Increasing Mist Net Captures of Migrant Northern Saw-whet Owls (Aegolius acadicus) with an Audiolure

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Abstract.—In 1986, an "audiolure" was developed and tested at the Little Suamico Ornithological Station near Green Bay, Wisconsin. The audiolure consisted of broadcast amplified "solicitation" calls of Northern Saw-whet Owls (Aegolius acadicus) normally associated with courtship activities. From 1971 through 1985, using passive mist netting at Little Suamico, the mean number of owls captured each autumn was 57. Using an audiolure, from 1987 through 1995, the mean annual catch was 636 owls. During 1989, an audiolure was also tested at Finzel Swamp in western Maryland by comparing captures during adjacent 3-hour time blocks. Use of an audiolure significantly increased capture rates over passive mist netting. Audiolures are now being used by all major Northern Saw-whet Owl banding stations in the western Great Lakes area to net 2,000-3,000 owls each autumn. Audiolures have also proven effective for netting saw-whet owls during both the breeding and wintering seasons. Descriptions of the audiolure and basic characteristics of captures at simple autumn migration netting operations are also presented.

Each year more Northern Saw-whet Owls (Aegolius acadicus) are banded in North America than any other owl species. In the Great Lakes region 2,000-3,000 are banded during each autumn migration. It has been assumed that these small owls, like most diurnal raptors, are reluctant to cross large bodies of water and that they concentrate along certain shorelines. Most bird watchers, unfamiliar with the results at banding stations, still consider saw-whet owls rare and a "great find."

Taverner and Swales (1911) suggested that Northern Saw-whet Owls were migratory during the early 1900s. The first published attempt at capturing and studying numbers of migrant Northern Saw-whet Owls came from the Cedar Grove Ornithological Station located along the Wisconsin shoreline of Lake Michigan. Mueller and Berger (1965) reported that "numbers" of these then "rare" owls could be captured with mist nets left open at night. Using that technique they documented a pronounced autumn migration during October and November, confirming Taverner's (1911) suggestions.

Since the 1960s many other banding stations have tried mist netting migrant owls, with varying degrees of success. The use of mist nets to capture migrant owls has been a passive technique. A general rule of passive mist netting is that to capture more individuals, one must operate more nets and cover more area. This paper details our development and use of audiolures to increase mist net captures of migrant Northern Saw-whet Owls. Use of audiolures significantly increases captures of migrant saw-whet owls while simultaneously allowing a reduction in the number of nets that must be maintained and operated.

STUDY AREAS AND METHODS

The breakthrough was developed in 1986 at the Little Suamico Ornithological Station (LSOS) along the western shore of Green Bay, 17 km north of Green Bay, Wisconsin. Additional testing of the audiolure was conducted in 1989 at Finzel Swamp in the mountains of the Allegheny Plateau, 16 km west of Cumberland, Maryland. Data are also included from banding stations at Assateague Island along the Atlantic Coast, 22 km south of Ocean City, Maryland and along the Casselman River, 40

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km southwest of Cumberland, Maryland. A detailed description of the Little Suamico Ornithological Station can be found in Brinker and Erdman (1983).

At all sites the mist nets used to capture Northern Saw-whet Owls were 12 m, 61 mm mesh. At LSOS, where nets are part of a diurnal raptor banding operation, nets remained open continuously. Maryland stations opened nets at dusk and closed them at dawn. At all stations, nets were checked frequently throughout the night. Nets were not opened during inclement weather.

The initial effort to capture migrant owls at LSOS consisted of placing nets in various locations thought to be good "flight lanes" for owls. In the search for good net sites, various single, double, and triple high net configurations were tried at different locations throughout the years from 1971-1986. This effort peaked at 38 nets in 1978. The audiolure was first used in 1986. Since then, at LSOS all use of nets in outlying areas has ceased, the number of nets operated each year has been reduced by 65 percent, and has remained stable at 12-13 nets.

Netting efforts at Finzel began in 1986 with 10 nets at three sites around the swamp. During 1987, 18 nets were placed in a single area, and by 1988 the effort consisted of 25 nets in an essentially continuous line along a single lane gravel road that crossed the swamp. The line of nets was established to investigate differential habitat use. An audiolure was first used at Finzel during 1989. The net line was reduced to six nets with an audiolure in 1990, and use of this site ceased after 1990. Studies began at Assateague in 1991 and at Casselman River in 1992. Audiolures were used at both Assateague and Casselman since establishment and these sites each operate 6-7 nets annually.

Design of our audiolures varied, but has stabilized around lures that produce sound pressure levels of 100-110 dB at 2 m. On calm nights, at this sound pressure level most people can hear the lures at distances of more than 1.5 km. Audiolures replay the primary solicitation calls of Northern Saw-whet Owls recorded on 3-minute continuous loop tapes. Several tapes with differing call sequences have been used with equal success. All tapes have quiet periods on them, some as long as 30 seconds. Construction details and a schematic of the audiolure are included as an appendix.

As a final test of the audiolure's effectiveness, a rigorous sampling design was applied to its operation at Finzel during 1989. The audiolure was operated on alternate nights during one of two randomly selected 3-hour blocks, either dusk-21:00 or 21:00-midnight. There is a strong seasonality component to capture rate effect. Early in the season capture rate is low and by mid-season it is high, capture rate then declines as the season progresses and comes to a close. Seasonality is not a linear effect, it is most similar to a quadratic relationship. The sampling design controlled for seasonality by treating each test night as a replicate. The design also controlled for major variation in weather effects that differed between test nights. Variation from weather effects occurring during the dusk-midnight period and time-of-night effects were relegated to random error. The difference between the two treatments, lure on or lure off, was tested with Analysis of Variance using SAS' General Linear Model (GLM). Although a Paired T-test could have been used to simply test for treatment effect, the GLM approach was used to facilitate providing an estimate of the total number of owls that would have been trapped during the 1989 season with and without the use of an audiolure. GLM was used to output daily predicted values for both treatments. To obtain the total for the season, daily predicted values were summed by treatment. When the GLM was run, date was a significant effect and the quadratic expression of date very closely approached significance.

RESULTS

The simplest and most dramatic test of the effectiveness of the audiolure was the significant difference in total annual captures at LSOS between the 1971-1985 passive netting period and 1987-1995 audiolure period ($F = 415.67$, $P < 0.0001$, fig. 1). The mean number of owls captured in the passive netting period was 57 (range 15-108). The greatest number of owls captured during the passive netting period occurred in 1978, the year when the maximum number of nets was operated. During the audiolure period the mean number of owls captured was 636 (range 526-864).

The test at Finzel Swamp also showed that an audiolure used with mist nets captured significantly more saw-whet owls than passive mist

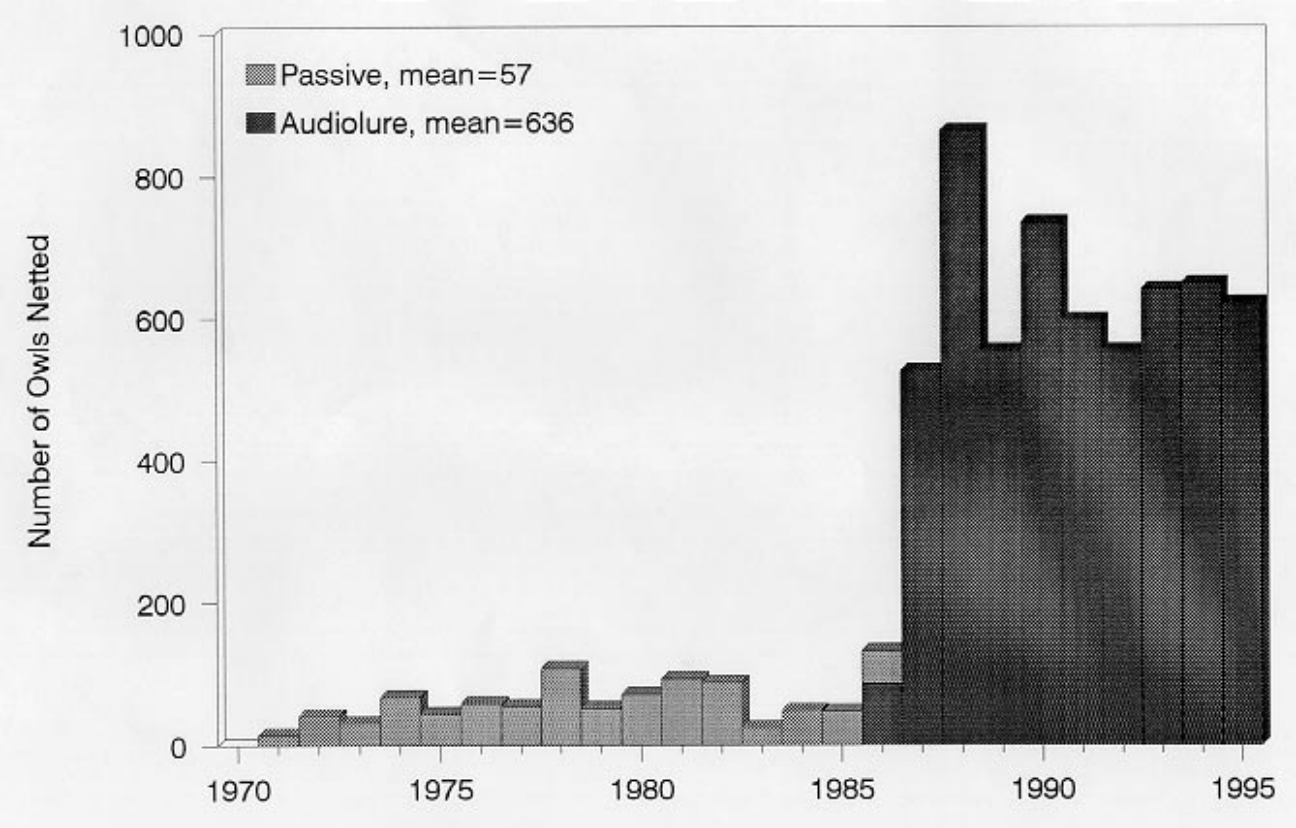

Figure 1.—Captures of Northern Saw-whet Owls (Aegolius acadicus) at the Little Suamico Ornithological Station near Green Bay, Wisconsin from 1971 through 1995. The difference between passive and audiolure mist netting was highly significant (F = 415, df = 23, P < 0.0001).

netting (F = 6.08, P = 0.002). Figure 2 summarizes the predicted number of owls captured in 5-day periods by treatment. The ANOVA model predicted an increase in captures by a factor of 4. From 1986 through 1988 the highest annual capture of saw-whet owls while using passive netting was 36 (in 1987). During 1989, 65 Northern Saw-whet Owls were captured at Finzel. Including recaptures, 61 percent of the captures occurred during audiolure periods, although the audiolure was used only 16 percent of the time that nets were open. During 1990, an audiolure was used throughout the season, the number of nets operated was reduced from 25 to 6, netting was reduced from dusk-dawn to dusk-midnight, and 114 saw-whet owls were captured.

From establishment of the stations at Assateague Island and Casselman River through the autumn of 1994, these two stations netted a combined total of 465 Northern Saw-whet Owls. In the east, the autumn 1995 migration was exceptional, and 628 saw-whet owls were banded at these two stations. The net arrays at both stations are similar: a relatively straight east-west line of six or seven nets. The distribution of captures by net at these stations is summarized in figure 3, with 1995 depicted separately from preceding years. Little difference was observed in the distribution of captures between 1995 and earlier years. Captures decline as distance from the audiolure increases. The results from Casselman River show a similar relationship near the audiolure but were complicated by a non-homogeneous habitat. The height of capture by net deck at Assateague and Casselman River is summarized in figure 4. Again 1995 data are presented separately from previous years. Most captures (67 percent) occurred within 2 m of the ground, i.e., the bottom net of a two net high rig, and captures decreased substantially above 2 m.

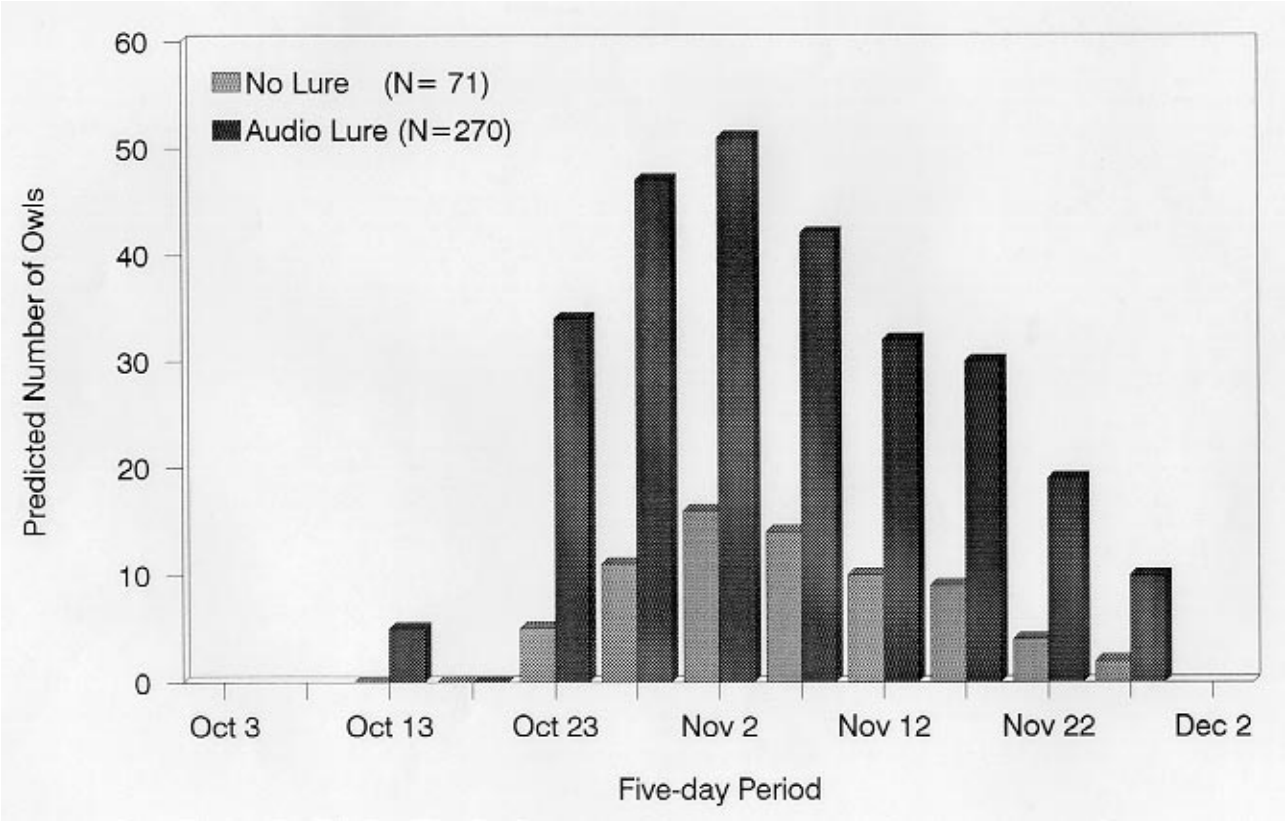

Figure 2.—Predicted number of Northern Saw-whet Owls (Aegolius acadicus) netted by 5-day period at Finzel Swamp, Maryland during 1989. The difference between passive and audiolure mist netting was significant (F = 6.11, df = 30, P = 0.002). N = the total number of owls predicted for each treatment.

DISCUSSION

Owl Captures

Using an audiolure significantly increased the capture of migrant Northern Saw-whet Owls over passive netting. Captures at LSOS increased by an order of magnitude, while the number of nets was reduced by approximately 65 percent. Increases in capture rates at Finzel Swamp, although smaller in magnitude, were also highly significant. Before work at Finzel Swamp, mist netting directed toward migrant Northern Saw-whet Owls had not been attempted in Maryland. Without the use of an audiolure, banding of migrant saw-whet owls would not be practical in Maryland or further south. Other researchers are now netting significant numbers of Northern Saw-whet Owls at sites where previous attempts had failed (E. Jacobs, pers. comm.). Several of these are not near any hint of a classical leading line, such as a shoreline or mountain ridge.

The audiolure is presumed to increase captures by attracting owls to the vicinity of mist nets from considerable distances and by increasing the time owls spend near the nets. Increased residency time near the nets significantly increases the probability of capture. This results in a considerable increase in captures above that of passive mist netting. Because of the strong attractive influence of the audiolure, capture rates at banding stations using audiolures are probably more indicative of larger scale regional and geographic influences than small scale local habitat effects.

The significant increase in captures with use of the audiolure indicated that a small proportion of the possible migrants was being netted with passive techniques. Undoubtedly this proportion has increased since use of audiolures became routine. However, the increase may not be as great as one might suspect. It is apparent from vocalizations that an unknown proportion of the migrants attracted to the vicinity of the mist nets are not being netted.

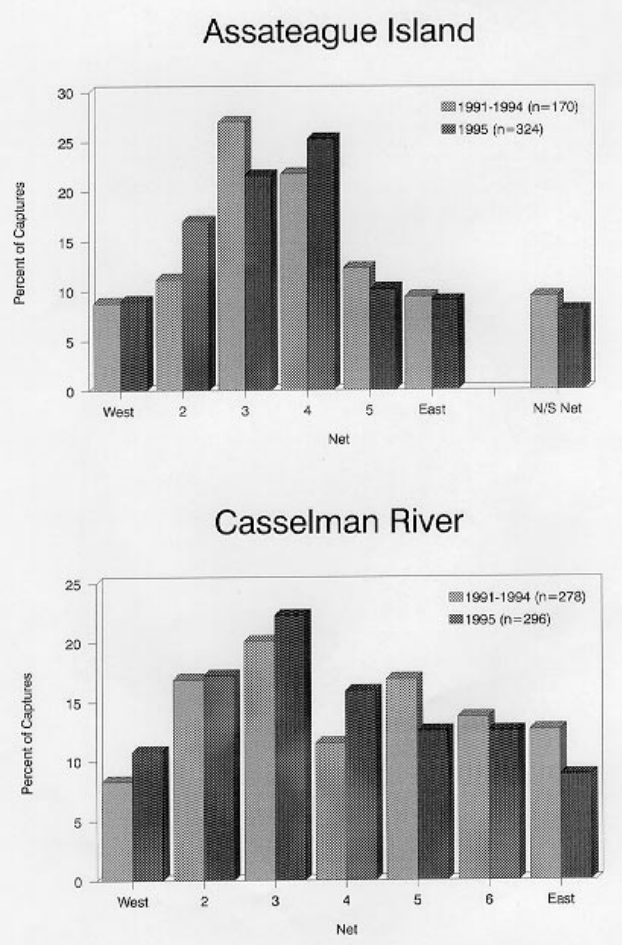

Figure 3.—Distribution of Northern Saw-whet Owl (Aegolius acadicus) captures by mist net using an audiolure at two autumn migration stations, Assateague Island and Casselman River, Maryland, 1991-1994. An exceptional migration occurred during 1995 and these data are reported separately. N = total number of owls for that station and period. N/S refers to a single perpendicular net mid way along the north side of the net line. At Assateague Island the audiolure was positioned at the junction of nets 3, 4, and the N/S net. At Casselman River the audiolure was positioned near the middle of net 4.

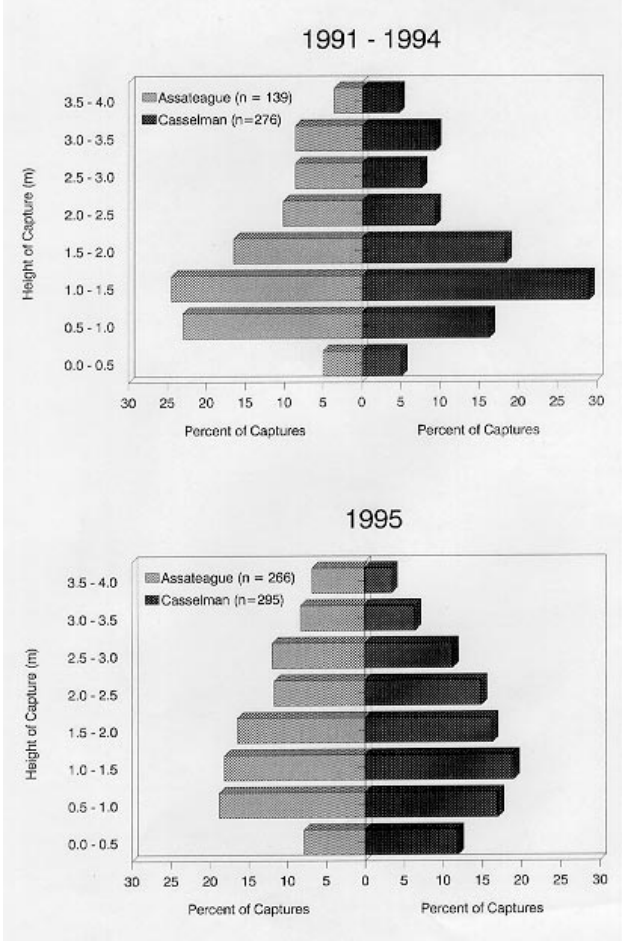

Figure 4.—Distribution of Northern Saw-whet Owl (Aegolius acadicus) captures by height using an audiolure at two autumn stations, Assateague Island and Casselman River, Maryland, 1991-1994. An exceptional migration occurred during 1995 and these data are reported separately. N = total number of owls for that station and period.

As with any improvement in a technique, new problems arise. One complication was housing large numbers of owls until they could be processed. A system of small boxes or mesh bags to individually hold owls is essential. For example, in Wisconsin it is not unusual to have one or more nights per season when over 50-75 saw-whet owls are netted in a night. In cases like this, additional personnel are absolutely necessary to tend nets properly and process birds. Another problem has been the increased threat from ground predators and larger owls. Mammals, such as common striped skunks (Mephitis mephitis), raccoons (Procyon lotor), red foxes (Vulpes fulva), opposums (Didelphis virginia), and feral cats (Felis domestica) have become major threats. The same is true for both resident Great Horned Owls (Bubo virginianus) and wandering Barred Owls (Strix varia). We now have to live trap and remove predators from the netting area continuously.

Observations on the distribution of captures will be useful to others initiating use of an audiolure to net migrant Northern Saw-whet Owls. In Maryland, we use essentially similar net arrays at each banding station. These consist of approximately straight lines of 6 or 7 nets. In homogeneous habitats, such as the open Loblolly Pine (Pinus taeda) forest at Assateague Island, captures concentrate at the nets closest to the audiolure speakers (nets 3 and 4 at the center of the net line) and decrease as distance from the speaker increases (fig. 3). A more complicated pattern was found at Casselman River where the habitat is not homogenous along the net line. These nets have been set up in a small clearing in a grove of eastern hemlock (Tsuga canadensis). Here, a dense stand of hemlock lies immediately south of nets 1 and 2, and there is a large red spruce (Picea rubens) immediately north of the junction of net 2 and 3, and nets 3-7 are in a small clearing with scattered hawthorn (Creategus sp.). Although the speaker was near the center of net 4, there was a very strong tendency to capture owls on the western end of the net array near the large red spruce and dense hemlocks. Northern Saw-whet Owls netted during migration at these sites tend to be low, with approximately 65 percent caught in the bottom net of 2-net high sets. The capture height at Casselman River is slightly higher than at Assateague because of the large red spruce north of net 3.

Audiolures have great potential to improve capture techniques for other species. We have found it to work for Eastern Screech- (Otus asio), Boreal (Aegolius funereus), Great Horned, and Barred Owls. Audiolures placed atop walk-in traps has also significantly improved capture success for migrant Soras (Porzana carolina). Annual captures used to be less than 35-40 individuals and now more than 500 are captured each season (G. Kearns, pers. comm.).

Portable audiolures can easily be used for other applications such as playback response survey and census efforts. We have used an audiolure successfully to mist net wintering Northern Saw-whet Owls as part of a mark recapture experiment on Assateague Island. We have also netted individual owls and family groups during the summer breeding season with the use of a mist net and audiolure.

Audiolure Construction

Construction and operation of an audiolure is relatively simple and inexpensive. The total cost of a recorder, storage battery, battery charger, amplifier, voltage converter, and outdoor speakers is approximately $200-$300 (U.S.). Good deep-cycle rechargeable 12v DC wet cells (RV/Marine battery) will last 10 to 14 days without recharging. For an additional $100 or so, a solar panel can be used to recharge the 12v battery in remote locations where 120v AC current is not readily available. An alternative power source is a sealed rechargeable lead-acid battery, commonly used for home security systems. These small batteries (9 x 11 x 7 cm) provide 4 amp-hours of current and are sufficient to run the audiolure for a 12 hour period. They can be recharged in approximately 4 hours. With a few extra accessories, it is also possible to run the audiolure from the cigarette lighter of a nearby vehicle. We recommend not wasting money trying to use standard C or D sized dry cells made for use in portable tape recorders. Even the most expensive dry cells seldom last more than one night, while a good quality 12v battery charger can recharge a wet cell in 12-24 hours. The tape used is a 3-minute continuous loop used in telephone answering machines, and costs about $5.00. Shorter loops are available, but they wear out much faster because of the increased number of times that the loop is played per night compared to the 3-minute loop. Just about any speaker will suffice, provided it is of sufficient wattage that it will not be ruined by over-powering and that it is properly protected from the elements.

For permanent sites, we build a weatherproof wooden shelter to house the audiolure. This shelter contains the battery, amplifier, tape player, and other electrical components. Standard coaxial speaker cable is run from the shelter to the speakers. For portable rigs, we use the small sealed lead acid batteries. Along with the other components, everything for a portable rig can be easily carried in a small backpack.

The actual saw-whet owl vocalization was recorded from a commercial bird vocalization record. Interestingly, quality of the call does not seem to matter to the owls, as considerable success was achieved by an associate using a tape recorded whistled imitation.

A schematic of the wiring necessary for an audiolure is presented in the appendix. The schematic illustrates the basic connections necessary to run the tape player and amplifier off a single power source. Either a mono or a stereo tape player can be used. The schematic illustrates wiring for when a mono tape player is used. In that case, the input to the right and left channels must be combined. When a stereo tape player is used, these wires are not connected together. We wire the system so that components are easily replaceable by using jacks and other electrical connectors rather than soldering all connections directly. This allows for quick and easy replacement of any components that may malfunction in the field. When several audiolures are available, this makes it easy to correct problems by simply swapping parts from an unused system.

ACKNOWLEDGMENTS

Over the years many people have assisted in our efforts to study Northern Saw-whet Owl migration; to all of those not mentioned here we offer our most sincere thanks for their contributions of time and effort. Throughout the years, a major contribution to LSOS has been made by our spouses, who have shown unusual support for our addiction to the study of raptor migration. R. Rost, the dairy farmer whose woods and pastures we have occupied since 1971, has been a continual friend tolerant of our unusual activities. Over the last 26 years others who deserve recognition are the assistants, i.e., "gabboons" and moral supporters, without whose help it would have been impossible to maintain thorough annual coverage. In Wisconsin, these people included, D. Erdman, J. Jacobs, G. Zuberbier, J. Steffen, J. Trick, G. Henklemann, B. Haug, and T. Meyer. In Maryland, major contributions were made by J. McKearnan, K. Dodge, J. McConnaughey, G. Shire, and many students from Frostburg State University and Garrett Community College. Funds for work in Maryland were obtained from grants to D. Brinker, J. McKearnan, and K. Dodge by the Maryland Ornithological Society and through in-kind contributions of equipment and housing by the Maryland Department of Natural Resources and Assateague Island National Seashore. Permission to operate on lands under their control was graciously provided by the Maryland Chapter of The Nature Conservancy (Finzel Swamp) and Assateague Island National Seashore.

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Appendix A.—Audiolur e schematic, parts list, and construction notes.

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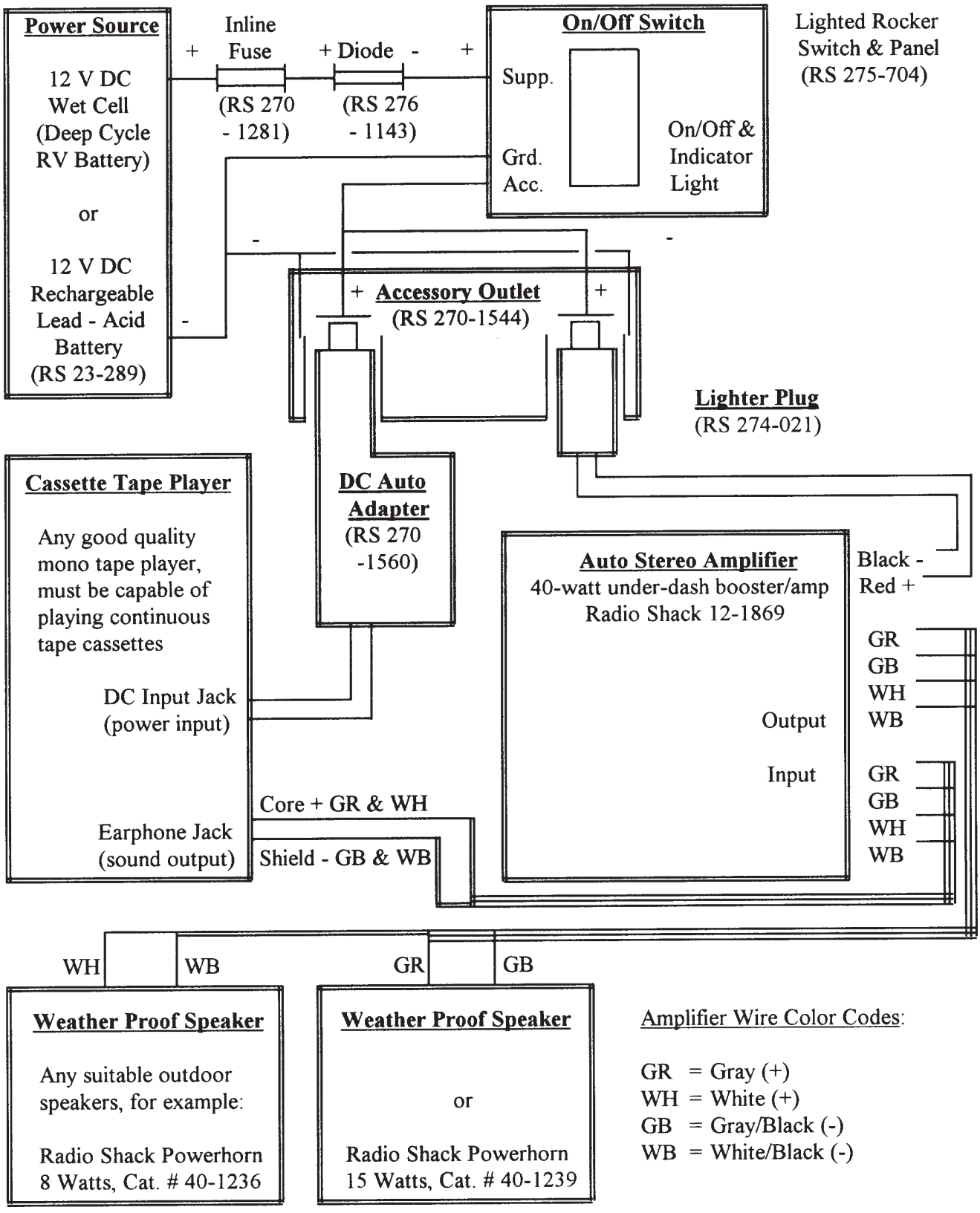

(Appendix A continued)

PARTS LIST

Major Components	Cat. No.	Price	Notes:
Any good quality tape player (for ex. Radio Shack)	14-1156	$49.99	mono
40 Watt Auto Stereo Amplifier	12-1869	$19.99	
Powerhorn Outdoor Speakers			
8 Watts **or**	40-1236	$43.98	cost is for 2
15 Watts	40-1239	$67.98	cost is for 2
Universal DC Auto Adapter	270-1560	$12.99	
Other Components			
Flip Switch/Light Panel	275-704	4.49	On/Off switch
Triple Accessory Outlet	270-1544	9.99	for power supply
Lighter Plug	274-021	3.49	or RS 274-331
In line Fuse Holder & Fuse	270-1281	1.59	
Diode	276-1143	1.19	
1/8" Mono Plug - 2 RCA Phono Jacks	42-2154	2.49	Y Adapter
RCA Phono Plugs (pkg. of 4)	274-319A	1.99	4 males required
RCA Phono Jacks (pkg. of 4)	274-337	2.59	2 females required
Quick Disconnect Connectors	64-3049	1.49	misc. connections
Heat Shrink Tubing Assortment	278-1627	1.99	misc. short protection
18 Gauge R/B Wire	278-567	4.19	misc. wiring needs
Endless Loop Cassette Tape (3 min. preferable)	EC-3M	3.78	suggest TDK
Tape Player Cleaner	44-1116	3.99	
12v Deep Cycle Wet Cell Battery (for ex. Sears RV-Marine)	96493	$75.00	

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Nominal Cost - all components purchased new, battery and tape player already available, substitute speakers also available — $76.24

Minimum Cost - all components purchased new, battery and tape player available, two 8 watt speakers — $120.22

Average Cost - all components purchased new, battery and tape player available two 15 watt speakers — $144.22

Maximum Cost - all components purchased new, Radio Shack Tape Player — $269.21

CONSTRUCTION NOTES

Almost all parts can be purchased from Radio Shack. In the schematic and parts list, RS 000-000 or (RS 000-000) represent Radio Shack part numbers. Other supply houses sell comparable parts for similar costs.

The following instructions and notes assume use of a mono tape player and construction of an audiolure that is designed to be housed in an outdoor shelter, such as a weatherproof wooden box. Common deviations will also be included. The instructions will include use of materials that allow quick disassembly and replacement without soldering, as much as possible, to facilitate quick field repairs.

Because this is a direct current (DC) system, throughout construction correct polarization is essential. If polarity is incorrect, components will not operate or may be damaged. This is particularly true of the tape player and amplifier. If audio input/output from the tape player and amplifier it is not correctly polarized, a noticeable loss of volume will occur and the amplifier may be damaged. The safest way is to test the tape output with a volt meter to determine polarity. A usually adequate compromise is to use preconstructed components and shielded cable.

Begin with the amplifier. There are ten wires that exit the back of the amplifier. The red and the black wires are for the power input. Red is positive (+) and black negative (-). Take the red wire (+) from the amplifier and slide a piece of the appropriate diameter heat shrink tubing over the wire. Connect the red wire to the (+) wire of the lighter plug and soldier together. Once the joint is cool, slide the heat shrink tubing down over the connection and shrink the tubing by holding it over a candle flame. Place heat shrink tubing over the black wire, connect the wire to the (-) wire of the lighter plug, soldier together, etc. If you want to make this connection stronger and more resistant to breakage from rough handling, do the following. Before connecting the wires together, place a larger diameter piece of heat shrink tubing over the wire from the lighter plug. After making the connections of the red and black wires, including shrinking the small diameter pieces of tubing over them, slide the large diameter tubing over the two smaller pieces and shrink it down also. This will provide a relatively strong connection that can withstand much abuse.

For use with either a mono or stereo tape player, connect RCA phono plugs (♂) to the input wires of the amplifier. Take a red plug for the right channel input wires (gray & gray with black strip) and unscrew the plastic cover. Notice that negative (-) wires have the black stripe. Feed the two wires through the cover. Connect the gray (+) input wire to the short tab and soldier it. Connect the gray-black (-) input wire to the long tab and soldier it. Lay the two wires against the long tab and squeeze the tab's wings around the pair of wires to lessen the risk that the wires will be pulled from their connections. Slide the cover down and screw it on tight. Take a black plug for the left channel input wires (white & white with black stripe) and connect the plug as described for the right channel. To "fool proof" the amplifier, use RCA jacks (♀) for the output wire connections. Take a red jack (♀) for the right channel output wires (gray & gray with black stripe) and unscrew the plastic cover. Feed the two wires through the cover. Connect the gray (+) output wire to the short tab and soldier it. Connect the gray-black (-) output wire to the long tab and soldier it. Complete as with input plugs.

When connecting the amplifier to a mono tape player, plug the Y adapter into the earphone jack of the tape player. Then plug the two RCA phono plugs from the amplifier input into the two jacks of the Y adapter. This will direct audio output to both channels of the amplifier. For a stereo tape player purchase a 1/8" stereo plug - 2 RCA phono jack adapter (RS 274-369, $3.59). Substitute this for the Y adapter.

The speakers come with bare wire ends. Connect a RCA phono plug (♂) to each of the speakers. The wire with the white stripe is the positive (+) wire that goes to the short tab. The wire without the stripe is the negative wire that goes to the long tab. To locate the speakers at a distance from the audiolure, use shielded speaker cables with plugs (♂) and jacks (♀) at opposite ends, for example RS42-2363, a 12 foot cable ($3.49).

There are a variety of options for connecting the amplifier and tape player to a power source. For example, one of the simplest is to operated the audiolure from the cigarette lighter of a vehicle. Purchase a DC-Y adapter (RS 270-1535, $5.99) and plug it into the vehicle's cigarette lighter outlet. Then plug the amplifier into one of the two outlets. Plug the universal DC auto voltage adapter into the other outlet. Set the voltage on the DC adapter to the correct setting for the tap player being used (often 6v). Set the polarity of the adapter output to match that required for the tape player. Connect the tape player to the amplifier, connect up the speakers, and the audiolure is set to operate. For use with a 12v wet cell in a weatherproof box, additional wiring is necessary.

Mount the on/off switch and the triple accessory outlet at some convenient location on the inside of the box. Use the 18 gauge supply wire to make the following connections. To obtain red and back wires, the 2-connector supply wire can be split. Throughout the following, all bare connections should be protected with either heat shrink tubing or electrical tape to prevent shorts. Crimp a female quick connector to a red piece of the supply wire. Soldier the opposite end to the negative (-) side of the diode. The purpose of the diode is to prevent equipment damage if the battery is connected with the polarity reversed. To the positive end (+) of the diode attach one end of the fuse holder (polarity is not important). The opposite end of the fuse holder is attached to the positive pole of the battery, either directly or via a second piece of supply wire. The completed audiolure draws a current of less than 0.5 A and a 2 or 3 amp quick blow fuse is sufficient protection. The female quick connector is connected to the supply (supp) tab of the on/off switch. Crimp female quick connector to a piece of black supply wire. To the opposite end, soldier two more pieces of black supply wire. One end of the two black wires is connected to the negative (-) pole of the battery. The other black wire is soldiered to the black (-) wire on the triple accessory outlet. The female quick connector is connected to the ground (grd) tab of the on/off switch. Lastly take a piece of red supply wire and crimp a female quick connector to one end. Soldier the other end to the red (+) wire of the triple accessory outlet. Connect the female quick connector to the accessory (acc) tab of the on/off switch. Plug the DC adapter and amplifier power supply plugs into the triple accessory outlet and proceed as described for powering from a vehicle.

ADDITIONAL SHORT NOTES:

Only one in-line fuse needs to be purchased, a second comes with the amplifier. Two fuses are used for added equipment protection. With added risk to equipment, a small cost savings can be obtained by only using the fuse supplied with the amplifier. This puts the tape player at some risk. Some lighter plugs and DC voltage adapters come with fuses in their tips. If power problems are encountered, check fuses , including those in plug tips.

A cost savings can be obtained by eliminating the on/off switch. To turn system on/off the battery must then be connected/disconnected each time, or plugs pulled from the accessory outlet.

The diode is highly recommended. It protects equipment from damage due to cross polarization when the battery leads are connected to the wrong battery poles. Basically it is very cheap insurance (i.e. additional "fool proofing")! However, if installed backwards the audiolure will not work.

Any suitable means of connecting the various components can be substituted for the triple accessory outlet and lighter plug used here. The recommended arrangement preserves the most flexibility in other uses of the equipment, such as from an auto cigarette lighter.

Be sure to set the DC power adapter for the correct voltage. Also be certain that the polarity of the input jack is correct to avoid damaging the tape player. The tape player will not operate properly if the voltage is too low or the polarity incorrect!

To cut costs, any available 8 ohm speakers can be used. Generally, the higher the wattage of the speakers, the more volume and thus the better the system will perform (i.e. attract owls). Combined wattage of the two speakers should not exceed 40 watts. When using lower power speakers, care must be taken not to overpower, and thus ruin the speakers. However, we have found the smaller and less expensive 8 watt speakers to perform as well as or better than the larger 15 watt speakers.

Solder all wire connections for best performance! Twisted poor connections end up being a headache and reduce system performance.

Loop cassettes have more internal friction than regular cassettes and do not work well in some tape players with an auto-stop feature. If you purchase a tape player, first check to see that it plays loop cassettes well. A safer bet is to not purchase one with an auto-stop feature.