less available to hunters there than in the past. Population size and distribution data are insufficient to determine whether changes in harvest are due to a population decrease, a shift in geographic distribution, or some other causes.

In the United States, most harvest of Long-tailed Ducks and Surf Scoters occurs from November through January along the Atlantic coast, whereas harvest of Common Eiders, White-winged Scoters, and Black Scoters (*Melanitta americana*) peaks in November and declines thereafter (Figure 12.11). The temporal patterns may be due to differences in wintering areas and differential exposure to hunting pressure. Common Eiders and White-winged Scoters winter primarily from Maine to Long Island (Silverman et al. 2013), and the cold temperatures of December and January at those latitudes may deter some hunters. On the other hand, wintering Surf Scoters and Long-tailed Ducks are more broadly distributed with concentrations in Chesapeake Bay (Silverman et al. 2013),

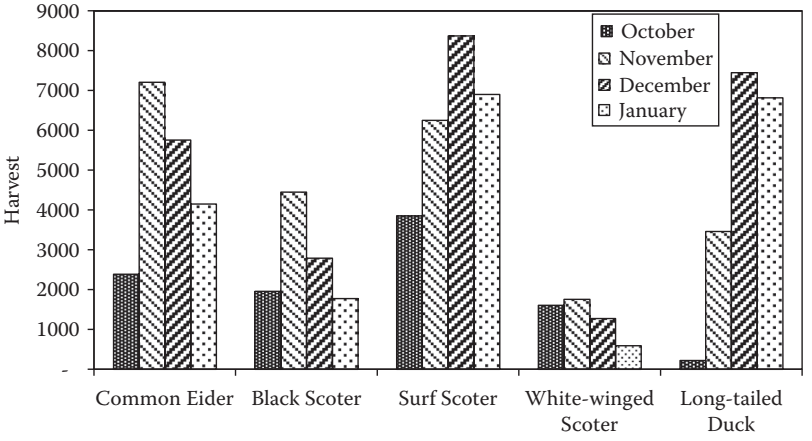

Figure 12.11. Seasonal distribution of the estimated mean annual harvest of Common Eiders, Black Scoters, White-winged Scoters, Surf Scoters, and Long-tailed Ducks in Atlantic coast states from 2002 through 2011.

which is heavily hunted throughout the comparatively mild winter. Black Scoters winter from Maine to northern Florida, with significant concentrations along the coasts of North and South Carolina and Georgia (Silverman et al. 2013), where wing survey receipts indicate there are few sea duck hunters.

The largest Common Eider harvest in Canada occurs in Newfoundland, where harvest reflects the seasonal abundance of birds in different parts of the province (Gilliland and Robertson 2009). In general, the harvest on the northern coasts peaks in November and December and is focused mainly on northern Common Eiders. In southern areas of the province, the harvest is distributed throughout the winter months of November through February, with a peak in December, and is split evenly between the northern and American Common Eiders (Gilliland and Robertson 2009). Patterns of harvest are driven by seasonal dynamics of sea ice, which push coastal species to southern waters as the winter progresses.

Sex and Age Composition of the Harvest

The sex and age composition of a population can provide insights about aspects of population status and ecology, such as effective size of the breeding population (adult sex ratio) and productivity (age ratio). In practice, sex and age information on sea ducks is obtained from samples of harvested birds via wing surveys rather than samples from entire populations. Thus, harvest sex and age ratios should be considered indices and not estimates of population composition.

Adult male sea ducks are readily identifiable from their plumage during fall and winter, making them easy for hunters to target (Metz and Ankney 1991). Consequently, sex ratios of harvested adult birds only provide indices of population sex ratios and not direct measures. Interestingly, adult sex ratios (males to females) of harvested Common Eiders and scoters are lower in Canada than in the United States (Table 12.3). It is thought that Canadian eider hunters do not preferentially target adult males and that sex ratios in the harvest reflect the population at large (Gilliland and Robertson 2009), whereas in the United States, hunters target adult males. However, it is also possible that adult male Common Eiders and scoters are less available to hunters in Canada, perhaps due to different migration patterns of adult males compared to adult females and birds that are young of the year. Assuming that most of the harvest of eiders, scoters, and Long-tailed Ducks in the United States consists of wintering birds, that hunters in Canada do not target males but US hunters target them, and that adult males and females winter together, it appears that male scoters and Long-tailed Ducks significantly outnumber females, whereas the Common Eider harvest sex ratio may be due primarily to hunters selecting adult males (Table 12.3).

Adult male sea ducks are obvious to most hunters, but plumage differences between adult females and immature birds of both sexes are subtle. To reduce the effects of hunter selectivity on harvest age ratio estimates, we excluded adult males and present the ratios as immatures to adult females (Table 12.3). However, immature birds are typically more vulnerable to hunting than adults. Thus, although they are correlated with population age structure, these age ratios are indices rather than direct measures (Martin and Carney 1977). With the exception of the White-winged Scoter

TABLE 12.3

Adult sex ratios (males–females) and age ratios (immature birds of both sexes–adult females) of eiders, scoters, and Long-tailed Ducks harvested in Canada and the United States from 2002 through 2011.

	Adult sex ratio		Age ratio		Wings examined	
Species	Canada	United States	Canada	United States	Canada	United States
Common Eider	0.94	2.24	1.65	0.63	1,890	2,485
Black Scoter	2.22	2.93	4.12	2.66	310	1,022
Surf Scoter	0.89	3.55	5.39	2.47	447	2,021
White-winged Scoter	1.24	3.04	3.77	5.36	237	783
Long-tailed Duck	2.85	2.65	6.49	2.22	284	1,528

(but note small sample sizes), harvest age ratios of eiders, scoters, and Long-tailed Ducks are greater in Canada than in the United States (Table 12.2), indicating that the initially naïve immature birds gain experience as they are exposed to hunting during migration to their wintering grounds.

The sex- and age-specific harvest rates that are needed to estimate vulnerability differences among sex and age cohorts are scarce for sea ducks. Joensen (1974) estimated that immature Common Eiders were two to four times more vulnerable to hunters in Denmark than adults. Merkel (2004a) found that eider age ratios were fairly even in Greenland wintering birds, but that harvest was heavily skewed (75%–95%) toward immature birds. In Newfoundland, Gilliland and Robertson (2009) estimated that 60% of King Eiders harvested were immature birds and that immature Common Eiders may have been five times more vulnerable to hunters than adults. However, reliable estimates of age-specific vulnerability are absent for most populations of sea ducks in North America.

Immature female midcontinent Mallards are about 1.75 times more likely to be shot than adult females (Runge et al. 2002). If we assume that vulnerability of immature sea ducks relative to that of adult females is of similar magnitude in the United States, recent productivity of Black Scoters, Surf Scoters, and Long-tailed Ducks is about 1.2–1.6 fledged young of both sexes per adult female. In contrast, the same assumptions yield a low estimate of the annual production rate for Atlantic Common Eiders: 0.36 total fledged young or about 0.18 fledged young females per adult female. The implications of such low productivity with regard to harvest management depend on whether production is density dependent or density independent (Chapter 3, this volume), but the answer to that question is presently unknown.

PACIFIC COAST FALL–WINTER TRADITIONS

Hunting traditions and harvest of sea ducks on the Pacific Coast are greatest in Alaska where breeding and wintering sea ducks are most abundant, less common in British Columbia and Washington, and primarily opportunistic take during hunts of diving ducks in Oregon, California, and Mexico. Undoubtedly, there are local traditions of waterfowl hunting on all bays and estuaries along the Pacific Coast, but popular and technical literature are scarce (Hagerbaumer 1998, Kramer 2003). Some notable historical hunting areas in California with populations of migrant and wintering sea ducks include San Francisco Bay, Tomales Bay, Bodega Bay, and Humboldt Bay. The Oregon Coast has fewer areas with sea ducks, including Coos Bay, Alsea Bay, Yaquina Bay, Siletz Bay, Netarts Bay, Tillamook Bay, and the mouth of the Columbia River. The principal sea duck areas in Washington include numerous sites in Puget Sound and outer coastal bays such as Willapa Bay and Grays Harbor.

Hunting Regulations: Past and Present

Pacific Flyway

In 1948, representatives of western state wildlife agencies, British Columbia, and the federal agencies initiated a collaborative waterfowl program (today, the Pacific Flyway Study Committee) to expand data collection and create a forum for discussing issues about management and harvest of shared populations in the west (Bartonek 1984). With expansion of the *flyway* concept nationwide, the Pacific Flyway Council was established in 1951 to provide policy direction and coordination of programs, as well as formulating state recommendations on US waterfowl hunting regulations. Representatives from the Yukon Territory, Northwest Territories, and British Columbia have worked with the Pacific Flyway Council at the technical level to exchange information and develop complementary management programs.

Unlike the Atlantic Coast where sea duck hunting has been more traditional, historic waterfowl hunting regulations in the Pacific Coast states and British Columbia seldom included special provisions for sea ducks. The one exception was special liberal bag limits for mergansers, based on the rationale of protecting economically valuable fisheries for salmon, trout, and herring. Since 1990, conservation concerns in British Columbia and Washington stimulated bag limit restrictions for Barrow's Goldeneyes, Harlequin Ducks, scoters, and Long-tailed Ducks.

Alaska

Sea duck hunting has been traditional in Alaska, originally as part of year-round subsistence economies of aboriginal groups that depended on diverse resources and later for pioneering immigrants. After Alaska became a territory of the

United States in 1867, early territorial laws were prompted partly in response to a fabricated story in the early 1890s that large numbers of wild bird eggs were being commercially exported from Alaska. Though "The Great Duck Egg Fake" was thoroughly refuted in an 1895 issue of *Forest and Stream* (Sherwood 1977), federal territorial laws adopted in 1900–1902 prohibited the collection and possession of "eggs of any crane, wild duck, brant, or goose" and established the first game bird hunting regulations (Cameron 1929); "Indians, Eskimos, miners, and travelers" in need of food were exempted.

In 1925, Congress passed the Alaska Game Act that established the federally appointed Alaska Game Commission, which adopted waterfowl regulations consistent with the Migratory Treaty Act and prevailing national management regime; sea ducks were included in general duck bag limits. During and after World War II, Alaska experienced unprecedented population growth, including many hunters, adding harvest management challenges. Alaska administratively became part of the Pacific Flyway in 1952 and gained full parity with other states at statehood in 1959.

From the 1940s through the 1960s, many adjustments were made to waterfowl regulations, but the rationale and justifications are largely lost to history. General duck season lengths varied in Alaska, from 40 days in 1948 to 94 days by 1960. In 1950–1953, the first special sea duck seasons (only scoters and eiders) allowed 6–51 days in addition to the general duck season, varying among several regions. From 1954 through 1960, seasons for sea ducks were extended to 105 days, varying from 11 to 30 days longer than the general duck season, and included all *regulatory* sea ducks, including scoters, eiders, Harlequin Ducks, Long-tailed Ducks, and mergansers. From 1950 through 1960, Alaska hunters were allowed to take 10 sea ducks in addition to general limits of 5–7 ducks and an additional limit of mergansers. The merganser limit was 25 birds of all three species in 1950–1952; 25 mergansers, but only one Hooded Merganser in 1953–1956; and five birds daily, 10 birds in possession, but only one Hooded Merganser only in southern Alaska in 1957–1959. Mergansers have been incorporated into the special Alaska sea duck limit since 1960.

Since the first waterfowl regulations were established, deference has been given to limited hunting opportunities in Alaska, similar to accommodations in northern Canada. Seasons cannot be opened before September 1, and most ducks and geese migrate south by late October, leaving only 40–60 days of hunting before freeze-up in most parts of the state. After October, hunting for Mallards and sea ducks settling into coastal wintering areas provides harvest opportunities through the latest seasons. Since 1961, Alaska has had the longest allowable seasons for all ducks (105 days, reinterpreted to 107 days in 1974), running through January 22. A special sea duck limit of 15 daily, 30 in possession, was established in 1961 in further recognition of the limited hunting opportunity in Alaska. In 1999, out of general concern for apparent liberal limits, the federal framework regulations reduced the special sea duck bag limits from 15 birds daily and 30 in possession, to 10 birds daily with 20 in possession.

Hunting Activity

Over the long term, the number of waterfowl hunters has declined in the Pacific Flyway (Figure 12.12), similar to trends across the United States and Canada. The number of active hunters in Pacific states has been relatively stable since 1999, averaging about 140,000 in the past 7 years. In British Columbia and Yukon Territory, permit sales have declined below 7,000 and active waterfowl hunters have averaged <4,000 during the past 10 years.

Implementation of HIP in the United States allowed a first systematic effort to identify and enumerate sea duck hunters for harvest survey sampling, providing the first estimates in 1999 from coastal states that had special sea duck seasons or limits, or required sea duck hunters to obtain special permits. In the Pacific Flyway, sea duck hunter activity and harvest have been estimated in Alaska since 1999. In Washington, HIP has not sampled hunters from a stratum of sea duck hunters, but a requirement to obtain a permit to hunt sea ducks in western Washington has provided hunter and harvest information since 2004. Stratified HIP sampling for sea duck hunters was expanded to Oregon in 2006 and California in 2008. Numbers of hunters hunting sea ducks are not estimated in the Canadian harvest survey.

There are likely <3,000 active sea duck hunters annually in the Pacific Flyway states (Table 12.4), with few in California and Oregon, and perhaps

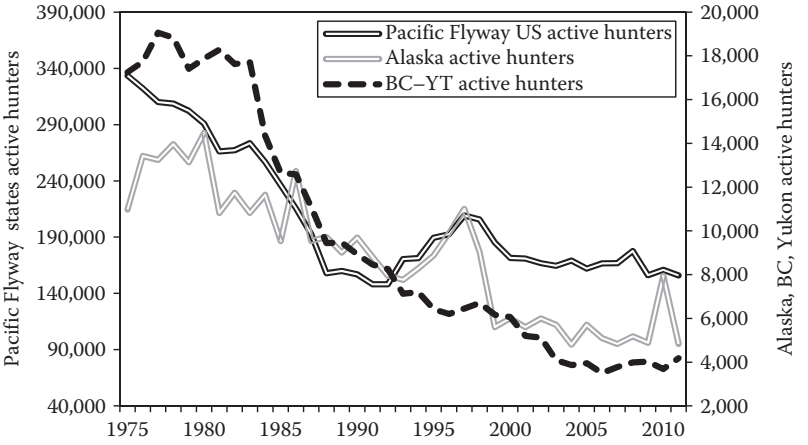

Figure 12.12. Trends in the number of active waterfowl hunters in the lower Pacific Flyway states, Alaska, and British Columbia and Yukon, 1975–2011.

TABLE 12.4
Estimated number of active sea duck hunters in Pacific coast states.

	Active sea duck hunters			Permits[a]
Year	Alaska	California	Oregon	Washington
1999	600			
2000	900			
2001	500			
2002	800			
2003	1,200			
2004	900			906
2005	900			1,359
2006	800		<50	1,861
2007	1,100		<50	1,941
2008	1,100	900	100	2,340
2009	1,100	400	200	2,129
2010	1,300	1,500	200	2,848
2011	600	100	100	1,757
2012	1,200	100	<50	1,895
AVG	929	600	150	1,893

SOURCE: Data from Washington State are holders of western Washington sea duck permits (Washington Department of Fish and Wildlife, unpubl. data).

[a] About 45% of Washington sea duck permittees were active hunters (D. Kraege, pers. comm.).

800–900 hunters in Washington (assuming about 45% of permittees hunt each year; Washington Department of Fish and Wildlife, unpubl. data). In Alaska, an average of about 1,000 hunters reported hunting sea ducks annually since the 1999 inception of HIP. Over the past 10 years, the number of active sea duck hunters has increased by 30%–40%, while the number of total active waterfowl hunters has remained stable around 5,500. Of Alaskan hunters that reported taking sea ducks, over 40% were residents of the Gulf Coast Zone that includes Anchorage, 28% were from southeast Alaska, and 15% resided in Kodiak. Fewer than 200 nonresident hunters reported taking sea ducks (Division of Wildlife Conservation, Alaska Department of Fish and Game, unpubl. HIP enrollment data).

In 2002–2011, Pacific Flyway hunters averaged about 8 days afield annually hunting waterfowl. Hunters in coastal states who indicated they hunted sea ducks spent fewer days hunting than general waterfowlers (California, 4.3 days vs. 10.1 days; Oregon, 1.9 days vs. 8.3 days; Washington, 2–3 days vs. 7.7 days; Alaska, 4.5 days vs. 5.1 days). In these coastal states, sea duck hunters averaged 6.9 sea ducks per season in Alaska, about 4.0 in Washington, 3.6 in California, and 3.4 in Oregon.

Fall and Winter Harvest

Annual HIP estimates of total duck harvest in the Pacific Flyway (including Alaska) averaged 3.04 million ducks in 2002–2011, including 94,000 sea ducks (Table 12.5). Sea duck taxa contributed an average of about 4.3% of total duck harvest in the 11 contiguous Pacific Flyway states. As expected, sea ducks make up 17% of total duck harvest in Alaska where sea ducks are numerous throughout fall and winter, but most dabbling ducks have departed by late October. The flyway harvest of all sea duck

TABLE 12.5

Average annual harvest of sea duck species in the Pacific flyway, 2002–2011.

State	COEI	KIEI	BLSC	SUSC	WWSC	LTDU	HARD	BUFF	COGO	BAGO	COME	RBME	HOME	Total
Alaska	324	60	531	1,418	818	309	1,844	1,416	1,331	2,078	860	981	7	11,977
Arizona	—	—	—	4	—	6	—	932	580	8	233	4	82	1,849
California	—	—	—	1,018	15	25	—	10,136	4,649	141	393	31	965	17,373
Colorado	—	—	—	9	—	—	—	71	1,095	21	98	—	48	1,342
Idaho	—	—	—	8	—	55	14	2,425	7,289	861	340	20	512	11,524
Montana	—	—	—	9	—	—	—	373	1,882	335	350	7	168	3,124
Nevada	—	—	—	7	6	—	—	471	307	8	89	13	72	973
New Mexico	—	—	—	—	—	—	—	13	103	—	70	—	6	192
Oregon	—	—	—	257	30	7	—	10,688	2,203	560	1,395	82	1,803	17,025
Utah	—	—	—	24	10	8	—	2,570	6,683	199	890	312	216	10,912
Washington	—	—	36	2,073	1,075	260	46	6,822	3,962	695	650	109	1,245	16,973
Wyoming	—	—	—	—	—	—	—	211	465	74	14	—	7	771
Coastal states	—	—	36	3,348	1,120	292	46	27,646	10,814	1,396	2,438	222	4,013	51,371
Inland states	—	—	—	61	16	69	14	7,066	18,404	1,506	2,084	356	1,111	30,687
PF Lower 48	—	—	36	3,409	1,136	361	60	34,712	29,218	2,902	4,522	578	5,124	82,058
Pac. Flyway	324	60	567	4,827	1,954	670	1,904	36,128	30,549	4,980	5,382	1,559	5,131	94,035
BC and YT	—	—	—	4	2	—	—	457	214	182	21	—	55	935

species was distributed primarily in California, Washington, and Oregon, each with 18% and Alaska with 13%. Idaho and Utah each harvested 12% of the flyway's sea ducks, largely on the occurrence of Buffleheads, goldeneyes, and mergansers.

Buffleheads and goldeneyes occur widely across North America and constituted 76% of sea ducks harvested in the Pacific Flyway. The harvest of these species creates a seeming paradox where sea ducks made up greater proportions of total ducks in Wyoming (9.1%), Colorado (5.2%), and Idaho (5%) than only 1.2% of California's large harvest of mostly dabbling ducks. In Alaska, 40% of sea ducks harvested were Buffleheads and goldeneyes.

Coastal-oriented species (eiders, scoters, Long-tailed Ducks, and Harlequin Ducks) subject to special regulations in Alaska and western Washington made up only 11% of the Pacific Flyway sea duck harvest. Across individual states, coastal species comprised 44% of sea duck harvest in Alaska, 21% in Washington, and <10% in California and Oregon. Alaska had the highest harvest of each coastal species, except that more Surf and White-winged Scoters were taken in Washington and California (Figure 12.13). Scoters have the greatest harvest among the coastal species, making up over 90% of this group in Washington, Oregon, and California. In Alaska, where sea duck availability and diversity are greater, scoters made up 23% of the sea duck harvest and 52% of coastal species taken. Harlequin Ducks are abundant in Alaska during winter and are managed separately from harlequins in the Pacific Northwest. Harlequins are relatively easy to hunt and made up 15% of the Alaska sea duck harvest and 41% of the Alaska coastal species harvest (Table 12.5).

The HIP survey was designed to accurately measure harvest at the statewide level but provides little information on harvest locations and seasonality. Alaska Department of Fish and Game (ADF&G) conducted mail questionnaire surveys in 1971–1996 that collected data specifically on sea duck harvest and hunting locations. Though the sampling was not robust, 11 years of data indicated that fall and winter sea duck harvest occurred primarily on Kodiak Archipelago (27%), Cook Inlet (26%), and Southeast Alaska (21%) where the majority of wintering sea ducks occur and most of the state's population resides. In addition, sea duck hunting is prevalent along the western Alaska Peninsula, Aleutian Islands, Pribilof Islands, and Saint Lawrence Island, but information on hunting activity and harvest from state and HIP surveys is not sufficient for harvest estimates.

Regional Harvest Issues and Management Responses

Overall, given the healthy status of most sea duck species along the Pacific Coast in fall and winter and relatively low levels of harvest, few concerns have been raised about the effects of hunting on sea ducks at the level of flyway populations.

Barrow's Goldeneye

During the 1980s, research and surveys in British Columbia provided new information on the

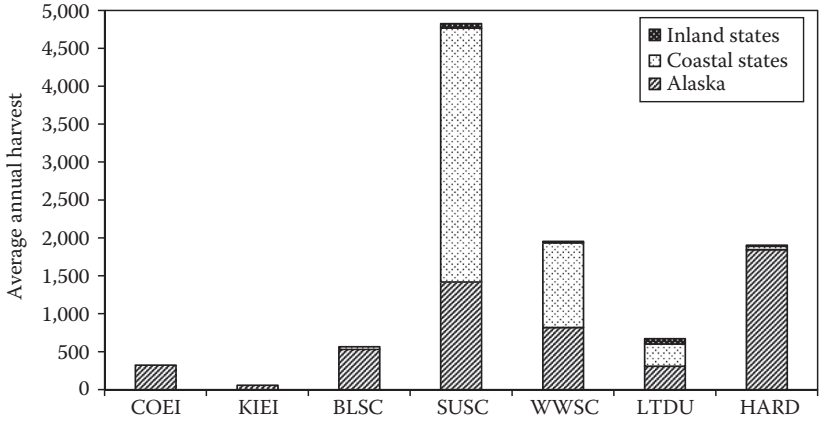

Figure 12.13. Distribution of average annual harvest of coast-oriented sea duck species in the Pacific Flyway across inland states, coastal states, and Alaska, 2002–2011.

numbers, distribution, and biology of Barrow's Goldeneyes in British Columbia and raised interest in the effects of contemporary harvest in the Pacific Flyway. Until recently, it was thought that up to 60% of the global population bred and wintered in British Columbia and that the Pacific population numbered up to 150,000 birds (Eadie et al. 2000). Limited banding data indicated that harvests in British Columbia and perhaps in Washington were derived from birds breeding in the Pacific Northwest (McKelvey and Smith 1990) and the regional harvest of western Barrow's was considered sustainable (Savard 1987).

As geographic coverage of winter waterfowl surveys expanded in Alaska, it has become apparent that more than 165,000 Barrow's Goldeneyes winter from the Gulf of Alaska westward through the Alaska Peninsula and that these birds constitute 85%–95% of all goldeneyes wintering in Alaska (Forsell and Gould 1981; Hodges et al. 2008; B. A. Agler et al., U.S. Fish and Wildlife Service, unpubl. report; A. McKnight et al., U.S. Fish and Wildlife Service, unpubl. report). Collectively, winter surveys indicate that there may be 250,000–300,000 Barrow's Goldeneyes in the western population from Alaska to California.

Recent telemetry work indicates that the Barrow's Goldeneyes breeding in interior British Columbia molt in northwestern Alberta and as far north as Great Bear Lake, NWT, then winter along the coasts of British Columbia and Washington (Boyd et al. 2013). These wintering birds probably define the southern extent of the species range in the west. Concurrent work in Alaska indicates that Barrow's Goldeneyes wintering in Prince William Sound breed in Interior Alaska, with males molting northeast only as far as Old Crow Flats in the Yukon. Barrow's Goldeneyes that were radio-marked near Juneau, Alaska, in spring of 2012 showed a breeding distribution in between the central Alaska birds and the British Columbia birds. Taken together, these studies indicate several regional affiliations of western Barrow's Goldeneyes, with only rare mixing of British Columbia and Washington birds with the abundant Alaska-wintering birds. Recent analyses of genetics and band recoveries indicate shallow structuring among western Barrow's Goldeneyes and low interchange between Alaska and British Columbia birds (Pearce et al. 2014).

As a precaution for regional Barrow's Goldeneyes, bag limits in British Columbia were restricted in 1990 to no more than two goldeneyes daily and four birds in possession within a general duck limit of eight ducks per day. In 2010, the aggregate bag limit for goldeneyes in western Washington was reduced to two birds per day as part of a broad sea duck harvest strategy that recognized the small number of Barrow's wintering in the state (Washington Department of Fish and Wildlife, unpubl. report).

The harvest of western Barrow's Goldeneyes is difficult to assess because, like many sea duck species, the number of wing samples submitted to the national harvest surveys is low and harvest estimates are variable. Since 1999, the HIP survey has estimated an average of 700 Barrow's Goldeneyes harvested in the entire state of Washington, and estimates based on state permit reports indicate a harvest of about 110 in western Washington. Several hundreds of Barrow's Goldeneyes are harvested annually in Idaho, Montana, Oregon, and Utah.

In western Canada, western Barrow's Goldeneyes are harvested in Yukon Territory, British Columbia, and Alberta; harvest of the species has declined substantially in each of these jurisdictions. Prior to 1990, combined harvest averaged 2,800 birds, with 85% occurring in British Columbia. The most recent 10-year average harvest of Barrow's Goldeneyes in the western provinces is <400 birds. Much of the decline in harvest likely reflects a steep drop in active waterfowl hunters in western Canada since the early 1980s (Figure 12.12). In British Columbia, however, implementation of a 2-bird bag limit in 1990 also may have contributed to harvest reduction. The most recent 10-year average harvest of western Barrow's Goldeneyes in British Columbia is about 155 birds, <50% of the species total of western provinces.

Harlequin Duck

Significant declines in Harlequin Ducks in eastern North America stimulated several investigations and surveys of the species on the Pacific Coast from British Columbia to Oregon during the 1990s (Robertson and Goudie 1999). Losses of many Harlequin Ducks during the *T/V Exxon Valdez* oil spill in the spring of 1989 led to several studies of breeding ecology, food habits, and seasonal distribution of Harlequin Ducks along the Gulf of Alaska coast.

Banding and survey programs on western Harlequin Ducks produced substantial evidence of a Rocky Mountain–Northwest Coast (RMNWC) component that breeds from British Columbia, Washington, and Oregon eastward to Colorado, Wyoming, and Alberta and winters along the British Columbia and Washington coasts (Pacific Flyway Study Committee, unpubl. report). Incomplete surveys of these birds suggest about 15,000–20,000 Harlequin Ducks wintering south of Alaska to Oregon (Robertson and Goudie 1999). Banding and telemetry data provide little evidence of exchange between these birds and the nearly 250,000 Harlequin Ducks wintering in Alaska (Forsell and Gould 1981; Byrd et al. 1992; Hodges et al. 2008; B. A. Agler et al., unpubl. report; C. P. Dau and E. J. Mallek, U.S. Fish and Wildlife Service, unpubl. report; A. McKnight et al., unpubl. report).

Concerns about low abundance, low productivity, and potential vulnerability to hunting of RMNWC Harlequin Ducks in winter stimulated regulatory restrictions, first in British Columbia with daily limits of harlequins reduced from eight to six concurrent with goldeneye reductions. In 1998, Washington adopted Harlequin Duck limits of one bird per day and one in possession within the seven-duck general limit. British Columbia followed suit in 2000 with reduced harlequin limits of two birds per day and four in possession within a daily limit of eight ducks. Washington further reduced the Harlequin Duck limit to only one bird per season in 2004 (Washington Department of Fish and Wildlife, unpubl. report). In 2012, possession limits in British Columbia were increased to three times daily limits (up to six Harlequin Ducks).

The former mail questionnaire survey and HIP surveys have registered only trace estimates of Harlequin Duck harvest in a few Pacific Flyway states, including rare records in Idaho, Montana, and Colorado. Since 1999, HIP estimated a harvest of only 70 birds in Washington State. Western Washington permit hunt data for 2004–2012 show an average of 134 Harlequin Ducks were taken per year under the 1-bird limit. Harlequin Ducks wintering in Puget Sound have been relatively stable at 3,000–4,000 birds since 1995 (Washington Department of Fish and Wildlife, unpubl. report).

Northwest Scoters and Long-tailed Ducks

Over the past 20 years, the WDFW, USFWS, CWS, and the province of British Columbia increasingly have collaborated to assess the status of wintering sea ducks from Georgia Strait south through Puget Sound, broadening conservation programs beyond initial focus on Harlequin Ducks and Barrow's Goldeneyes. The efforts were supported by cooperative international programs initiated to address increasing regional environmental and economic issues, including human encroachment on coastal areas and environmental hazards (Mahaffy et al. 1994). As part of the Puget Sound Ambient Monitoring Program, later renamed Puget Sound Ecosystem Monitoring Program, the WDFW has conducted aerial and boat surveys of wintering sea ducks since 1992 (D. R. Nysewander et al., Washington Department of Fish and Wildlife, unpubl. report). The resulting survey program was integrated with prescriptive harvest guidelines and other management actions in 2010 and updated in *Sea Duck Management Strategies* (Washington Department of Fish and Wildlife, unpubl. report) focused on sustaining the number of wintering scoters in the sound and avoiding redirection of harvest to Barrow's Goldeneyes and Long-tailed Ducks.

In 1998, Washington State established special sea duck restrictions, limiting daily bag limits to no more than four birds each of scoters, Long-tailed Ducks, and Harlequin Ducks within the general daily limit of seven ducks in western Washington. In 2004, in order to develop better harvest information, Washington Fish and Wildlife Commission required sea duck hunters in western Washington to obtain a license permit to identify participants and to report their sea duck harvest. The 1998 bag limit restrictions for scoters prevailed until the 2010–2011 season, when wintering scoters had dropped below the management threshold of 75,000; daily species limits were reduced to two scoters and two Long-tailed Ducks. In addition, goldeneyes were added as a restricted species with two birds per day.

The number of scoters wintering in Puget Sound has declined by over 50% since 1995 to about 50,000 birds (Washington Department of Fish and Wildlife, unpubl. report). Since 2004, state survey data indicate that average scoter harvest declined in western Washington from 2,300 under the 4-bird limit to about 1,300 in 2010–2012 under a 2-bird limit. Since 2010, the harvest of goldeneyes also declined, perhaps by half, to <400 birds (~60% Common Goldeneyes).

Alaska Sea Duck Conservation Concerns

Alaska has abundant sea ducks year-round, during migration, breeding, and wintering periods, and in general, harvest of sea ducks has been low in relation to the number of birds found throughout the state. A few situations have raised conservation concerns resulting in restrictions of sea duck hunting. The T/*V Exxon Valdez* oil spill killed large numbers of scoters, goldeneyes, Harlequin Ducks, and Long-tailed Ducks during spring migration through Prince William Sound and later near the Kodiak Archipelago, in Lower Cook Inlet, and westward along the Alaska Peninsula (Piatt et al. 1990, Piatt and Ford 1996).

The most prominent concern was the resulting reduction of resident breeding Harlequin Ducks in Prince William Sound and potential impacts of additional mortality from harvest. The prevailing sea duck season had opened September 1 with bag limits of 15 birds/day and 30 in possession. From 1991 through 1998, the Alaska Board of Game delayed the opening of Harlequin Duck season by 1 month to October 1 and imposed a limit on Harlequin Ducks of two birds per day and six in possession in Prince William Sound. The restrictions were deemed necessary to promote restoration of Harlequin Ducks breeding in the sound, but pre- and postspill harvest surveys lacked scope and accuracy to detect effects of these regulations on harvest. State and federal harvest survey data suggest that prespill harvest of Harlequin Ducks from fall and winter aggregations may have been <200 birds in the entire Gulf Coast Zone, based on an average annual harvest of 500 sea ducks, including about 15% Harlequin Ducks (Alaska Department of Fish and Game, unpubl. data; U.S. Fish and Wildlife Service, harvest survey).

In 1990, a petition was filed with USFWS to list Spectacled Eiders (*Somateria fischeri*) and Steller's Eiders (*Polysticta stelleri*) under the Endangered Species Act. Hunting seasons for both species were closed statewide in 1991. In May 1993, Spectacled Eiders were listed as threatened rangewide (U.S. Fish and Wildlife Service 1993). In August 1993, the USFWS determined that rangewide listing was not warranted for Steller's Eiders because substantial numbers breed in Russia and winter along the Alaska Peninsula. In 1997, Alaska-breeding Steller's Eiders were listed as threatened, based on a significant reduction in range in western Alaska (U.S. Fish and Wildlife Service 1997).

Evaluation of the role of harvest in historical declines or during recovery is difficult for these species. Harvest has not been implicated as a primary cause of critical population declines (U.S. Fish and Wildlife Service, unpubl. reports), but minimizing harvest is an important part of recovery programs for the listed populations. Historical harvest data from USFWS harvest surveys are sparse; there have been no records of Spectacled Eider wings in the wing survey, which have been conducted in Alaska since 1965, and therefore no means to detect or estimate harvest among surveyed hunters. Steller's Eider wings have been recorded in only 10 years since 1965, and harvest estimates average <100 birds/year. Since the 1991 season closure, an annual average of 0.1 wings of Steller's Eiders have been submitted to the wing survey, providing a projected total statewide harvest of 3.7 birds. These data illustrate the difficulty in estimating harvest of birds that occur in remote areas where access is limited for nonlocal hunters. Harvest of Spectacled and Steller's Eiders in Alaska is documented primarily from subsistence hunters that have access to these birds but are rarely sampled in the federal and state mail questionnaire surveys linked to hunting license sales.

Federal reductions in Alaska sea duck bag limits were implemented in 1999 and arose from general caution about harvest of sea duck species that have relatively low recruitment rates and the appearance of liberal limits. In an effort to reduce impacts for Alaska residents, the Alaska Board of Game set regulations for nonresident hunters to be a season limit of 20 sea ducks, including no more than four birds of each species. In 2001, the state capped Harlequin Duck and Long-tailed Duck limits for resident hunters at 6 birds/day and 12 in possession.

Similar to situations in other coastal areas where community development, seafood harvesting, and public recreation have expanded, hunting has stirred conflicts among user groups and with local residents in a few areas of the southern Alaska Coast. Kachemak Bay, within a 4 h drive from populous Anchorage and the Matanuska-Susitna Valley, has been a traditional sea duck hunting area for many years. Over the past 20 years, controversy has continued about potentially increasing numbers of duck hunters and hunting guides, the nature of sea duck hunting practices, and the importance of local winter aggregations of sea ducks to manageable population units. In 2010,

the Alaska Board of Game reduced daily bag limits in Kachemak Bay to one eider, two Harlequin Ducks, and two Long-tailed Ducks. The ADF&G has conducted multiyear surveys to assess changes in wintering sea duck abundance in the bay, but conventional harvest surveys cannot provide insights on the effects of local regulations. The restriction of one eider per day is not likely to affect harvest because King and Common Eiders are rare in Kachemak Bay but 2-bird limits are likely to reduce the local harvest of Harlequin and Long-tailed Ducks.

Changing Coastal Environments and Hunting

Concerns are growing about human encroachment, commercial exploitation of coastal resources, habitat degradation, and hunting pressure in some staging and wintering areas. Expanding residential and commercial development, more intensive recreational activities, and increasingly diverse uses of coastal lands and waters not only affect habitat quality for sea ducks but also have resulted in steady losses of accessible hunting areas and local harvest traditions. As a result of broad biological uncertainties about sea duck populations, provincial and state management agencies and public interest groups have taken steps to maintain levels of winter aggregations in many areas through zoning of hunting and other activities and through conservative harvest regulations for sensitive areas such as Kachemak Bay, the Fraser River Delta, and Puget Sound.

NORTHERN SUBSISTENCE TRADITIONS

Subsistence Economies in the North

Historically and to this day, the harvest of birds is an important activity for subsistence cultures in Alaska and Canada (Figure 12.14). Birds constitute a small proportion of the total subsistence harvest in Alaska (Wolfe and Walker 1987), which is estimated to be 3% of 1.2 million edible pounds/year (J. A. Fall, unpubl. report), but the timing of harvest is important. In spring, when food supplies are depleted, the arrival of migratory birds brings relief until other subsistence resources such as fish and caribou become available. Fall and winter harvest is also important in some areas. Birds are a special treat and bring diversity to the subsistence diet, which tends to be monotonous. Besides nutritional aspects, bird harvesting also has cultural and social importance for these communities. Subsistence harvest is widely shared in the communities; numbers of users of these resources are much larger than numbers of harvesters.

Originally, Arctic and sub-Arctic peoples lived in small, nomadic groups moving across landscapes following the seasonality of biological resources. In the early 1900s, demographic and socioeconomic developments such as construction of schools and trading posts and population reductions caused by disease led to aggregation of people in villages or rural communities. The seasonal rounds of hunting, fishing, and gathering that still are a main characteristic of life in these communities date back thousands of years, although the congregation in villages likely affected original patterns of wildlife uses. In recent decades, most subsistence bird hunting is done with shotguns and aluminum skiffs, although some older harvest methods are still used in small scale. Hunting gear is owned and operated by family groups.

Some subsistence bird hunts are specialized, but bird hunting is commonly a supplemental and opportunistic activity done in conjunction with pursuits such as whaling, seal and walrus hunting, berry picking, travelling, or wood gathering. In most areas, bird hunting decreases or stops during summer because of other subsistence activities such as fishing and because of traditions of letting birds alone to breed. In contrast to most fall and winter hunting that includes recreation and food gathering, subsistence hunting is based on needs and optimizes harvest efficiency. Most bird parts are considered edible including head, feet, gizzard, heart, liver, and brain. For instance, the fatty bill knobs of male King Eiders are especially appreciated by some people (Wolfe and Paige 1995). Patterns of subsistence uses of birds, including sea ducks, are shaped by species distribution and seasons of occurrence and interactions with use patterns of other subsistence resources. Sea ducks are widely accessible as subsistence resources to northern peoples. In some regions, sea ducks represent the bulk of harvest: eiders on the coast and scoters inland.

History of Regulations and Public Involvement

In the seventeenth and eighteenth centuries, British, French, Spanish, and Russian explorers brought changes to indigenous cultures and

Figure 12.14. Regions relevant for the understanding and management of subsistence harvest in Alaska and northern Canada. Alaska regions followed U.S. Code of Federal Regulations (Title 50 Part 92.5). Canada regions were based on modern land claims agreements. (http://www.landclaimscoalition.ca/, accessed 22 January 2014; Map prepared by the ADF&G Division of Subsistence, Anchorage.)

introduced large-scale commercial harvest of fish and wildlife. In Alaska, indigenous peoples, trappers, whalers, miners, and immigrants harvested waterfowl and other wildlife for food and commerce. There was little regulation of hunting and fishing, if any, until 1900 when federal laws prohibited egging and destructive harvesting. The earliest US federal laws barely recognized the extensive waterfowl harvest by Alaska Native peoples, granting only that Indians, Eskimos, and travelers could take what they needed for food.

The 1916 Convention between the United States and Canada guided regulation of hunting, but provisions for subsistence hunting in the north were narrow and did not match customary and traditional practices. The Convention set an annual closed hunting season on migratory game birds between March 10 and September 1 for their protection during the breeding season. However, the closed season banned waterfowl hunting when most traditional harvest occurred: spring migration when food storages were depleted, summer molt migrations and aggregations of flightless birds, and early fall migrations. Perceptions of species that were taken for food and deemed appropriate for harvest were narrowly defined in Article II stating that Eskimos and Indians could take scoters and several species of nongame seabirds and their eggs at any time for food. Article IV provided specific protections for eiders by a 5-year closed season, establishing refuges and other rules to restrict harvest. The treaty recognized the importance of scoters, eiders, and some seabirds in the seasonal rounds of subsistence activities across northern North America, but it outlawed harvest of cranes, swans, geese, 19 common species of ducks (including seven species of sea ducks), and dozens of other migratory species that have been traditionally taken across Alaska.

Federal laws implementing the treaty in Canada and the United States made most traditional spring–summer migratory bird hunting illegal and set increasingly restrictive regulations for the fall–winter hunts (September 1–March 10). Despite the spring–summer hunting closure, harvest continued as an activity essential for subsistence. Decades of law enforcement issues, community hardships, and the inability to assess and manage these harvests prompted considerations to create legal, managed seasons involving subsistence users in the management process. In Canada, a Supreme Court decision (R. v. Sparrow, 1990 Can LII 104 SCC) affirmed that subsistence harvest of migratory birds by aboriginal peoples is an assured right under section 35(1) of the Constitution Act of 1982. In 1995, the United States and Canada agreed on a protocol to amend the treaty, which was ratified by the US Senate in 1997. A similar treaty between United States and Mexico was subsequently amended to be consistent with the Canada treaty. The purposes of these amendments were to sustain migratory bird populations through guiding conservation principles and legally recognize traditional spring and summer subsistence harvest, including constitutional rights in Canada and authorization of regulated spring–summer subsistence hunts in Alaska.

Implementation of the amended treaty in the United States directs that subsistence hunting in Alaska is to be incorporated in national management processes, provided that (1) subsistence harvest remains at traditional levels relative to the size of bird populations, (2) subsistence harvest data are integrated with flyway and national harvest management programs, and (3) regulatory processes for all migratory bird hunting are inclusive to users and responsive to conservation needs. Incorporation of Alaska's indigenous inhabitants into the management process was established through the formation of the Alaska Migratory Bird Co-Management Council (AMBCC) in 2000. The AMBCC includes representatives from the USFWS, ADF&G, and regional Alaska Native entities (FR 65(60): 16405–16409). An Alaska spring–summer subsistence season (April 2–August 31) has been authorized annually since 2003. The fall and winter migratory bird hunt (starting September 1) is managed under 50 Code of Federal Regulations Part 20, covering all states including Alaska.

In Canada, wildlife harvest is a component of comprehensive settlement agreements, which have been finalized or are under negotiation with First Nations and Inuit peoples. These agreements recognize the importance of traditional and cultural wildlife harvest and commonly include detailed harvest studies as part of their implementation. First Nations and Inuit peoples have preferential access rights to natural resources and wildlife within their jurisdictions, and their needs must be considered first before allocations for other hunters are set in conventional regulations. Wildlife management in First Nations and Inuit jurisdictions is generally undertaken within a comanagement board structure (Berkes 2009).

Subsistence Harvest of Sea Ducks in Northern Canada

Data Sources for Subsistence Harvest in Canada

Aboriginal peoples (First Nations, Inuit, and Métis) are not required to obtain a migratory bird hunting permit when harvesting waterfowl in traditional territories; therefore, their harvest is not captured in the national harvest survey. Reports of bands recovered in subsistence harvest are sporadic and depend on individual and community attitudes toward marking birds. Attempts to quantify subsistence use of birds and eggs in northern Canada have employed harvest logbooks or calendars, where hunters are asked to report their harvest of all fish and wildlife species over a period of time. Some studies have used interviews to validate or complement the data. However, these studies have been primarily designed to assess harvest of large game, such as caribou and marine mammals involving few species and of which a small number of animals are taken annually by individual hunters. On the other hand, a diversity of bird species may be hunted in relatively large numbers, which makes species identification and recall issues more prominent in bird harvest assessments.

Subsistence Harvest Patterns in Canada

Of the sea ducks present in coastal regions of Canada's north, the Common Eider is the species harvested in highest numbers. Large body size and relatively high abundance at certain times of the year make eiders an important subsistence resource. King Eiders make significant contributions to harvest only in the western portions of the Arctic. Long-tailed Ducks are taken in small numbers.

Generally, the first opportunity to harvest eiders is during spring migration. Spring hunting traditions occur in areas where eiders reliably congregate in open water patches such as near the community of Holman, on Victoria Island (Fabijan et al. 1997, Byers and Dickson 2001). Egging is important in communities close to breeding colonies, such as those on Belcher Islands, Hudson Strait, and coastal Labrador (Reed 1986). Adult birds are taken during the breeding season as well. Fall harvest is important in some regions, especially where migration routes take birds close to shore. Communities in the Belcher Islands have the opportunity to hunt Common Eiders, King Eiders, and Long-tailed Ducks during winter in polynyas and shore leads (Gilchrist and Robertson 2000). At inland sites, scoters are an important supplement to spring and summer diets. In the western Northwest Territories, most scoter harvest occurs in spring (May, Gwich'in Renewable Resource Board 2009). On the north shore of the Gulf of St. Lawrence, scoters are harvested by Innu people in spring when birds stage in marine waters before continuing migration toward inland breeding grounds. Scoters then move inland into Québec and Labrador, where Innu hunt scoters and other waterfowl at traditional early open water sites known as *Ashkui* (Sable et al. 2006). The following paragraphs refer to the harvest data available for several regions, from east to west along the coast, and then for the interior of northern Canada.

In a comprehensive recall harvest survey conducted in 2007 in Nunatsiavut (the Inuit region of Labrador), almost all households in Inuit communities were surveyed (Natcher et al. 2011). The Common Eider (2,608 birds/year), Surf Scoter (745 birds/year), Black Scoter (615 birds/year), and White-winged Scoter (86 birds/year) were among the bird species harvested in the largest numbers and were taken mainly in spring (Natcher et al. 2011). Egg harvest estimates in 2007 included 4,019 eggs from the nests of Common Eiders (Natcher et al. 2012).

In Nunavik (the Inuit region of northern Québec), estimates are available for 1973–1980 (James Bay and Northern Québec Native Harvesting Research Committee 1988). The average estimated duck harvest (species combined) was 12,970 birds/year (range 8,258–14,851), and was comprised of eiders (79%, 10,246 birds/year), scoters (10%, 1,297 birds/year), and mergansers (6%, 778 birds/year). The average estimated harvest of duck eggs was 35,421 eggs/year (range 11,189–111,322). Egg harvest was not identified to species, but eggs of Common Eiders likely represented the vast majority of the take: the subspecies *borealis* is available to communities in the Hudson Strait, while Common Eider eggs taken by communities in eastern Hudson Bay are mostly of the *sedentaria* subspecies.

The Nunavut Wildlife Harvest Survey provides estimates for all Inuit harvest in the territory of Nunavut in 1996–2001 (Priest and Usher 2004). The annual average eider harvest was 6,000

birds/year (range 5,004–6,387) including mostly Common Eiders and a small proportion of King Eiders. Other sea duck species were taken in low numbers: Common Mergansers (117 birds/year), Long-tailed Ducks (100 birds/year), Surf Scoters (11 birds/year), White-winged Scoters (9 birds/year), Red-breasted Mergansers (9 birds/year), and Black Scoters (5 birds/year). The estimated egg harvest included 7,909 eider eggs/year (range 4,446–11,669, Priest and Usher 2004). Some estimates from this survey seem low when compared to other studies. For example, 1982 harvest estimates included 6,000 eiders alone in the Belcher Islands, 554 eiders in the High Arctic, and 8,067 eiders in the Low Arctic (Donaldson 1984, Reed and Erskine 1986).

In the Inuvialuit Settlement Region (western Canadian Arctic), eider harvest averaged 3,446 birds/year in 1988–1994 (range 1,804–5,013, Fabijan et al. 1997). The community of Holman accounted for most of this harvest, composed of King Eiders taken in June (96%) and Pacific Common Eiders (*v-nigra*). In 1996–1998, a follow-up study was conducted in Holman to provide a detailed assessment of the harvest (Byers and Dickson 2001). Total harvest mortality (including wounding losses) ranged from 2,517–2,801 King Eiders and 19–29 Common Eiders annually, which corresponds to 3.7%–6.9% and 0.3%–0.9% of the populations migrating past Holman in those years. Wounding losses were low in years with extensive sea ice (3.2%–9.1%) but increased in one year with extensive open water (13.0%–20.0%). Sex ratios in the harvest reflected those in the population (Byers and Dickson 2001).

At inland sites south of the tree line, First Nations peoples take species such as scoters, goldeneyes, and mergansers. Harvest data for these areas are sparse, but in 1995–2001, a comprehensive study was conducted in the Gwich'in Settlement Area (far northwestern Northwest Territories and south of the Inuvialuit Settlement Region, Gwich'in Renewable Resource Board 2009). White-winged and Surf Scoters, collectively referred to as "black ducks" by Gwich'in people, were taken in the largest numbers (717 birds/year, range 452–1,002) and the majority of the harvest occurred at Fort McPherson. Other sea ducks harvested were goldeneyes (14 birds/year, range 0–61) and Long-tailed Ducks (7 birds/year, range 0–34). Harvest of sea ducks occurred mostly in May (Gwich'in Renewable Resource Board 2009).

A 1983–1984 study in the Cree community of Pinehouse (central Saskatchewan) likely represents typical annual harvest levels of communities in boreal forests of the prairie provinces. Harvest included 332 unspecified scoters, 179 Common Goldeneyes, 142 Surf Scoters, 139 Red-breasted Mergansers, 119 Common Mergansers, 36 Buffleheads, 16 unspecified mergansers, 13 White-winged Scoters, and 3 Black Scoters (Tobias and Kay 1994).

Subsistence harvest studies in the Hudson Bay and James Bay Lowlands of Ontario and Québec partitioned duck harvest into only three species: Mallards, American Black Ducks, and Northern Pintails. Other species, including sea ducks, were considered of minor importance and likely had low levels of harvest. Bird harvest by the Cree people in this area was largely composed of geese (Berkes et al. 1994).

Regional Management Topics

Subsistence harvest of Common Eiders in northern Canada is substantial, and harvest of the different subspecies needs to be considered in studies of population ecology. The *borealis* subspecies of Common Eiders are also subject to large fall and winter harvest in southern Canada and to recreational, subsistence, and commercial harvest in Greenland (Gilliland et al. 2009), where a significant portion of the Canadian breeding population winters (Mosbech et al. 2006). The Greenlandic harvest of *borealis* Common Eiders became a major management concern because population trends and modeling suggested the harvest was not sustainable (Merkel 2004b, Gilliland et al. 2009). Harvesting in Greenland is different than in northern North America, as the major harvest is done by Greenlandic harvesters that are allowed to sell their harvest in community markets (Merkel and Christensen 2008). Therefore, harvest regulations not only impact harvesting opportunities but also cash income in these isolated communities. Harvest limitations were implemented in 2002, substantially reducing the harvest from 52,000 to 84,000 eiders harvested annually between 1993 and 2001 to between 18,000 and 27,000 eider taken annually in 2002–2010 (Merkel and Christensen 2008, Greenland Home Rule 2013). Reduced levels of harvest were projected to be sustainable and even lead to population growth (Gilliland et al.

2009), and the Greenlandic breeding population of Common Eiders has shown signs of recovery (Merkel 2010, Burnham et al. 2012). Changes in regulations should lead to reduced harvest pressure on Canadian breeding eiders wintering in Greenland, but detecting a positive response from this reduced harvest pressure was not possible as large-scale outbreak of avian cholera in the early 2000s overwhelmed the dynamics of northern Common Eider populations in eastern Canada (Descamps et al. 2012). Egg collecting has also led to the apparent decline of eider colonies close to some communities (Cooch 1986), and so efforts have been made to manage the harvest through education and promotion of egging practices that minimize impact to colonies.

The harvest and relationships that the Inuit of the Belcher Islands have with the *sedentaria* population that spends the entire year in that region are a special case. The *sedentaria* subspecies occurs only in Hudson Bay and harvests by other communities are minimal. Therefore, the management of this subspecies can be done at a relatively local level. Harvest of eiders can be significant at the Belcher Islands (Reed and Erskine 1986), but is likely sustainable unless winter kill or other factors cause additional mortality (Robertson and Gilchrist 1998). Recent aerial surveys indicate that large numbers of eiders winter in ice leads well beyond the reach of the community of Sanikiluaq creating a natural refuge for this population (Gilchrist et al. 2006).

Important harvest in the western Arctic of Pacific Common Eiders (*v-nigra*) and King Eiders has generated management concerns for these populations (Suydam et al. 2000). Harvest of King Eiders that migrate past Holman (Victoria Island) may take 4%–7% of the regional subpopulation but is thought to be sustainable (Byers and Dickson 2001). This population of eiders is not hunted elsewhere in Canada (Fabijan et al. 1997) but is hunted in Alaska's North Slope (Braund 1993a,b) and Yukon–Kuskokwim Delta (C. Wentworth, unpubl. report) and also in eastern Russia, where harvest levels are unknown but suspected to be relatively high (E. Syroechkovski, Jr. and K. B. Klokov, IPEE RAN, unpubl. report).

Given the overall concerns for scoter populations in North America, subsistence harvest needs consideration. However, the overall take of scoters in the northern subsistence harvest in Canada is likely small, on the order of 10,000 annually, and probably not a major factor driving population decreases.

Subsistence Harvest of Sea Ducks in Alaska

Data Sources for Subsistence Harvest in Alaska

Until the mid-1980s, research on subsistence harvest was qualitative and focused on methods of harvest and uses, seasonal rounds, and patterns of sharing. Quantification of subsistence harvest developed as management systems for biological resources emerged and became more complex, and economic development initiatives progressively overlapped subsistence regions. Until the 1990s, surveys referred to categories of birds (ducks, geese, seabirds) and some subcategories are still used (eiders, scoters). Wolfe et al. (1990) compiled the first statewide subsistence bird harvest estimates referring to bird categories, and Paige and Wolfe (1997, 1998) provided estimates at the species level. In the mid-1990s, the estimated harvest was 63,301 sea ducks/year and represented 32% of the total duck harvest and 17% of the total bird harvest in the state (Table 12.6).

Annual harvest monitoring for waterfowl in 1980–2002 started in the context of the Yukon–Kuskokwim Delta Goose Management Plan (Copp and Roy 1986; Pamplin 1986; Zavaleta 1999; C. Wentworth, unpubl. report). The AMBCC harvest monitoring program started in 2004 to meet the intentions of the amended Migratory Bird Treaty and relies on collaboration among USFWS, ADF&G, and Alaska Native partners (Reynolds 2007; Naves et al. 2008; Naves 2010, 2012). The AMBCC survey covers 193 rural communities in 10 regions (population of 89,481; U.S. Census Bureau 2011). Regions have been surveyed depending on annual management priorities and funding availability. Harvest reports are completed by face-to-face interviews conducted by local surveyors. Survey seasons are spring (April 2–June 30), summer (July 1–August 31), and fall (September 1–October 31; not done in the North Slope, because birds out-migrate in late summer). Winter surveys (November 1–March 9) are done in southern coastal Alaska (Gulf of Alaska–Cook Inlet, Kodiak Archipelago, Aleutian–Pribilof Islands, and South Alaska Peninsula), a wintering area for many species, including sea ducks.

Harvest estimates presented in this chapter were based on AMBCC data (2004–2012; 368 community-years) complemented by data generated by the ADF&G Division of Subsistence (1993–2011; 50 community-years; Table 12.7).

TABLE 12.6
Alaska subsistence harvest of sea ducks and fall and winter harvest in the Pacific flyway.

	Alaska subsistence harvest			Fall–winter harvest[a] (2002–2011 average)	
	Mid-1980s–Early 1990s	1996[b]	2011[c]	Alaska	Pacific flyway, Lower 48
Steller's Eider	313[d]	438	230	0	0
Spectacled Eider	896[d]	1,127	222	0	0
King Eider	11,138[d]	16,469	16,203	60	0
Common Eider	4,204[d]	6,919	4,460	324	0
Harlequin Duck	—	2,217	2,080	1,844	60
Surf Scoter	—	967	2,765	1,418	3,409
White-winged Scoter	—	3,506	7,538	818	1,136
Black Scoter	—	8,451	11,617	531	36
Scoter (unidentified)	—	4,689	0	0	0
Long-tailed Duck	—	10,341	4,020	309	361
Bufflehead	—	3,916	3,782	1,416	34,712
Goldeneye	—	6,973	7,252	3,400	32,000
Merganser	—	1,977	1,556	1,900	5,000
Total sea ducks	—	63,301	61,725	11,977	94,035
Total ducks	210,448[e]	197,577	—	70,138	2,970,620
Total birds	307,242[e]	371,223	342,778[f]	79,931	3,370,600

NOTES: Total birds in "[a]," "[b]," and "[e]" did not include resident grouse and ptarmigan. —, data not available.

[a] S. M. Olson and R. E. Trost, U.S. Fish and Wildlife Service, unpubl. report; U.S. Fish and Wildlife Service Harvest Information Program (HIP) report series. Available online http://www.fws.gov/migratorybirds/NewReportsPublications/HIP/hip.htm. Accessed January 13, 2014.
[b] Paige and Wolfe (1998).
[c] Present study.
[d] Wolfe and Paige (1995).
[e] Wolfe et al. (1990).
[f] 2004–2010 average based on AMBCC data, including resident grouse and ptarmigan (L. C. Naves, Alaska Department of Fish and Game Division of Subsistence, unpubl. data).

The analyses are intended to portray current sea duck harvest levels and therefore did not include older surveys, except for 19 community-years (CSIS, 1993–1997) poorly represented in more recent data. The regions most represented in the dataset were Yukon–Kuskokwim Delta, Bering Strait–Norton Sound, and North Slope, and the regions least represented were Northwest Arctic, Kodiak Archipelago, and Aleutian–Pribilof Islands. Studies including harvest surveys may have different objectives and methods: sampling methods, species categories, definition of seasons, availability of seasonal estimates, and geographic scale for reporting. Studies combining data from different sources, such as estimates presented here, are constrained by compatibility issues and usually include only a subset of the data potentially available.

We present annual average harvest estimates at region and statewide levels, and used them to estimate harvest for the reference year 2011. Data were not available to assess and account for wounding losses in harvest estimates. Average estimates were generated for communities with >1 year of data. Within subregions, average community estimates were expanded to nonsurveyed communities by the following equation:

$$\text{Subregion harvest} = \text{Sum of average community harvest} \times \left(\frac{\text{Total households in subregion}}{\text{Households in surveyed communities}} \right)$$

where the number of occupied households per community was based on results of the U.S.

TABLE 12.7
Dataset used to generate sea duck subsistence harvest estimates for Alaska.

	Gulf of AK–Cook Inlet	Kodiak Archipelago	Aleutian–Pribilof Is.	Bristol Bay	Y–K Delta	Bering Strait–Norton Sound	NW Arctic	North Slope	Interior AK	Upper Copper River	Total
1993	—	3	—	—	—	—	—	—	—	—	3
1994	—	—	2	—	—	—	1	—	—	—	3
1996	—	—	4	—	—	—	2	—	—	—	6
1997	—	2	—	—	—	—	5	—	—	—	7
2004	4	—	—	13	16	11	—	—	18	6	68
2005	1	—	3	15	24	9	—	7	9	—	68
2006	2	4	—	1	24	—	4	—	19	—	54
2007	—	—	1	12	20	11	—	4	8	5	61
2008	—	—	4	8	14	—	—	4	2	—	32
2009	—	—	—	—	18	2	—	3	—	1	24
2010	2	5	—	1	15	7	—	—	20	2	52
2011	—	—	—	6	13	2	1	1	14	—	37
2012	—	—	—	—	—	2	1	—	—	—	3
Community-years	9	14	14	56	144	44	14	19	90	14	418
Communities in region	5	12	12	27	47	16	11	8	43	8	189
Data year per community	1.8	1.2	1.2	2.1	3.1	2.8	1.3	2.4	2.1	1.8	2.2

Census Bureau (2011). Similarly, within regions, subregion estimates were expanded to nonsurveyed subregions by

$$\text{Regional harvest} = \text{Sum of subregion harvest} \times \left(\frac{\text{Total households in region}}{\text{Households in surveyed subregions}} \right)$$

Harvest estimates were presented at the species level except for mergansers and goldeneyes, which included all species occurring in different areas of the state. In five community-years, estimates of 2–17 unknown eiders and scoters were omitted in calculations of region estimates causing negligible underestimation of harvest.

Considerations on Species Identification

Bird species identification in most harvest surveys is subject to hunters' abilities to correctly identify and report species harvested. A limited proportion of subsistence and sport hunters may develop the advanced bird identification skills necessary to identify some species. In the US fall–winter harvest surveys, species composition of harvest estimates is derived from biological sampling and verification by wings and tails provided by hunters. The subsistence harvest survey has not included species verification through parts collection or bag checks because of cultural sensitivities and of logistic difficulties of operating in these remote areas. This fact further increases the need to test and fine-tune harvest survey materials to accurately represent local systems of species identification and naming, especially regarding species of management concern. Mismatches between ethnotaxonomy and scientific taxonomy and confusion related to English bird names must be carefully considered to minimize species identification issues. Some potential sea duck species identification issues require further

assessment and must be considered when interpreting subsistence harvest data.

It is unknown whether Native cultures commonly distinguish between Common and Barrow's Goldeneyes, or Common and Red-breasted Mergansers. Potential issues arise for species identification when English names include the word "common", which may be misunderstood as the locally most common species (Naves and Zeller 2013). Harvest of species with "common" in their English name may be overestimated, while harvest of other species in the area may be underestimated. This issue creates problems for separation of different species of mergansers and goldeneyes in subsistence harvest surveys. Estimates of harvest for Common Eiders may also be affected by this issue.

Female eiders may be difficult to tell apart, and Alaska Native words for undefined female eiders suggest that these birds may be treated as a category at least in some circumstances. Female scoters also may be difficult to tell apart by species. Locally, scoters are commonly referred to as "black ducks". Therefore, a tendency to report all species of scoters combined as Black Scoters could lead to overestimation of Black Scoter harvest and underestimation of other scoter species locally available. A small number of goldeneye and Bufflehead eggs were reported as harvested. These species are obligate tree cavity nesters, and it is unknown whether subsistence harvesters indeed encounter harvest opportunities or if harvest reports are due to species identification issues. Last, the Long-tailed Duck is sometimes locally called "pintail", which may lead to confusion with the Northern Pintail, but the extent of this potential issue is unknown.

Subsistence Harvest Patterns in Alaska

The 2011 estimated subsistence harvest of sea ducks in Alaska was 61,725 birds/year; this value corresponds to about 18% of the statewide subsistence harvest of all migratory and resident birds (Table 12.6). Regionally, sea ducks represented 71%–78% of the total bird harvest in the North Slope, Kodiak Archipelago, and Gulf of Alaska–Cook Inlet; 24% of the harvest in Interior Alaska; and 6%–15% in the remaining regions of the state (2004–2010 average; L. C. Naves, unpubl. data). Compared to the 1995 estimates (Paige and Wolfe 1998), the main differences were lower harvest of Common Eiders (−2,459 birds/year) and Long-tailed Ducks (−6,321 birds/year) and higher harvest of scoters (+4,307 birds/year, species combined). The seasonal distribution of the estimated sea duck harvest was 54% spring, 17% summer, and 29% fall–winter (Figure 12.15). A large proportion of summer harvests (68%) were King and Common Eiders in the North Slope, likely harvested during the postbreeding migration. Excluding this region, the seasonal breakdown of harvest was 57% spring, 7% summer, and 37% fall–winter.

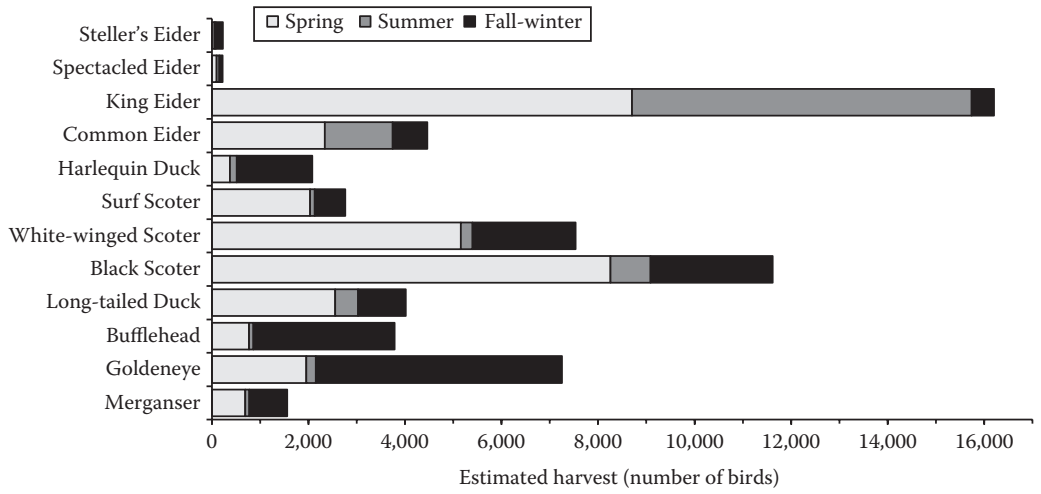

Figure 12.15. Seasonality of subsistence harvest of sea duck species in Alaska. Harvest during the postbreeding migration of King and Common Eiders in the North Slope accounts for a large proportion of the summer harvest of these species.

King Eiders (16,023 birds/year) and Black Scoters (11,617 birds/year) were harvested in the largest numbers statewide, followed by White-winged Scoters (7,538 birds/year) and goldeneyes (7,252 birds/year, Table 12.6, Figures 12.16 and 12.17). Eiders were harvested mostly in the North Slope and Bering Strait–Norton Sound, but King Eiders were also harvested in relatively large numbers in the Yukon–Kuskokwim Delta. Scoters and Long-tailed Ducks were harvested mostly in the Yukon–Kuskokwim Delta, Northwest Arctic, and Interior Alaska. Harlequin Ducks, Buffleheads, and goldeneyes were mostly harvested in southern coastal regions although relatively large harvest of Buffleheads and goldeneyes also occurred in the Yukon–Kuskokwim Delta and Interior Alaska. Merganser harvest was distributed statewide.

The estimated harvest of sea duck eggs (5,794 eggs/year) was largely comprised of eggs of Common Eiders (60%), Long-tailed Ducks (18%), and King Eiders (16%). The regions accounting for most of the egg harvest were Bering Strait–Norton Sound (84%; mostly Common Eiders, Long-tailed Ducks, and King Eiders) and North Slope (7%; mostly Common and King Eiders).

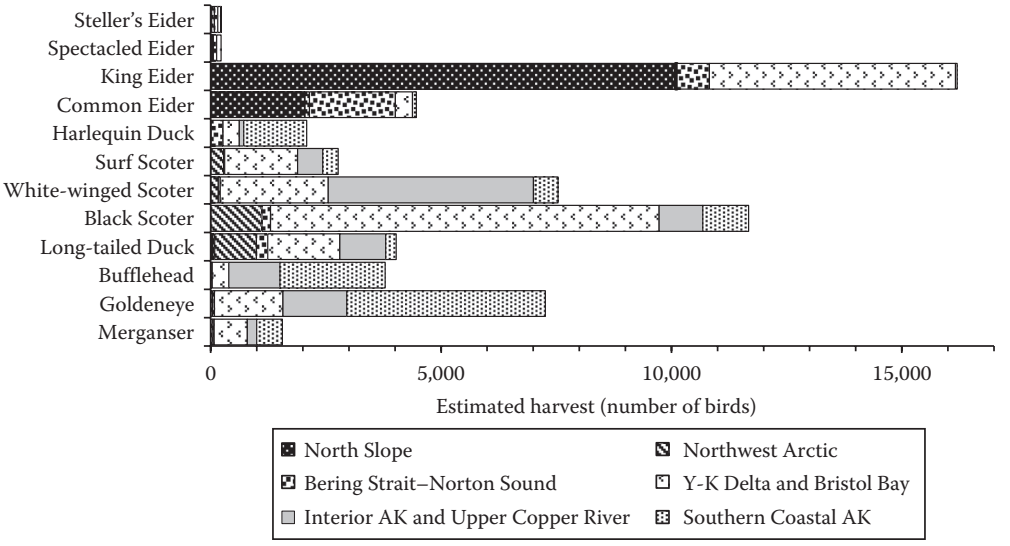

Figure 12.16. Distribution of subsistence harvest of sea duck species by region of Alaska.

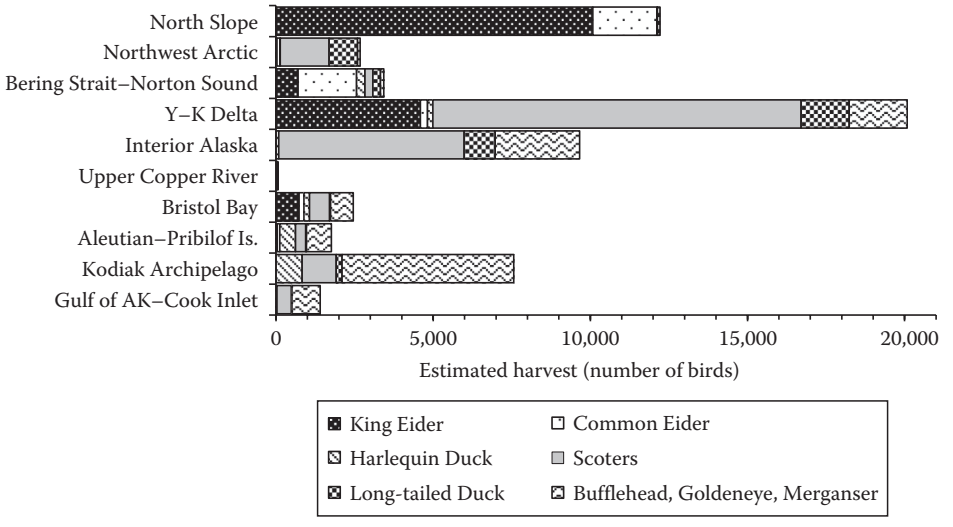

Figure 12.17. Species composition of subsistence sea duck harvest by region of Alaska.

Steller's Eider

The estimated Alaska subsistence harvest of Steller's Eider was 230 birds/year. Most harvest was in the Northwest Arctic, Bering Strait–Norton Sound, and Yukon–Kuskokwim (53–72 birds/year each), while the North Slope, Bristol Bay, and Aleutian–Pribilof Islands accounted for 13–20 birds/year each. More than half (65%) of bird harvest reports occurred in fall–winter and 24% occurred in spring. The estimated harvest of Steller's Eider eggs was 50 eggs/year divided between Bering Strait–Norton Sound (76%) and Yukon–Kuskokwim Delta (24%).

Spectacled Eider

The estimated harvest of Spectacled Eiders was 222 birds/year divided among four regions. Summer harvest (26% of the annual total) occurred in the North Slope, Bering Strait–Norton Sound, and Yukon–Kuskokwim Delta. Harvest in the Bristol Bay region occurred largely in fall–winter (57%), while harvest in the Yukon–Kuskokwim Delta (68%) and Bering Strait–Norton Sound (52%) was largely in spring. The estimated harvest of Spectacled Eider eggs totaled 25 eggs/year and occurred only in the Bering Strait–Norton Sound.

King Eider

The estimated harvest of King Eiders in Alaska was 16,203 birds/year, mostly in the North Slope (62%) and Yukon–Kuskokwim Delta (28%). In all regions south of the North Slope, most harvest occurred in spring (82%), likely during the prebreeding migration. In the North Slope, there was a tendency for a small harvest of King Eiders in spring (37%), with the primary harvest (63%) in summer during the postbreeding migration through the North Slope coast to molting areas in Russia (Woodby and Divoky 1982, Dickson et al. 1997).

The estimated harvest of King Eider eggs was 925 eggs/year. Harvest reports of King Eider eggs in known breeding areas in the North Slope and Northwest Arctic represented 27% of the annual estimated harvest. Harvest reports in the Bering Strait–Norton Sound represented 69% of annual estimates. Out of 44 community-years representing the Bering Strait–Norton Sound, harvest reports of King Eider eggs occurred in 10 community-years. Although species identification may be an issue, harvest of King Eider eggs seems to regularly occur in this region, indicating that the breeding range of the species extends farther south than shown in most sources (Bellrose 1980).

Common Eider

The estimated harvest of Common Eiders in rural Alaska was 4,460 birds/year. Most of the harvest occurred in the North Slope (46% of the species annual harvest) and in the Bering Strait–Norton Sound (42%). In the North Slope, harvest occurred in spring (59%) and in summer (41%). In the Bering Strait–Norton Sound, harvest occurred in all seasons, but mostly in spring (46% spring, 22% summer, 32% fall–winter). The estimated harvest of Common Eider eggs was 3,496 eggs/year, of which 91% were in the Bering Strait–Norton Sound and 5% in the North Slope.

Harlequin Duck

The estimated harvest of Harlequin Ducks was 2,080 birds/year. More than half (64%) of the harvest occurred in the Kodiak Archipelago and Aleutian–Pribilof Islands; 75% occurred in fall–winter. Breeding Harlequin Ducks are sparsely distributed on high gradient streams and rivers throughout southern, interior, and western Alaska. The majority (92%) of the small summer harvest occurred in the Bering Strait–Norton Sound, Interior Alaska, and Kodiak Archipelago. Harvest in the Bristol Bay and Yukon–Kuskokwim Delta typically occurred in spring and fall. Harvest of Harlequin Duck eggs was not documented in the harvest surveys, probably because their nests are difficult to find.

Surf, White-winged, and Black Scoters

The Surf Scoter estimated harvest totaled 2,765 birds/year. About half of the harvest (51%) occurred in the Yukon–Kuskokwim Delta; 74% occurred in spring. The estimated harvest of Surf Scoter eggs was 15 eggs/year and occurred only on the Yukon–Kuskokwim Delta.

The estimated harvest of White-winged Scoters was 7,541 birds/year, and most harvest occurred in Interior Alaska (59%) and Yukon–Kuskokwim Delta (30%). In Interior Alaska, White-winged Scoter harvest occurred mostly in spring (68%) and

fall (28%). In the Yukon–Kuskokwim Delta, most harvest occurred in spring (83%). The estimated harvest of White-winged Scoter eggs was 47 eggs/year and occurred in interior and western Alaska.

The Black Scoter estimated harvest was 11,617 birds/year. More than half of the harvest (69%) occurred in the Yukon–Kuskokwim Delta; 71% occurred in spring. The estimated harvest of Black Scoter eggs was 78 eggs/year and occurred in interior and western Alaska and North Slope.

The scoter species composition in subsistence harvest requires consideration because of potential for species misidentification. The contribution of Black Scoters to the statewide harvest may be overestimated because of potential confusion with the name "black scoter". In Alaska, Surf and White-winged Scoters are generally more abundant than Black Scoters and breed more commonly in interior boreal forest. However, most of Alaska scoter harvest occurs in high-harvest, western coastal areas, which are the primary breeding range of Black Scoters. Scoter migration ecology is not well known, and several factors may influence regional scoter harvest composition across seasons, including variation in scoter availability and factors affecting amount and distribution of harvest effort.

Long-tailed Duck

The estimated harvest of this species was 4,020 birds/year. Most harvest occurred in Yukon–Kuskokwim Delta (38%), Interior Alaska (25%), and Northwest Arctic (22%). The estimated harvest of Long-tailed Duck eggs was 1,027 eggs/year, of which 93% were in the Bering Strait–Norton Sound, 5% in the Yukon–Kuskokwim Delta, and 2% in the North Slope.

Bufflehead

The estimated harvest of Buffleheads was 3,782 birds/year. Most harvest occurred in the Kodiak Archipelago (55%) and Interior Alaska (29%). Harvest in the Kodiak Archipelago occurred mostly in fall–winter (94%), while harvest in Interior Alaska was divided between spring (40%) and fall (58%). The estimated harvest of Bufflehead eggs was 62 eggs/year and was in interior and western Alaska, mostly in the Yukon–Kuskokwim Delta (48 eggs/year). Buffleheads are obligate tree cavity nesters, and it is unknown whether subsistence harvesters indeed encounter egg harvest opportunities or if harvest reports are due to species misidentification.

Goldeneyes

The estimated harvest of goldeneyes was 7,252 birds/year. Harvest in the Aleutian–Pribilof Islands, western Alaska, and Interior Alaska (48%) likely refers to Common Goldeneye and was divided between spring (48%) and fall–winter (46%). Harvest in the Gulf of Alaska-Cook Inlet, Kodiak Archipelago, and Upper Copper River (52%) likely refers to both Common and Barrow's Goldeneyes and occurred mostly in fall–winter (92%). The estimated harvest of goldeneye eggs was 17 eggs/year. Goldeneyes are obligate tree cavity nesters, and egg harvest reports may be due to species misidentification.

Mergansers

The estimated harvest of mergansers was 1,556 birds/year. Most of the harvest (95%) occurred in regions of the state where both Common and Red-breasted Mergansers occur (southern coast, Yukon–Kuskokwim Delta, Bristol Bay, and interior) and was divided between spring (46%) and fall–winter (49%). The estimated harvest of merganser eggs was 52 eggs/year, of which 77% occurred in the Kodiak Archipelago and Aleutian–Pribilof Islands.

Regional Distribution of Harvest

The Yukon–Kuskokwim Delta ranked first in the number of sea ducks harvested (20,170 birds/year) and had a diverse species composition. The species harvested most often were Black Scoter (40%), King Eider (23%), and White-winged Scoter (11%). The North Slope ranked second in the number of sea ducks harvested but had the least diverse species composition (two species represented 99% of the harvest). King and Common Eiders represented most of the sea duck harvest in the Bering Strait–Norton Sound (72% of 3,579 birds/year) and North Slope (99% of 12,300 birds/year, Figure 12.17). Interior Alaska ranked third in the number of sea ducks harvested (9,663 birds/year), 46% of which were White-winged Scoters. Sea duck harvest in the Northwest Arctic region was largely

composed of Black Scoters (40%) and Long-tailed Ducks (33%) and differed from its neighboring regions to the north and south (Figure 12.17).

The Bering Strait–Norton Sound (4,888 eggs/year) and the North Slope (409 eggs/year) had the highest harvest of sea duck eggs. North Slope harvest was largely composed of eggs of King Eiders (45%) and Common Eiders (45%). Bering Strait–Norton Sound harvest was composed of eggs of Common Eiders (65%), Long-tailed Ducks (20%), and King Eiders (13%). In these regions, Common Eiders were represented in more egg harvest (45% in North Slope, 65% in Bering Strait–Norton Sound) than bird harvest (17% in North Slope, 52% in Bering Strait–Norton Sound). The difference may arise from (1) preference for harvest of Common Eider eggs, (2) indirect factors leading to selective harvest such as overlap between breeding areas and harvest effort, and (3) difficulty in identifying the species of incubating females, nests, and eggs, leading to a tendency to report unknown eider eggs as "common eiders" on the survey form.

Regional Management Topics

Steller's and Spectacled Eiders are closed to harvest in Alaska, but some birds and eggs are taken in subsistence harvest. Russian breeding birds likely comprise most of Alaska harvest occurring during fall–winter (65% of Steller's Eider and 32% of Spectacled Eider annual harvest estimates) and may be part of spring harvest (24% of Steller's Eider and 42% of Spectacled Eider annual harvest estimates, Table 12.8). Information on the status of Russian populations is sparse, but there are concerns about potential rangewide declines of Steller's Eiders and the security of wintering Spectacled Eiders. Recent statewide harvest estimates suggest a reduction in harvest of Steller's and Spectacled Eiders compared to the mid-1980s through the early 1990s and 1996 (Table 12.7). The current lower harvest estimates may be related to (1) outreach and communication work focusing on conservation and harvest closure, (2) law enforcement efforts, (3) reduced reporting rate because of law enforcement action, or (4) reduced availability of these species at least in some areas in the last 25 years. It is difficult to estimate harvest of species taken in low numbers because only few data points are available for generalization over a large geographic area. The AMBCC recognizes the need for continued outreach and communication work among all stakeholders to address management and conservation concerns.

Final Considerations for Subsistence Harvest in Canada and Alaska

In general, Common Eiders are a primary resource for coastal communities in eastern North America, and King Eiders are important for west coastal communities. Common Eiders represent a special challenge to management because of strong population structure with four subspecies in North America and many hybrid zones (Sonsthagen et al. 2011). Moreover, different population segments are subject to various combinations of subsistence and fall–winter harvest (Gilliland et al. 2009). Eiders have been sensitive to overexploitation but, on the other hand, also have shown a surprising ability to quickly recover when harvest is managed at appropriate levels (Merkel 2010).

Wildlife harvests, including sea ducks, are poorly known or estimated for large regions in interior Canada. Scoters are important subsistence resources in coastal and interior regions and in the Arctic and sub-Arctic (21,981 scoters/year in all regions of Alaska). All harvests of scoters from Alaska to Mexico need to be considered in management plans for these species. Harvests in eastern Russia are poorly documented but are important for understanding population dynamics of shared populations of eiders, Long-tailed Ducks, and other species (E. Syroechkovski Jr. and K. B. Klokov, IPEE RAN, unpubl. report). Well-considered regional management plans and effective collaboration across jurisdictions will help to ensure that harvests of key species, such as eiders and scoters, are sustainable into the future.

New information provided and older information assembled in this chapter allow better understanding of sea duck harvest patterns and quantification of harvest demand. While progress is made in delineating and estimating population sizes, information on harvest demand is important to set minimum management and conservation objectives.

Subsistence harvest is challenging to monitor or manage because harvest occurs in remote areas and in a particular cultural context. Additionally, data obtained may include species identification issues and issues resulting from difficulty in implementing standard data collection methods.

TABLE 12.8

Alaska average annual subsistence harvest of sea ducks by region.

	North Slope	NW Arctic	Bering Strait–Norton Sound	Y–K Delta	Interior AK	Upper Copper River	Bristol Bay	Aleutian–Pribilof Is.	Kodiak Archipelago	Gulf of AK–Cook Inlet	Total
Steller's Eider, birds	20	58	72	54	[b]	[b]	13	13	0	0	230
Spring	12	0	8	22	[b]	[b]	12	0	0	0	54
Summer	8	0	13	5	[b]	[b]	0	0	0	0	26
Fall–winter	[c]	58	51	27	[b]	[b]	1	13	0	0	150
Steller's Eider, eggs	0	0	38	12	[b]	[b]	0	0	0	0	50
Spectacled Eider, birds	55	0	73	31	[b]	[b]	63	[b]	[b]	[b]	222
Spring	8	0	38	21	[b]	[b]	27	[b]	[b]	[b]	94
Summer	47	0	9	1	[b]	[b]	0	[b]	[b]	[b]	57
Fall–winter	[c]	0	26	9	[b]	[b]	36	[b]	[b]	[b]	71
Spectacled Eider, eggs	0	0	25	0	[b]	[b]	0	[b]	[b]	[b]	25
King Eider, birds	10,087	32	707	4,598	[b]	[b]	740	38	1	0	16,203
Spring	3,695	22	448	3,814	[b]	[b]	702	24	1	0	8,706
Summer	6,392	9	104	529	[b]	[b]	0	0	0	0	7,034
Fall–winter	[c]	1	155	255	[b]	[b]	38	14	0	0	463
King Eider, eggs	185	61	643	15	[b]	[b]	3	18	0	0	925
Common Eider, birds	2,045	99	1,862	224	[b]	[b]	148	82	0	0	4,460
Spring	1,198	60	859	148	[b]	[b]	72	0	0	0	2,337
Summer	847	21	402	15	[b]	[b]	47	75	0	0	1,407
Fall–winter	[c]	18	601	61	[b]	[b]	29	7	0	0	716
Common Eider, eggs	185	15	3,188	41	[b]	[b]	0	67	0	0	3,496
Harlequin Duck, birds	[b]	7	261	170	92	0	184	504	832	30	2,080
Spring	[b]	4	77	72	18	0	118	24	54	5	372
Summer	[b]	0	98	2	22	0	0	5	14	4	145
Fall–winter	[c]	3	86	96	52	0	66	475	764	21	1,563
Harlequin Duck, eggs	[b]	0	0	0	0	0	0	0	0	0	0
Surf Scoter, birds	0	277	27	1,417	543	0	163	5	214	119	2,765

(*Continued*)

TABLE 12.8 (*Continued*)
Alaska average annual subsistence harvest of sea ducks by region.

	North Slope	NW Arctic	Bering Strait–Norton Sound	Y–K Delta	Interior AK	Upper Copper River	Bristol Bay	Aleutian–Pribilof Is.	Kodiak Archipelago	Gulf of AK–Cook Inlet	Total
Spring	0	251	22	1,277	323	0	70	4	62	29	2,038
Summer	0	9	1	33	41	0	12	0	0	0	96
Fall–winter	[c]	17	4	107	179	0	81	1	152	90	631
Surf Scoter, eggs	0	0	0	15	0	0	0	0	0	0	15
White-winged Scoter, birds	1	165	43	2,257	4,432	24	80	171	300	65	7,538
Spring	0	89	29	1,870	3,033	8	47	4	50	26	5,156
Summer	1	9	2	61	161	8	0	0	0	4	246
Fall–winter	[c]	67	12	326	1,238	8	33	167	250	35	2,136
White-winged Scoter, eggs	13	0	6	10	18	0	0	0	0	0	47
Black Scoter, birds	5	1,101	184	7,989	920	21	399	144	570	284	11,617
Spring	5	926	150	6,182	520	0	287	4	46	137	8,257
Summer	0	64	0	681	62	13	8	5	0	0	833
Fall–winter	[c]	111	34	1,126	338	8	104	135	524	147	2,527
Black Scoter, eggs	9	0	16	18	35	0	0	0	0	0	78
Long-tailed Duck, birds	86	904	249	1,533	991	0	29	28	185	15	4,020
Spring	35	784	160	800	722	0	14	0	28	10	2,553
Summer	51	62	27	250	83	0	0	0	0	0	473
Fall–winter	[c]	58	62	483	186	0	15	28	157	5	994
Long-tailed Duck, eggs	15	0	959	53	0	0	0	0	0	0	1,027
Bufflehead, birds	[b]	0	35	295	1,106	8	59	147	2,091	41	3,782
Spring	[b]	0	35	134	442	5	20	0	121	10	767
Summer	[b]	0	0	66	22	0	0	3	0	4	95
Fall–winter	[c]	0	0	95	642	3	39	144	1,970	27	2,920
Bufflehead, eggs[a]	[b]	0	7	48	0	2	0	0	5	0	62
Goldeneyes, birds	[b]	41	38	1,166	1,374	11	313	509	3,212	588	7,252
Spring	[b]	32	10	723	675	7	226	0	113	170	1,956

(*Continued*)

TABLE 12.8 (*Continued*)
Alaska average annual subsistence harvest of sea ducks by region.

	North Slope	NW Arctic	Bering Strait–Norton Sound	Y–K Delta	Interior AK	Upper Copper River	Bristol Bay	Aleutian–Pribilof Is.	Kodiak Archipelago	Gulf of AK–Cook Inlet	Total
Summer	[b]	0	0	94	76	1	12	1	11	0	195
Fall–winter	[c]	9	28	349	623	3	75	508	3,088	418	5,101
Goldeneyes, eggs[a]	[b]	0	6	8	0	0	0	0	4	0	17
Merganser, birds	0	44	30	371	203	0	346	135	159	268	1,556
Spring	0	0	8	206	144	0	193	15	19	105	690
Summer	0	0	6	21	41	0	9	8	0	0	85
Fall–winter	[c]	44	16	144	18	0	144	112	140	163	781
Merganser, eggs	1	0	0	5	0	0	6	16	24	0	52

[a] Obligate tree cavity nesting, reported egg harvest may need further assessment.
[b] Species unlikely to occur in this region has not been included in harvest surveys and has not been reported as harvested.
[c] AMBCC surveys not conducted in North Slope in fall because birds migrate out of this region starting in late summer.

Better understanding of sea duck ethnotaxonomy likely will help to minimize issues with species identification. However, ethnotaxonomy may include biological units defined by plumage, age, or other elements and may confound integration with the species-based scientific taxonomy. Implementation of a species verification system remains a main challenge in subsistence bird harvest monitoring.

Despite difficulties, subsistence harvest surveys are important for conservation of sea duck populations and also to ensure sustainable hunting opportunities, through the values they bring to resource management: (1) Documentation of subsistence harvest is important in resource allocation among user groups; subsistence communities depend on these resources and by law aboriginal peoples in Canada and qualified rural residents in Alaska have priority of access. (2) Subsistence harvest accounts for the bulk of the take for some sea duck populations, and continued harvest monitoring generates key information for management, especially for species with declining populations. (3) Harvest surveys are a main channel of communication between subsistence users and resource management agencies. Surveys create opportunities for stakeholders to work together and engage subsistence users in management and conservation of the resources they depend on for food and also to maintain a lifestyle that supports their social and cultural well-being.

Subsistence harvest differs from recreational harvest in fundamental ways, including the socioeconomic context and seasonal timing primarily as a spring hunt. It is difficult to fit subsistence harvest in the current framework of the Migratory Bird Convention and associated hunting regulations in Canada and the United States. Measures to monitor and, where needed, regulate subsistence harvest are still being developed and implemented in comanagement systems including subsistence users. Management of subsistence harvest in North America is evolving toward a workable framework recognizing the importance of harvest for northern peoples and honoring the intent of the Migratory Bird Treaty: to maintain viable populations for future generations through management that accounts for the seasonal travels of birds across multiple jurisdictions. Compared to a generation ago, managers now have better tools to estimate subsistence harvest, and partnerships are evolving for effective communication and comanagement of birds, including sea ducks. Care will be needed in the future; sea duck populations can be overexploited and climate change may bring extensive modifications to habitats and to their patterns of use by both people and sea ducks.

Changes to environments and human activities in the north will present both challenges and opportunities to sea ducks and other wildlife.

CONTEMPORARY SEA DUCK HARVEST ISSUES AND INFORMATION GAPS

The annual surveys that monitor fall and winter sea duck harvest in Canada and the United States are adequate to track the relative magnitude, distribution, and species composition of harvest over time at a continental scale. However, current harvest surveys and resultant datasets are not reliable and detailed enough to assess regional harvest or evaluate impacts on defined populations. Information needed to fill this gap includes (1) improved harvest sampling methods, (2) improved understanding of the structure of sea duck populations and how harvest is linked to breeding populations, and (3) larger sample sizes in wing surveys in both countries or alternate methods to assess species, sex, and age composition.

Comprehensive demographic data that provide context for annual harvest estimates and guide harvest management are unavailable for nearly all sea duck species. Harvest assessment goals cannot be achieved without fundamental definition of cohesive sea duck population units, including interpretation of seasonal structuring and the validity of management at regional scales; once populations are defined, the effects of harvest can be assessed with associated rates of recruitment and survival. For example, sex- and age-specific harvest rate estimates are needed in combination with harvest sex and age ratios to provide reliable estimates of population sex ratios and productivity. Development of population models that are parameterized with improved demographic information and recent harvest data will ensure that resources are focused on more effective population surveys, research, and appropriate hunting regulations.

Subsistence harvest estimates are not comprehensive, particularly for northern Canada, primarily due to (1) difficulties in obtaining complete sample frames of subsistence hunters, (2) logistical challenges with conducting surveys in remote areas, and (3) sociocultural barriers to participation in surveys. Government wildlife agencies and organizations representing subsistence hunters recognize these challenges and are collaborating to develop and improve methods to estimate subsistence harvest. These joint efforts are more fully describing the extent and value of sea duck harvest in subsistence economies and a more complete understanding of waterfowl harvest in North America.

The role of harvest in sea duck population dynamics is uncertain (Chapter 3, this volume), but current harvest levels appear to be sustainable for most populations. Managers have reduced or curtailed hunting of small populations that were at greatest risk, such as the eastern populations of Harlequin Duck and Barrow's Goldeneye, as well as Steller's and Spectacled Eiders in Alaska. High levels of harvest of Common Eiders in Greenland were substantially reduced through regulation and international cooperation, and the population appears to be recovering. The most heavily harvested sea duck species are abundant and seem to have stable (Bufflehead and Common Goldeneye) or increasing population trends (Hooded Merganser) since the mid-1900s, and productivity indices based on age ratios among harvested birds are relatively high.

Harvest of scoters, Long-tailed Ducks, and Common and Red-breasted Mergansers are much lower. Based on harvest age ratios, these species are apparently productive enough to sustain current harvest levels. Limited band recovery data also suggest that these species are harvested at low rates. For example, adult male Surf Scoters banded in eastern Canada in 2004–2008 were harvested at about a 2%–3% rate (Gilliland et al. 2011). The other scoter species and Long-tailed Ducks have similar temporal and spatial distribution along the Atlantic coast during the hunting season and likely experience similarly low harvest rates. Atlantic Common Eiders may be an exception. Despite high adult survival rates and low harvest rates (Krementz et al. 1996), eiders can experience widespread reproductive failure, sometimes for prolonged periods. Productivity is low in this population, especially along the Maine coast where nearly all eider ducklings are killed by predators, primarily gulls (B. Allen, pers. comm.).

The Sea Duck Joint Venture's Continental Technical Team is currently employing the *potential biological removal* analytical method to determine harvest potential for scoters, Atlantic Common Eiders, and Long-tailed Ducks (Wade 1998, Runge et al. 2004). The method allows estimation of

allowable take or levels of sustainable harvest despite uncertainty about the magnitude and variability of the demographic parameters used in the analyses. Results of this work will provide an initial indication of whether current harvest levels are indeed sustainable. More importantly, these analyses will show researchers and managers what demographic information is needed to most effectively inform and ensure sound harvest management of sea ducks in North America.

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