J. Field Ornithol., 67(4):669–679

ABUNDANCE, DISTRIBUTION, AND BEHAVIOR OF COMMON MERGANSERS WINTERING ON A RESERVOIR IN SOUTHERN NEW MEXICO

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Abstract.—Arrival dates, mean numbers, departure dates, and proportion of adult males differed for Common Mergansers (*Mergus merganser*) on Caballo Reservoir between winters of 1992–1993 and 1993–1994. Wintering Common Mergansers spent daylight hours loafing (58.6%), sleeping (17.5%), flying (5.7%), preening (4.0%), stretching (4.0%) and swimming (3.8%). Feeding accounted for <4% of daily activity. Diet of Common Mergansers consisted solely of large gizzard shad (*Dorosoma cepedianum*) during the first winter, but was predominantly threadfin shad (*D. potenense*) during the second winter. The change in diet was probably a result of most gizzard shad having grown too large to be eaten by Common Merganser by the second winter. Fish caught in gill net samples during both winters were predominately gizzard shad. Other fish netted were: white bass (*Morone chrysops*), walleye (*Stizostedion vitreum*), channel catfish (*Ictalurus punctatus*), and common carp (*Cyprinus carpio*). We suggest that managers should promote consistent annual recruitment of shad to provide a reliable food source for wintering Common Mergansers.

ABUNDANCIA, DISTRIBUCIÓN Y COMPORTAMIENTO DE *MERGUS MERGANSER* INVERNANDO EN UN EMBALSE EN EL SUR DE NEW MEXICO

Sinopsis.—Hubo diferencias en las fechas de llegada, números promedios, fechas de salida y proporción de machos adultos de *Mergus merganser* en el embalse Caballo entre los inviernos de 1992–1993 y 1993–1994. Individuos invernando pasaron el día haraganeando (58.6%), durmiendo (17.5%), volando (5.7%), acicalándose (4.0%), estirándose (4.0%) y nadando (3.8%). Menos del 4.0% de la actividad diaria consistió en alimentación.

La dieta de *Mergus merganser* consistió estrictamente de *Dorosoma cepedianum* durante el primer invierno, pero durante el segundo invierno *D. potenense* fué el alimento principal. El cambio en la dieta probablemente resultó de que *Dorosoma cepedianum* creció demasiado para ser ingerido por este ave el segundo invierno. Los peces muestreados en redes durante ambos inviernos eran principalmente *Dorosoma cepedianum.* Otros peces capturados fueron: *Morone chrysops, Stizostedion vitreum, Ictalurus punctatus* y *Cyprinus carpio.* Los manejadores deben promover consistentemente un reciutamiento anual de *Dorosoma cepedianum* sp. para promover una fuente alimenticia confiable para *Mergus merganser* que inviernen.

Wintering Common Mergansers (*Mergus merganser*) have increased in the Central Flyway as a result of artificial reservoirs (Bellrose 1976). On

Caballo Reservoir, located in the Rio Grande Basin of southern New Mexico, Common Mergansers numbered fewer than 300 birds in the winter of 1960–1961, whereas over 29,000 birds were counted there in January 1990 (New Mexico Department of Game and Fish, unpubl. data). Common Mergansers are significant predators, consuming up to half of their body mass in fish daily (Salyer and Lagler 1940). In 1954–1957, Huntington and Roberts (1959) reported that gizzard shad comprised 95% of the diet of Common Mergansers on Caballo Reservoir. Because this species is also important in the diets of sport fish (Sublette et al. 1990) and endangered bald eagles (*Haliaeetus leucocephalus*) (Tarrant 1995), the objectives of this study were to quantify the abundance, distribution, behavior, and food habits of wintering Common Mergansers on Caballo Reservoir.

STUDY AREA

Caballo Reservoir, located approximately 32 km south of Truth or Consequences, was built in 1938 by the U.S. Bureau of Reclamation (USBR). Caballo Reservoir is to hold a maximum of 55,000 ± 5000 acre-feet of water at the end of May, and to be drawn down to 25,000 ± 5000 acre-feet of water by the end of August (USBR, unpubl. rep.). The water level has been drawn below 25,000 acre-feet to allow for maintenance and repair of the dam, and high runoff has caused the reservoir to fill well above 55,000 acre-feet (USBR, unpubl. data). Consequently, there are wide fluctuations in surface area among and within years. During the 1992–1993 winter, surface area of Caballo Reservoir was 1174–1863 ha, while during the 1993–1994 winter surface area was 2430–3362 ha.

METHODS

We censused Common Mergansers from shore using a 20× spotting scope at approximately weekly intervals during January–February 1993, and from December 1993–March 1994. Because adult females and immature birds are indistinguishable from a distance (Erskine 1971), we recorded the number of adult males and "other" Common Mergansers. For each flock censused, we recorded location on U.S. Geological Survey topographical maps of the reservoir and whether members of the flock were observed feeding. We assigned feeding locations to three distance-from-shore categories: <50 m, 50–200 m, and >200 m. In addition, on 22 and 27 Jan., and 17 and 24 Feb. 1994 we conducted 5-min flock scans of behavior at 15-min intervals, beginning at sunrise and continuing until sunset (Altmann 1974). Any flock scan that appeared to be influenced by human disturbance was not included in analyses.

We obtained daily high and low temperatures from the Caballo State Park weather station located near the dam. For analysis, we used a weighted average of daily high and low temperatures, depending on the particular time of day the census was completed.

After acquiring federal and state permits, we collected 70 Common Mergansers by shotgun from a fast-moving boat from flocks observed

feeding on Caballo Reservoir. Twenty mergansers were collected during three collections between 25 Jan.–8 Feb. 1993, and 50 were collected during five collections between 10 Dec. 1993–2 Mar. 1994. We recorded whether birds readily flew, were hesitant to fly, unable/unwilling to take flight, or only flew a short distance when pursued, because Huntington and Roberts (1959) reported that Common Mergansers that have been most successful in catching fish may be hesitant or unable to take flight.

In the laboratory, we removed throat, gullet, proventriculus, and gizzard contents from thawed carcasses. We identified prey items and recorded total length, maximum girth, and mass for whole fish.

We used gill nets to sample fish populations in Caballo Reservoir for a 24-h period, once every three weeks from January–March 1993, and from December 1993–March 1994. At areas of Common Merganser use we set three floating gill nets that measured 40-m long by 1-m wide, with a variable mesh size ranging from 25–75 mm. This net configuration was capable of capturing fish within a wide range of sizes, the upper limit being greater in size than Common Mergansers reportedly swallow (Latta and Sharkey 1966). Species, total length, maximum girth (1993–1994), and mass of each captured fish were recorded.

Analysis of covariance was used to analyze mean total mass of digestive tract contents and mean length and girth of prey items relative to sex, age, flight status, and winter of collection. Pool size, time of day, and minimum and maximum temperature were covariates. Pearson correlation coefficients were used to analyze the relationship among numbers of Common Mergansers recorded on Caballo Reservoir during annual aerial waterfowl surveys (New Mexico Department of Game and Fish, unpubl. data), standing crop estimates of fish populations in the reservoir (R. A. Cole, unpubl. data), and minimum and maximum surface areas for the reservoir (USBR, unpubl. data). A *t*-test or Chi-square test was used to analyze all other differences for significance. Means are reported ± one standard error. Results were considered statistically significant at $\alpha = 0.05$.

RESULTS

Population census.—During the first winter, we recorded the highest number of Common Mergansers ($n = 3964$) on our first census (Fig. 1). Of these, 45% were adult males. Many adult females and immature birds left the reservoir shortly thereafter (Fig. 2). No Common Mergansers were seen on the reservoir after 15 February.

During the second winter, Common Mergansers began arriving on Caballo Reservoir in early January, peaked at 10,897 on 15 February, and departed by 15 March (Fig. 1). When numbers peaked, 40% were adult males (Fig. 3). Mean numbers of Common Mergansers on Caballo Reservoir counted during weekly surveys differed between winters ($t = 2.29$, $P = 0.028$), as did the proportion of adult males to adult females and immature birds ($\chi^2 = 3627.5$, df = 1, $P < 0.001$).

Time budgets.—Common Merganser flock size averaged 280 ± 48 ($n =$

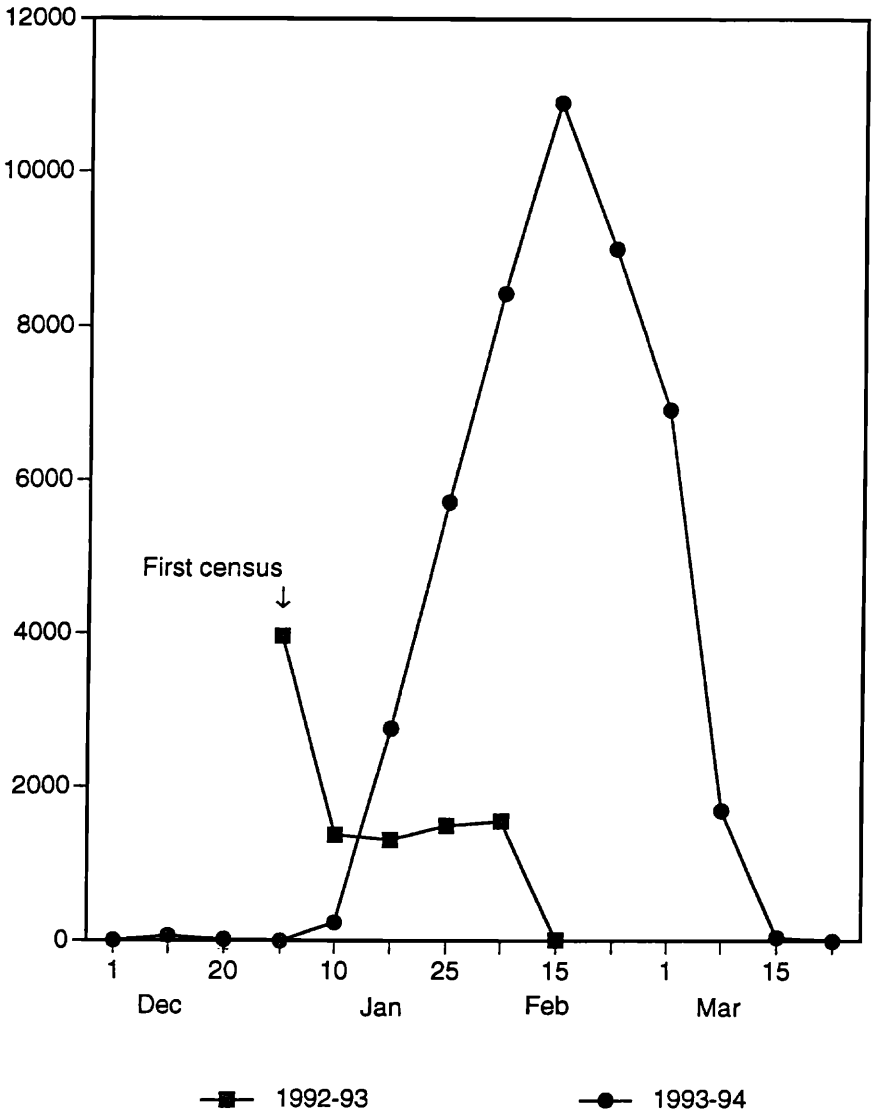

FIGURE 1. Numbers of Common Mergansers counted on Caballo Reservoir, New Mexico, during weekly surveys from January–March 1993, and December 1993–March 1994.

96). Proportion of time spent in particular behaviors differed among four sampling dates in 1994 ($\chi^2 = 3652.9$, df = 45, $P < 0.001$) and across time of day ($\chi^2 = 6637.5$, df = 150, $P < 0.001$). Overall, individuals spent a majority of time loafing (58.6%), followed by sleeping (17.5%), flying (5.7%), preening (4.0%), stretching (4.0%) and swimming (3.8%). Feed-

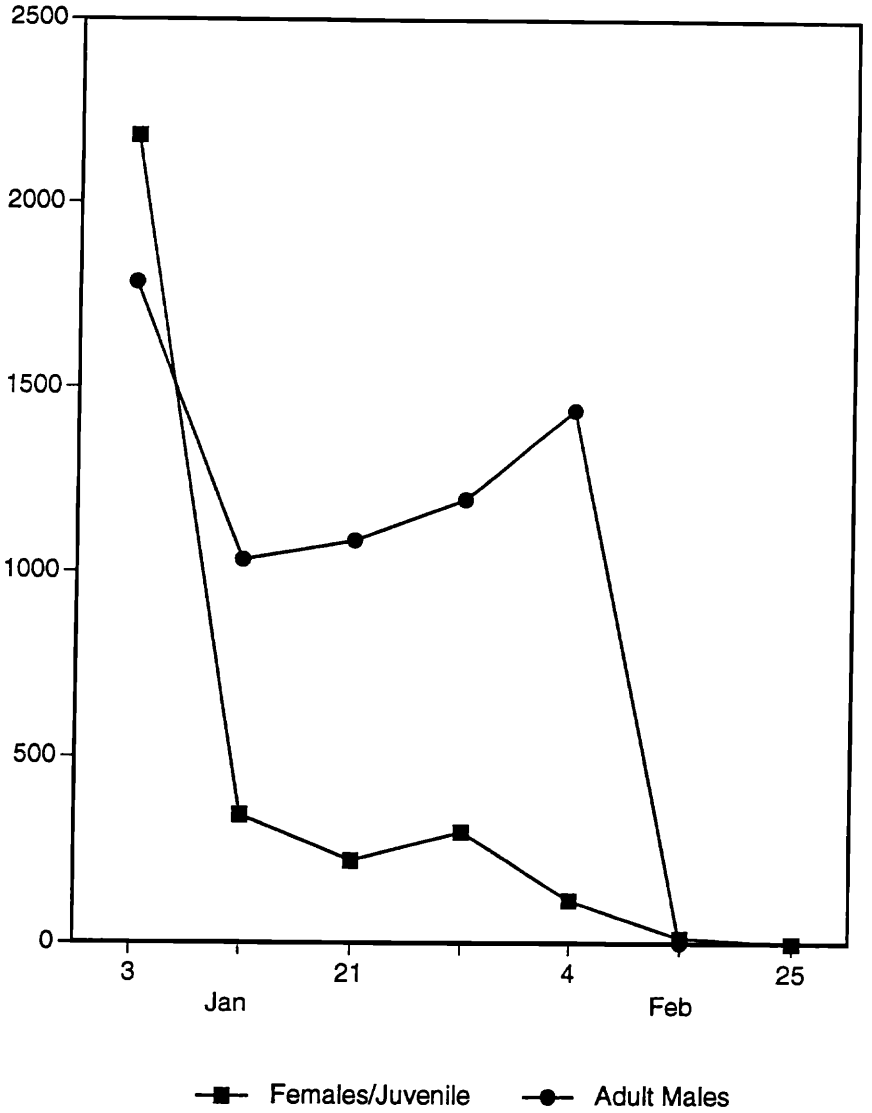

FIGURE 2. Numbers of adult males and other (adult females and immature males and females) Common Mergansers counted on Caballo Reservoir, New Mexico, during weekly surveys from January–February 1993.

ing (diving, surfacing, hunting, and swallowing) occurred during <4% of daylight hours.

Diets.—Twenty adult male Common Mergansers were collected during the first winter, and all appeared reluctant to fly or only flew a short

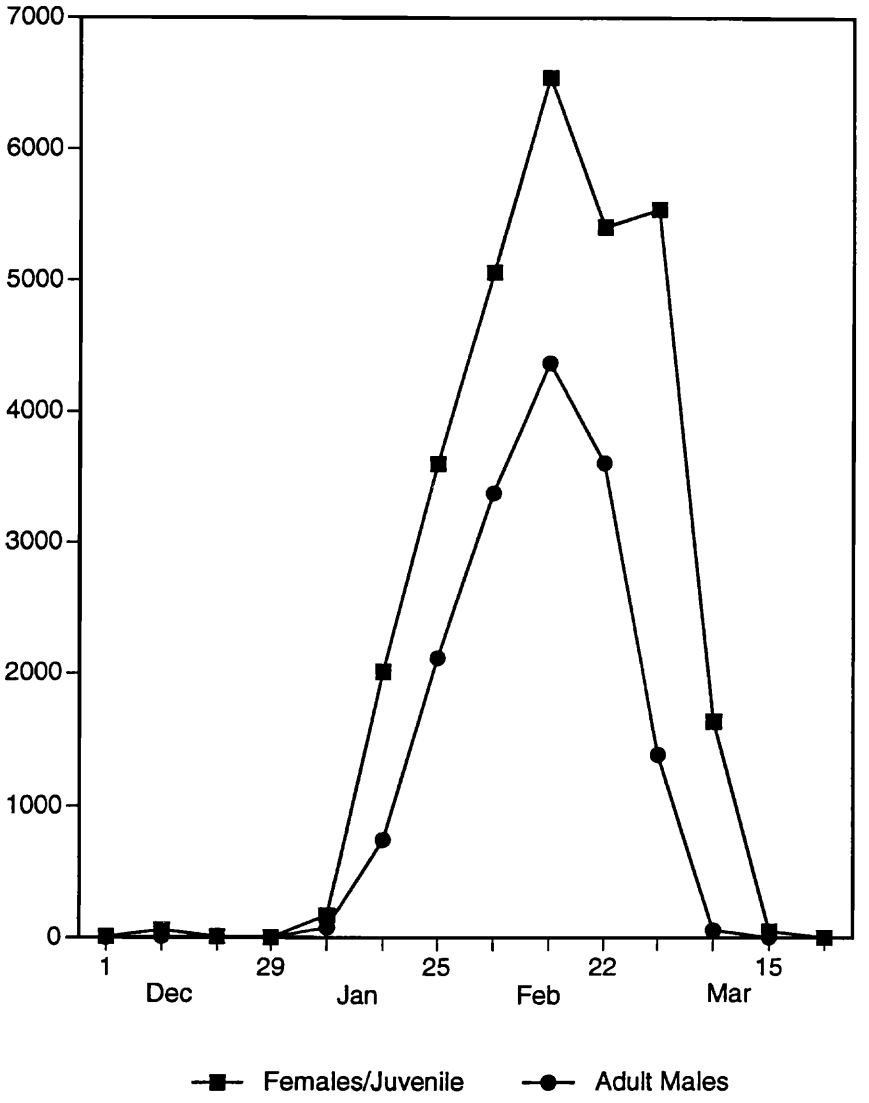

FIGURE 3. Numbers of adult males and other (adult females and immature males and females) Common Mergansers counted on Caballo Reservoir, New Mexico, during weekly surveys from December 1992–March 1993.

distance when pursued. Collected birds had a mean mass of 1723 ± 27 g. Ingesta of these males consisted solely of large gizzard shad (*Dorosoma cepedianum*) (n = 30). Lengths of whole fish (n = 19) ranged from 247–310 mm ($\bar{x}$ = 276 ± 3 mm), masses ranged from 112–204 g ($\bar{x}$ = 160 ± 6 g), and girths ranged from 144–198 mm ($\bar{x}$ = 165 ± 4 mm). One bird

had four fish in its digestive tract, seven birds had two fish, 11 birds had one fish, and one contained a small but identifiable portion of a gizzard shad.

Common Mergansers collected during the second winter consisted of 18 adult males, 14 adult females, 13 immature males, and five immature females. Mean mass was 1813 ± 42 g for adult males, 1308 ± 45 g for adult females, 1689 ± 47 g for immature males, and 1267 ± 23 g for immature females. Thirty-five of the mergansers collected during the second winter were hesitant to fly or unable to fly strongly. Of these, 22 had food in their digestive tracts. Eleven of 15 strong flyers had food in their digestive tracts as well.

Ingesta of Common Mergansers during the second winter consisted of 77 threadfin shad (*D. petenense*), 54 shad identifiable only to genus, two bluegill (*Lepomis macrochirus*), one largemouth bass (*Micropterus salmoides*) and one yellow perch (*Perca flavescens*). Lengths of whole threadfin shad (n = 69) ranged from 60–145 mm ($\bar{x}$ = 112 ± 3 mm), masses ranged from 12–29 g ($\bar{x}$ = 13 ± 1 g) and girths ranged from 48–94 mm ($\bar{x}$ = 77 ± 1 mm).

Common Mergansers collected during the first winter had a greater total mass of fish biomass in their digestive tracts ($P < 0.001$) than did adult males collected during the second winter. Also, birds that were hesitant to fly or were unable to fly strongly had a heavier mass of fish biomass in their digestive tracts ($P = 0.003$) than did birds that were strong flyers. Common Mergansers had more fish biomass in their digestive tracts on days with higher maximum temperatures ($P = 0.024$). Longer fish were in the digestive tracts the first winter ($P = 0.032$) and in digestive tracts of birds that were not strong flyers ($P = 0.026$).

Fish abundance.—In the first winter's nets, gizzard shad were most abundant, followed by white bass (*Morone chrysops*), walleye (*Stizostedion vitreum*), channel catfish (*Ictalurus punctatus*) and common carp (*Cyprinus carpio*) (Table 1). During the second winter, gizzard shad were again the most abundant species in the sample, followed by white bass, common carp, walleye and threadfin shad. Gizzard shad in nets the first winter were larger ($t = -4.98$, $P < 0.001$) and had greater mass ($t = -9.92$, $P < 0.001$) than gizzard shad in Common Merganser diets during the first winter. Gizzard shad caught in nets the second year were larger ($t = -9.29$, $P < 0.001$) and had greater mass ($t = 16.761$, $P < 0.001$) than those caught in nets the first winter.

Reservoir pool size.—Of the 9721 Common Mergansers tallied in flocks observed feeding the first winter, 16.0% were >200 m from shore, 69.6% were 50–200 m from shore, and 14.4% were <50 m from shore. Of 45,782 birds in flocks observed feeding the second winter, 44.1% were >200 m from shore, 27.6% were 50–200 m from shore and 28.3% were <50 m from shore. Between years, the proportion of Common Mergansers feeding in the three distances from shore differed ($\chi^2 = 6276.3$, df = 2, $P < 0.001$). Also, time spent in particular behaviors differed in relation to reservoir surface area ($\chi^2 = 2943.5$, df = 15, $P < 0.001$). During the first

TABLE 1. Length and girth of fish caught in gill nets in Caballo Reservoir during winter 1992–1993 and 1993–1994.

Species	n	Length (mm)		Mass (g)		Girth (mm)	
		$\bar{x} \pm SE$	Range	$\bar{x} \pm SE$	Range	$\bar{x} \pm SE$	Range
1992–1993							
Gizzard shad	242	303 ± 2	203–393	252 ± 6	60–560	—	—
White bass	48	239 ± 10	172–381	261 ± 41	50–930	—	—
Walleye	20	488 ± 34	279–730	1773 ± 343	190–5250	—	—
Channel catfish	6	511 ± 35	406–584	1635 ± 403	660–2800	—	—
Common carp	4	459 ± 5	445–470	1125 ± 75	1000–1300	—	—
1993–1994							
Gizzard shad	117	351 ± 5	168–416	494 ± 13	41–815	226 ± 4	91–279
White bass	19	290 ± 11	241–400	302 ± 38	130–850	200 ± 9	159–298
Common carp	14	500 ± 15	431–673	1284 ± 206	1300–4500	278 ± 19	222–355
Walleye	8	512 ± 33	430–660	1284 ± 206	750–2268	—	—
Threadfin shad	3	146 ± 2	142–150	33 ± 3	30–60	93 ± 2	91–96

[a] No data.

winter when reservoir pool size was smaller, almost all feeding (99.2%) was by birds congregated in large rafts in southern, deeper areas of the reservoir. After feeding, Common Mergansers congregated in the center of the reservoir. During the second winter, when reservoir surface area was larger, most birds (96.2%) again fed in southern quadrants. However, feeding mergansers congregated in several large rafts, as well as scattered small rafts. After feeding, mergansers gathered in the shallow end of the reservoir during the day.

From 1980–1994, numbers of Common Mergansers at Caballo Reservoir were negatively correlated with maximum pool size ($r = -0.5273$, $P = 0.043$). However, there was no correlation with minimum pool size or standing crop of the various fish species in the reservoir.

DISCUSSION

The diet of Common Mergansers during the first winter consisted of a single species, gizzard shad. Although this species was also the most abundant fish in gill net samples, other genera contributed approximately 25%. Disproportionate use of gizzard shad by wintering Common Mergansers has been previously reported by Huntington and Roberts (1959). Gizzard shad were also the most common fish in Common Merganser diets in warm water reservoirs in Oklahoma (Miller 1973), Nebraska, South Dakota, and Minnesota (Timken and Anderson 1969). Gizzard shad may have been chosen disproportionately as prey by Common Mergansers because they are numerous, travel in compact schools (Jester and Jensen 1972, Sublette et al. 1990), and usually live near the surface when young (Miller 1960).

The diet of Common Mergansers during the second winter was predominantly composed of threadfin shad and small shad identifiable only to genus. All unidentifiable shad were either found in digestive tracts that also contained threadfin shad or in birds that were collected at the same time and location as other birds that contained threadfin shad. These specimens were also relatively small. Because shad are schooling species (Jester and Jensen 1972), it is probable that many of these fish identifiable only to genus were threadfin shad. Gizzard shad, however, remained the predominant fish caught in gill nets during the second winter. Latta and Sharkey (1966) reported the upper size limit a merganser could swallow was a girth of 165 mm, but Common Mergansers that we collected on Caballo Reservoir during the first winter contained gizzard shad with girths up to 198 mm. If this girth is at or near the actual maximum girth a Common Merganser can swallow, then it is probable that a large portion of the gizzard shad population in Caballo Reservoir had exceeded by the second winter the size range that Common Mergansers were capable of swallowing.

Reservoir surface area.—During the first winter, low water levels associated with small reservoir pool size resulted in a shoreline consisting of rocky and sandy substrate with little vegetation. Higher water levels associated with a larger pool size the second winter partially submersed veg-

etation that was above the waterline during the first winter. Partially submersed vegetation provided cover for Common Mergansers, and probably provided cover and food for fish that could be preyed upon by mergansers.

Caballo Reservoir pool size during the first winter of this research was one of the smallest in recent years (USBR, unpubl. data) and Common Merganser numbers were relatively low as well. Merganser numbers were substantially higher during the second winter, coinciding with one of the largest pool sizes recorded for Caballo Reservoir (USBR, unpubl. data). However, since 1980, numbers of Common Mergansers at Caballo Reservoir have been negatively correlated with maximum pool size. Drawdown in 1992–1993 may have contributed to this apparent incongruity as Wegener and Williams (1974) found that extreme drawdowns actually boost fish populations by rejuvenating littoral substrate, aquatic plants, and macroinvertebrate production. The resultant increase in the standing crop of fish in the reservoir provides an increased prey base for piscivorous predators 1–2 yr following the drawdown.

Gizzard shad are pelagic spawners (Sublette et al. 1990), so reservoir pool size should have little impact on reproduction. However, recruitment of other fish species consumed by Common Mergansers on the reservoir is reduced by rapidly changing pool size (New Mexico Department of Game and Fish, unpubl. data). Most gizzard shad in net samples were similar in size, suggesting that a strong year-class existed. Wintering Common Mergansers stopped feeding on gizzard shad by the second winter, but switched primarily to threadfin shad. Managers should attempt to determine causes of strong year-classes in shad on the reservoir and promote consistent annual recruitment of shad to provide a reliable food source for wintering Common Mergansers.

ACKNOWLEDGMENTS

Financial support for this research was provided by the New Mexico Agricultural Experiment Station and U.S. Bureau of Reclamation through a cooperative agreement with New Mexico State University. Research was conducted under the auspices of the New Mexico Cooperative Fish and Wildlife Research Unit. Cooperators include: U.S. National Biological Service, New Mexico State University, New Mexico Department of Game and Fish and Wildlife Management Institute.

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Received 1 Dec. 1995; accepted 18 Mar. 1996.