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PROPAGATION OF CAPTIVE EASTERN SCREECH-OWLS

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ABSTRACT.—A colony of captive Eastern Screech-Owls (*Otus asio*) was established at the Patuxent Wildlife Research Center in 1967. During 1981–86, birds were housed in outdoor cages and fed a commercial bird of prey diet, day-old chicks and laboratory mice. Sex was determined by laparoscopy. In 1984–86 pair assignments were made with assistance of computer generated parentage data in order to reduce the level of inbreeding. Most known causes of adult mortality were related to attacks by cage mates and to trauma. Owl weights increased with age and fluctuated with season; birds were heaviest in the fall and lightest in the summer. In 140 nesting attempts involving first clutches average clutch size was 4.63 eggs, 3.21 eggs hatched/attempt, and 3.03 young fledged/attempt. Seventy percent of eggs hatched. Infertility and embryo death were major causes of egg failure. Ninety-four percent of all nestlings fledged. Most nestling losses occurred due to unknown causes during the first week following hatching. Eighty-four percent of nesting attempts produced at least one young. Few second clutches were laid, and the success of these clutches was generally poor. Most yearling birds did not attempt to breed. Techniques for the care and breeding of this species in captivity have made it suitable as a laboratory animal for use in a variety of studies.

Many species of owls have been bred in captivity (for examples and species listings see Muller 1970; Wayre 1970; Yealland 1970; Harrison 1974; Sayers 1976), including the Common Barn-Owl (*Tyto alba*) which has been bred in large numbers (Mendenhall et al. 1983). The Eastern Screech-Owl (*Otus asio*) was bred in captivity 100 yr ago (Carpenter 1883). A colony of captive Eastern Screech-Owls was established at the Patuxent Wildlife Research Center (PWRC) in 1967. Early work on the colony involved the development of methods for managing and captive breeding followed by use of pairs to determine the effect of DDE on eggshell thickness (McLane and Hall 1972), and the effects of Aroclor 1248®[1] (PCBs), endrin, fluoride, and Kelthane® on reproduction (McLane and Hughes 1980; Fleming et al. 1982; Hoffman et al. 1985; Wiemeyer et al., unpubl.).

Descriptions of basic colony management and propagation methods have been very brief in earlier reports on the effects of contaminants on Eastern Screech-Owls. Herein, I describe recent techniques for captive breeding screech-owls at PWRC and present information on reproductive success for 1981–86. Data are from birds not involved in contaminant studies, except as specifically noted.

METHODS

Source of Birds. The colony was established with 20 wild owls taken in Ohio as nestlings from the area described by VanCamp and Henny (1975). Ten additional nestlings were obtained in 1980 from the same location in order to improve genetic diversity. Three additional owls obtained during the early years of the colony are presumed to have come from Maryland. The original 20 birds from the wild were not present in the colony in 1981, nor were those obtained in 1980 present in 1986.

Facilities and Maintenance. Most birds were housed in outdoor pens 12.2 × 2.4 × 2.1 m high. Forty pens were in the primary unit, 20 pens in each of two rows, with the backs of the rows in common. Each pen also had its long sides in common with adjacent pens. Pens were constructed of a wooden frame with top, sides and interior partitions of 2.5 cm mesh wire netting. Netting on sides and partitions was buried to prevent burrowing into pens by mammalian predators and movement of owls be-

[1] Use of trade names does not constitute endorsement by the U.S. Government.

tween pens. Access to each pen was provided by a 0.9 × 1.8 m door. An electric fence encircled the area in which the pens were located.

Each pen was equipped with a nest box, shelter box, wooden perches, a sheltered feeding platform and a water pan. Nest boxes were 28 × 32 cm and 37–43 cm tall with a sloping, removable roof to allow cleaning of box interiors. Each box had an 8 cm dia opening in front with an external perch directly beneath. An internal perch was placed under the entry hole about 18 cm above the floor. The back of the box had a 13 cm dia access and observation hole with hinged, wooden, 16 cm^2 door and a latch. Boxes were mounted on the front of pens with their backs abutting the wire, allowing for inspection of contents from outside the pens through the observation door and a hole in the wire. Several centimeters of fine hardwood chips were placed in the bottom of each box. Chips were replaced following and immediately preceding each reproductive season. Boxes were disinfected and washed with a high pressure washer following each reproductive season.

Shelter boxes were 40 cm^2 plywood and opened at the front and bottom; each contained a 1.8 cm dia dowel perch. One box was placed in the rear corner of each pen. A 55 × 120 cm plywood sheet was placed on the top of each of two rear abutting pens over the top of the shelter boxes. Other perches in the pens were variable, and included: swinging perches suspended from the roof by wire strands; a stationary 1.8 cm dia dowel perch, 90 cm long, attached to an interior post and shared by two adjacent pens; and one to two, 1.6–2.0 cm dia dowel perches 45 cm long attached to or through an 80 cm vertical, 4 cm^2 wooden post suspended from the center of a horizontal 45 cm^2 plywood sheet attached to the pen roof.

Sheltered feeding platforms, open on the front and back, were plywood with bases 24 × 27 cm. The sides supported a sloping roof 18–23 cm above the platform base; roofs were 29 × 40 cm. Aluminum flashing covered the top surface of each platform base and extended 11 cm up each of the interior sides. A perch (1.8 cm dia dowel, 30 cm long) supported by wooden strips extending along each side of the platform exterior was located 3 cm away from the front of the platform, and at the same level as the base. A stainless steel insert tray was placed on the platform base and was removed periodically for cleaning. Feeding platforms were mounted on a post at the front of the pens. The rear of the structure abutted and was attached to the wire. A hinged wire door provided access to the platform from outside each pen.

Stainless steel water pans (20 cm dia × 7 cm deep) were placed on stands about 0.6 m above the ground. Pans were cleaned 2–3 times/wk. Each pen was equipped with a 110 volt electrical outlet. Electrical warmers were placed under water pans during winter so that water was always available.

Secondary units of pens measuring 14.3 × 3.0 × 1.8 or 2.0 m high housed some birds in certain years. The pens were equipped in the same general manner as those described above except each contained two shelter boxes.

Vegetation in the pens was controlled by periodic mowing, except during incubation, and in some years when nestlings were present. Short vegetation in the pens facilitated finding newly fledged young and allowed them to move to sheltered areas, reducing the likelihood of their becoming soaked during wet weather. Spot applications of a granular herbicide (Tordon®) were occasionally used to control woody vegetation and vines in some pens.

Sex Determination and Pairing. Sex of each owl was determined during its first winter by laparoscopy conducted under local anesthesia, except in December 1984 when no anesthesia was used. Birds were usually returned to their pens on the day of the operation. Sex determination sample included 163 ♂♂ (49%) and 170 ♀♀ (51%) for birds produced during 1981–84, which did not deviate significantly from the expected 50:50 sex ratio (χ^2; $P > 0.50$). VanCamp and Henny (1975) reported a sex ratio in wild Eastern Screech-Owls slightly in favor of females (48:52) for the northeastern United States. Fowler (1985) reported a sex ratio of 49:51 for 127 Eastern Screech-Owls found dead on Tennessee roads. Sex ratio of 84 road killed Eastern Screech-Owls in southern Connecticut was not different from 1:1 (Devine and Smith 1985). Sex ratio of captive owls for clutches in which all eggs hatched and the sex of all young was determined was essentially even (66 ♂♂:67 ♀♀).

New pairs of owls were formed each year. Pairing was conducted on 7–27 January 1981, 2 February 1982, 27 January 1983, 16 January 1984, and 21 November 1985. All pairs in the colony during the 1985 reproductive season were used in an experimental study; therefore, no reproductive data are reported. Most individuals that had lost a mate were provided with a new one. When new pairs were

formed, rarely (<5% of pairings) did one bird kill or injure its new mate.

No special considerations appeared to have been made in pairing the owls in 1981, except that siblings were not paired nor were birds paired with their parents. In several cases, members of a pair had one or more grandparents in common. Greater precautions were taken in 1982–83 to avoid pairing closely related individuals; no members of a pair had one or more grandparents in common. All available data on parentage of birds that were or had been in the colony were compiled for computer analysis in 1984 (Miller and Barr 1981). Computer generated coefficients of inbreeding were obtained for all possible new pair combinations for unpaired birds in the colony. Those potential pair combinations with the lowest coefficients (least related) were selected. All new pairings in the years 1984–86 had coefficients ≤ 0.05.

Since the end of the 1981 reproductive season, reductions in the number of birds in the colony have been conducted periodically. The level of inbreeding in the colony in 1981 was considered unacceptable, and there was the occasional appearance of an eye defect which could have had a genetic basis. Several birds with the defect had a common male parent or grandparent. Many birds with common lines of parentage were used in non-reproductive studies (Serafin 1984; Franson et al. 1985; Wiemeyer et al. 1986; Beyer et al., in press) or in the establishment of a new captive colony in Canada to increase the average heterozygosity of the colony.

Adaptation to Pens and Adult Mortality. Owls produced in the colony readily adapted to their pens. Fledglings, however, were often seen with minor injuries to their ceres. Eye injuries were most common, and in severe cases involved the rupture of the eyeball or tearing of the lid. Some eye injuries appeared to result from attacks by cage mates, whereas others may have resulted from striking objects in the pens. Some birds that became blind in one eye were used in non-reproductive studies. Others remained as members of productive pairs. Some torn eyelids were sutured and healed well. Bumble foot was seen infrequently.

Unpaired owls were often housed in groups of three to four/pen. Owls of both sexes were combined in pens prior to sex determination. Thereafter, only birds of like sex were housed in a given pen. A few owls died due to fighting when housed together as non-pairs, especially shortly after their assignment to pens with new pen mates; however, the rate of loss was unsubstantial.

Mortality of adults and fledgings during April 1981–June 1986 resulted from a variety of causes. Data on causes of mortality were primarily based on gross necropsies. Ten owls were euthanized: two had suffered trauma, two were unable to fly, two had eye defects, and one each had a slipped tendon of the leg, eye deterioration, eye injury and an eye infection. Fifteen birds died of unknown causes during this period, and seven died from injuries that apparently resulted from attacks by cage mates. Two birds died of trauma and two appeared to have been killed by predators. Two birds died of emaciation and one bird each died of cardiac hemorrhage, visceral gout and an overdose of anesthesia during surgery. Mortality appeared to be heaviest during May and June (five deaths each month), followed by November and January (four), December and March (three) and July and September (two). No owls died during October and February and only one each died in April and August. Recoveries of banded wild Eastern Screech-Owls, in comparison, were lowest during August and September and highest in March (VanCamp and Henny 1975). Most road kill mortality of Eastern Screech-Owls in southern Connecticut occurred during October–March, with the highest number recorded in March (Devine and Smith 1985).

Diet. From 1981 through the 1982 breeding season, the owls were fed day-old chicks (supplemented with calcium phosphate or calcium carbonate, Vionate® and thiamine) and laboratory mice. Nebraska Brand Birds of Prey Diet® was used in summer 1982 to replace the mice; chicks and the commercial diet were each fed three to four d/wk, alternating days. This diet was continued into the 1983 reproductive season until the first egg hatched in each clutch; chicks were then fed daily. Commercial diet was earlier found to be nutritionally inadequate for nestlings or adults were unable to adequately feed it to them (M. Anne R. McLane, pers. comm.). Commercial diet also became coated with wood chips in nest boxes. Day-old turkey poults were often substituted for chicks. Chicks or poults were fed four d/wk and Nebraska Brand Birds of Prey Diet three d/wk in 1984 until hatching began, when chicks, poults and mice were fed. The same regimen was followed in 1986 except that poults were not substituted for chicks. Mice were used about two d/wk because of their expense. Owls were fed slightly more

Table 1. Mean weights (g) of captive Eastern Screech-Owls in relation to age and season.

AGE AND DATES OF WEIGHING	MALES				FEMALES			
	N	$\bar{x}$	SE	RANGE	N	$\bar{x}$	SE	RANGE
<One year[a]								
9 Nov 1981–20 Jan 1982	52	173.6	2.4	(146–215)	55	193.1	2.4	(152–238)
7 Dec 1982–21 Jan 1983	18	186.2	4.8	(156–222)	26	210.5	4.3	(178–262)
18 Oct–15 Nov 1983	31	170.5	1.7	(150–187)	33	187.8	3.3	(154–258)
7–28 Dec 1984	54	180.8	2.1	(148–210)	49	201.9	2.8	(170–252)
≥One year								
30 Nov 1981[b]	33	216.2	3.8	(158–256)	33	247.5	4.8	(188–300)
2 Feb 1982[c]	25	182.6	3.7	(160–222)	25	198.4	4.2	(169–244)
27 Apr 1983[d]	—				18	196.9	3.3	(180–228)
18 May 1983[e]	—				13	183.1	4.0	(167–215)
22 Jun 1983[e]	—				13	180.5	3.4	(168–214)
12 Oct 1983[e]	—				13	201.9	5.7	(176–250)
28–29 Nov 1984[f]	16	204.9	7.3	(158–254)	16	260.7	8.6	(210–310)
8–9 Jan 1985[f]	16	211.1	5.8	(167–245)	16	264.1	7.6	(212–310)
8–9 Jan 1985[g]	25	190.1	3.1	(153–225)	30	221.3	5.0	(173–264)
21 Nov 1985[h]	34	210.4	3.2	(170–246)	36	232.0	3.9	(192–282)
27 Feb–3 Mar 1986[h]	34	168.7	1.7	(145–190)	36	203.9	3.5	(163–263)

[a] Weights for birds <one yr old were taken at the time laparoscopies were conducted. Birds were housed three to four/pen.
[b] Paired birds.
[c] Weights at time of pairing; previously one to three birds/pen.
[d] Unpaired; two to three birds/pen.
[e] Same females weighed repeatedly; all hatched in 1982.
[f] Previously paired birds hatched in 1982 or earlier. Birds remained in same unit of pens before first weighing and between weighings Same birds weighed on both dates.
[g] Birds paired in 1984; all hatched in 1983. They were housed in a different unit of pens than the older birds weighed on the same date
[h] Birds paired on 21 November 1985; all hatched in 1984. The same birds were weighed on both dates.

than they would eat; each was provided ≥35 g of food/d. Leftover food items were removed from trays daily and from nest boxes, where much food was cached, especially when nestlings were present, at least twice weekly. One or two fresh food items were left in nests when nestlings were present. Food was placed on food tray inserts on the water warmers to prevent freezing before consumption during winter months.

Weights of Birds. Owls were weighed when laparoscopies were conducted and occasionally at other times, although not on a systematic basis (Table 1). Young birds generally weighed less than older birds during October–January. Males (N = 42) averaged 181.1 g (SE = 2.4) when <one yr old in December 1984 and 212.0 g (SE = 3.0) on 21 November 1985, a significant increase ($P < 0.001$; paired t-Test). Females (N = 50) of the same cohort averaged 202.8 g (SE = 2.7) in December 1984 and 230.1 g (SE = 3.1) on 21 November 1985 ($P < 0.001$; paired t-Test). The average weight gain for this period for males and females was 17% and 13%, respectively.

Weights also fluctuated with season. Owls were heaviest in October–November, but weights declined by January or February. Sixteen older pairs had similar weights on 28–29 November 1984 and 8–9 January 1985 (Table 1; $P > 0.10$; paired t-Test). More than 30 paired birds of each sex that hatched in 1984 weighed significantly less in February 1986 than on 21 November 1985 (Table 1; $P < 0.001$; paired t-Test). Males lost nearly 20% and females 12% of their weight during the winter.

Weights were the lowest in summer, but increased significantly by October. No significant change in weight was noted for 13 females between 18 May and 22 June 1983 (Table 1; $P > 0.10$; paired t-Test), but they were significantly heavier on 12 October than on 22 June (Table 1; $P < 0.001$; paired t-Test), an increase of 12%. Although the annual weight cycle of wild Eastern Screech-Owls is not

well defined, Henny and VanCamp (1979) also reported a weight gain between the spring (April–May) and fall–winter (October–February) months with a peak in October–December and suggested that weight loss occurred in January and February. However, no major weight loss occurred during the spring and early summer (mid-April to mid-June). Their weights during April–June were primarily of breeding birds, whereas the limited data for the captive owls were from paired, but nearly all, nonbreeding females. The weight cycle of captive Eastern Screech-Owls may be somewhat different than that of wild birds due to their access to a constant food supply. Captive owls tended to be heavier than wild owls in Ohio as reported by Henny and VanCamp (1979) and those reported by Earhart and Johnson (1970) for museum collections. Captive females weighed an average of 15.8% more than males, which is similar to the 15.3% and 16.4% differentials between sexes reported for wild screech-owls (Earhart and Johnson 1970; Henny and VanCamp 1979).

RESULTS

Clutch Size. Captive owls laid first clutches of 2–8 eggs (Table 2). Five-egg clutches were most common, followed by four- and six-egg clutches. Frequency distribution of clutch sizes for captive females was significantly different (χ^2; $P < 0.05$) from that of wild females in Ohio where the mean clutch size (N = 91) was 4.43 eggs (VanCamp and Henny 1975). Murray (1976) reported a mean clutch size (N = 96) of 4.06 based on eggs in museum collections for the region and latitudinal area encompassing northern Ohio. Captive birds laid more six-egg clutches and fewer four-egg clutches than wild birds in northern Ohio (VanCamp and Henny 1975). Seven- and eight-egg clutches were not observed in the wild population but were seen on a few occasions in captivity. However, one brood of seven young was observed in northern Ohio (VanCamp and Henny 1975). Some unpaired females laid eggs while housed in pens with other females; data from these birds were not included in the above analysis.

Hatching Success. Seventy percent of all eggs laid in first clutches hatched (Tables 2 and 3). Hatching success of yearling females exceeded that of older females; every yearling female that laid hatched at least one egg. Hatching success by yearling females averaged 84%, whereas that of older pairs never exceeded 76% in any year and averaged somewhat lower ($\bar{x}$ = 69%).

Table 2. Frequency of clutch and brood sizes for captive Eastern Screech-Owls, 1981–86.

Clutch or Brood Size	Eggs Laid (%)	Eggs Hatched (%)	Young Fledged (%)
0	—	19 (14)	22 (16)
1	0 (0)	7 (5)	10 (7)
2	5 (4)	17 (12)	16 (11)
3	20 (14)	28 (20)	27 (19)
4	36 (26)	31 (22)	31 (22)
5	46 (33)	29 (21)	27 (19)
6	26 (19)	8 (6)	7 (5)
7	5 (4)	1 (1)	0 (0)
8	1 (1)	0 (0)	0 (0)
Mean	4.63	3.21	3.03

A number of factors were involved in the failure of eggs to hatch. No embryo was detected in 42% of unhatched eggs, but small embryos may have gone undetected. Dead embryos were found in 15%, while eight percent of the eggs disappeared. Some of the latter may have hatched, but died shortly thereafter and were removed or consumed by the parents. Ten percent of eggs that failed were cracked or broken; some were also infertile or had dead embryos, but were not included above. Breakage in many cases was caused by struggles of females (kicking of eggs) when nest box contents were being examined. Boxes of pairs that had completed clutches were normally examined only once/wk until hatching was expected. Boxes were examined daily during egg laying in most years. Eleven percent of egg failures were due to abandonment during incubation, four percent were not examined for embryo development, and nine percent were not incubated. Egg abandonment and failure to incubate were most severe in 1986 (nine clutches).

Broods of three, four and five young were most common at hatching (Table 2). Broods of five young were predominant in 1984, broods of three and four were the most common in 1981 and 1986, and broods of two were most frequent in 1983.

Fledging Success. Ninety-four percent of all known hatchlings fledged during 1981–86 (Tables 2 and 3). Some early loss of young could have been undetected and attributed to egg disappearance. An average of 3.03 young fledged/laying pair and 3.59 fledged/successful attempt. VanCamp and Henny (1975) reported that 3.80 young fledged/successful

Table 3. Reproductive success of captive Eastern Screech-Owls, 1981–86.

Year and Group	No. Pairs			Eggs Laid		Eggs Hatched			Young Fledged			% Laying Pairs Successful[a]
	Total	With Eggs	%	N	Mean/ Clutch	N	Mean/ Clutch	%	N	Mean/ Clutch	% of Eggs Hatched	
1981												
Yearlings[b]	14	9	64	33	3.7	29	3.2	88	28	3.1	97	100
>One yr old												
Previously productive	10	10	100	53	5.3	37	3.7	70	34	3.4	92	80
Not previously paired[c]	18	17	94	82	4.8	50	2.9	61	48	2.8	96	82
Miscellaneous	6	4	67	17	4.3	7	1.8	41	3	0.8	43	75
1982												
Yearlings[d]	7	2	29	8	4.0	7	3.5	88	7	3.5	100	100
Older	9	8	89	40	5.0	29	3.6	73	28	3.5	97	88
1983												
Yearlings[d]	14	1	7	5	5.0	2	2.0	40	2	2.0	100	100
Two yr olds[e]	6	6	100	23	3.8	16	2.7	70	14	2.3	88	67
>Two yr olds[f]	15	15	100	70	4.7	50	3.3	71	47	3.1	94	100
1984												
Yearlings[b]	6	1	17	5	5.0	5	5.0	100	5	5.0	100	100
Two yr olds	14	13	93	63	4.8	48	3.7	76	47	3.6	98	100
>Two yr olds[g]	20	18	90	98	5.4	70	3.9	71	69	3.8	99	83
1986												
Two yr olds	43	36	84	146[h]	4.2	99	2.8	68	92	2.6	93	72

[a] A successful pair is one fledging one or more young.
[b] Both members of all but one pair were yearlings; one yearling female paired with older male.
[c] No record of previous pairing.
[d] Both members of each pair were yearlings.
[e] One female had a yearling mate.
[f] Some females had mates that were at least two yr old.
[g] One female with a two-yr-old mate.
[h] Clutch size unknown for one pair; broken eggs found on ground long after laying.

nest in Ohio, only slightly in excess of captive production, and estimated that 2.63 young fledged/nesting attempt, a value somewhat lower than the production of captive owls. The number of young fledged/captive pair was higher in 1982 and 1984 than in 1983 and 1986. Fledging success was variable in 1981 in relation to age and past reproductive history (Table 3).

Cause of most nestling deaths was unknown, because in many cases young disappeared. Most losses occurred during the first week post-hatch. Documented causes of nestling deaths involved the loss of one young each to aspergillosis, pneumonia, umbilical hemorrhage, possible food compaction in the ventriculus and a fractured leg resulting in septicemia.

Second Clutches. Ten second clutches were laid after 19 first clutches failed to hatch. Nine were laid after the first clutch was abandoned during incubation or the female failed to initiate incubation. Eight eggs hatched in three second clutches and all nestlings fledged. However, three were hand-reared following the death of a female parent and failure of the male to feed the young in one brood. One female died while incubating a second clutch. One third clutch was laid in 1984 following the aban-

donment of two earlier clutches. Four of six pairs laid a second clutch in 1983 after their first clutches were removed immediately before hatching.

Second clutches have also been laid following death or removal of hatchlings from first clutches. A second clutch was laid following the death of a single first clutch young within 24 hr of hatching in 1986; the second clutch failed. Two control pairs in a contaminant study (Hoffman et al. 1985) laid second clutches in 1982 after their first clutch young were removed at seven days of age; one second clutch failed and the other produced three fledglings.

Average size of the first clutch (4.35 eggs) was significantly greater ($P < 0.005$; paired t-Test) than that of the second clutch (3.06 eggs) in 17 cases where second clutches were laid. Greater declines in size between first and second clutches tended to occur when first clutches were incubated full term. VanCamp and Henny (1975) suggested that Eastern Screech-Owls in northern Ohio renested based upon their observations of small young in nests during the first week of June.

Proportion of Females Laying. The proportion of females that laid eggs varied among ages and years. Eight of 13 (62%) yearling pairs produced eggs in 1981: four of six (67%) females taken from Ohio as nestlings and four of seven (57%) captive produced females. Two pairs that involved a yearling bird (one of each sex) paired with an older mate were both successful in producing young in 1981, one being two yr old. Three females (one each two, four, and five yr old) that were paired with males three to seven yr old failed to lay. Two of seven (29%) yearling pairs produced eggs in 1982 and two of three (67%) two-yr-old females laid; one female from Ohio did not lay eggs until 1983 when she was three yr old. Only one of 14 (7%) yearling pairs laid in 1983, although six of six (100%) two-yr-old pairs laid. One additional pair comprised of a yearling male and an older female successfully produced young. One of five (20%) yearling pairs laid eggs in 1984; one yearling female paired with a two-yr-old male did not lay. Thirteen of 14 (93%) of the two-yr-old pairs laid in 1984. Two of 20 older pairs failed to lay in 1984 which included 12-yr- and 8-yr-old females. Only 36 of 43 (84%) two-yr-old pairs laid in 1986. Decline in the proportion of yearlings that laid in 1983–84 compared to 1981–82 could have been due to change in diet made in 1983. The oldest banded wild Eastern Screech-Owl recovered in the northeastern United States and Ontario for 1915–64 was 12–13 yr old (VanCamp and Henny 1975). One captive 13-yr-old female laid eggs and produced young in 1982 while in a contaminant study (Hoffman et al. 1985); she was sacrificed at the end of the study.

The proportion of females laying as yearlings and when two yr old may also be an indication of age of sexual maturity. Sixty-two of 72 (86%) two-yr-old females laid during 1981–86, compared to 13 of 41 (32%) yearling females. VanCamp and Henny (1975) estimated that 77–83% of wild yearlings attempted to nest. Although captive yearling females from Ohio nested at near this rate, captive-produced yearling females nested at a much lower rate, especially after 1981.

DISCUSSION

Development of techniques to breed Eastern Screech-Owls in captivity on a large scale has made the species available as a laboratory animal for use in a variety of studies. The species' response to exposure to environmental contaminants can be considered representative of the Order Strigiformes.

Eastern Screech-Owls have several characteristics that make them a desirable laboratory species. They are not readily disturbed by routine maintenance activities around their cages, remaining perched unless closely approached. To date they have not succumbed to disease outbreaks; annual mortality rate was estimated to be well under 10%. They are relatively small and thus easily handled, and space requirements are somewhat lower than for larger species, such as the Common Barn-Owl.

The species also has several characteristics that may be considered disadvantages for a laboratory species. The species exhibits little sexual dimorphism, therefore laparoscopies are required to determine sex, a procedure that causes minor risk to the owls. However, an experienced veterinarian can conduct at least 10 Eastern Screech-Owl laparoscopies per hour if assisted by additional personnel in handling and restraining the birds. Captive owls did not reproduce well until their second year and did not flush readily from their nests, making it difficult to examine eggs or young without attacks on the observer, increasing the risk of accidental injuries to the nestlings by their parents.

Additional research should aid in making the species more desirable as a laboratory animal. The feasibility of artificial insemination should also be investigated. Proper artificial incubation techniques have not been determined. Eggs incubated at 37.6°C and 55% relative humidity experienced high mor-

tality (Bunck et al. 1985). Additional knowledge regarding nutritional requirements and disease would be helpful.

Several contemplated modifications to our facilities should improve care to birds and result in lower maintenance costs. First, new facilities should be constructed with heavily galvanized steel pipe frame and with vinyl bonded welded wire, which should reduce injuries from striking the pen frame and limit damage to ceres from striking rough wire. The life of such a facility should be much greater than those constructed with wooden frames and galvanized wire. All wooden materials used for nest and shelter boxes and feeding stations should be sealed to aid in cleaning and improve sanitation; alternatively such items should be constructed with nonporous materials. Additional shelter, a variety of perch sizes and types and a water delivery system for bathing are also being considered.

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