Stephen R. Cook[1] *and Gilbert Proulx*[1]

Mechanical Evaluation and Performance Improvement of the Rotating Jaw Conibear 120 Trap

---

REFERENCE: Cook, S. R. and Proulx, G., **Mechanical Evaluation and Performance Improvement of the Rotating Jaw Conibear 120 Trap,"** *Journal of Testing and Evaluation,* JTEVA, Vol. 17, No. 3, May 1989, pp. 190-195.

ABSTRACT: The momentum and clamping force values of a standard Conibear 120 rotating jaw animal trap and various modifications were determined using accelerometers and a load cell. These values were then compared against each other and against previous biological studies to determine which have the potential to quickly kill select species of animals.

It was found that by increasing the strength of the springs, and by adding clamping bars to the traps, it was possible to significantly increase both the momentum and clamping force of the standard Conibear 120 trap.

The Conibear 120 does not meet the requisites of the Canadian General Standards Board. More work should be done on traps, such as the C120 Mark IV, which do meet these requirements.

KEY WORDS: Conibear 120 trap, killing traps, momentum, clamping force, waveform analyzer, accelerometers, load cell

The harvesting of wild furbearing animals for their pelts is a multimillion dollar industry in North America. Recently, however, there has been a growing concern over the inhumane manner in which these animals are captured. One widely used capture system is the Conibear trap, which is simple to use, lightweight, and relatively inexpensive. However, until the past two decades, there has been virtually no research into these very popular spring-powered killing traps.

Previous engineering studies [*1-3*] attempted to analyze and optimize the Conibear trap. These studies used equipment which has since become technologically dated. Accelerometers were connected through a signal conditioner to a chart recorder, while the signals were digitized and saved on a permanent tape storage unit. This system involved many separate components through which the signal had to be fed. The number of required data transfers meant that contaminated record and playback heads, bad connections, or externally generated noise could influence the signal.

Due to the extensive use of these traps and the lack of conclusive data on the trap's performance, this study was designed to evaluate and improve the Conibear 120 trap, a trap used to harvest small furbearers. The assessment of the Conibear 120 was made by comparing its momentum and clamping force to standards established by the Canadian General Standards Board [*4*]. The system used for this study involved the use of accelerometers, signal conditioners, and a digital waveform analyzer with disk storage capability. This allowed the sampling and storage of data without the necessity of multiple data transfers [*5*]. Traps were fitted with accelerometers connected to the waveform analyzer that captured and permanently stored to disk the acceleration signal of each trap as it fired. A program in the waveform analyzer then multiplied the acceleration signal by the accelerometer constants and performed integrations to yield the velocity and displacement waveforms. This led to a determination of the trap momentum at any point along the trap's path of motion. A method was previously developed using a load cell connected to a transducer readout [*5*] to determine the clamping force of the traps at different openings. This system was used to assess the killing potential of traps according to established standards [*4,6*] and to improve the mechanical energies of actual trap designs.

The objectives of this study were to:

1. Assess the impact and clamping forces of the rotating-jaw Conibear 120 trap.
2. Assess the potential of the trap to quickly kill mink *(Mustela vison)* and marten *(Martes americana)* according to existing kill thresholds.
3. Improve the killing power of the trap.

Experimental Design

For each trap design, three traps were fired ten times each and the peak velocity and velocity at half displacement were recorded for each firing. After each firing, the velocity value of each jaw was multiplied by the jaw's equivalent mass to give its momentum. The momentum was determined when both jaws had moved half their displacement (HDISP). This is a conservative simulation of a situation where the animal's head is centered on the trap frame. For each trap, momentum values calculated for each jaw were added together to give the trap's HDISP momentum value for that firing. The values for ten firings were then averaged to obtain the HDISP value for the trap. The HDISP value of the trap model (three traps together) was obtained by averaging the 30 values of the three traps.

Clamping force was determined before any firings had occurred and after ten firings to determine if the clamping force of the trap had been affected by its firing (e.g., due to spring overstress or frame bending). The trap was slowly closed onto load cell hooks keeping the jaws 40 mm apart. The force registered was recorded and then the springs were shaken in an attempt to simulate the

---

Manuscript received 5/9/88; accepted for publication 11/14/88.

[1] Humane Trapping Program (FIC), Animal Sciences Wing, Alberta Environmental Centre, Vegreville, Alberta, Canada T0B 4L0.

0090-3973/89/0005-0190$02.50

tightening effect created by the springs when they fire and the shaking of an animal when caught in the trap. This procedure was repeated three times; averages were calculated for openings ranging from 40 to 5 mm, in steps of 5 mm.

The momentum and the clamping force were determined with traps positioned as they would be in the field. They were restrained on a platform which prevented them from moving around and damaging the accelerometers (Fig. 1). The procedure, equipment, and software were as detailed by Cook and Proulx [5].

Materials and Methods

Traps of the Conibear series (Woodstream Company, Niagara Falls, Ontario) were tested. The basic Conibear 120 is made of two wire (3.7 mm diameter) frames (11.9 by 11.9 cm) hinged at their centerpoint to operate in a scissor-like action, and equipped with two torsion springs (11.4 cm arm, 4.3 cm I.D. coil) made of 4.1 mm wire (Fig 2*a*). This model was compared with the Conibear 126, which has longer spring arms (15.2 mm) made of larger wire (5.3 mm diameter) (Fig. 2*b*). In-house modifications to the basic model involved shortening the Conibear 126 springs to the Conibear 120 size (C120 MARK II, Fig. 2*c*), welding on one or two metal bars[2] of different sizes (7.62 by 1.27 by 0.28 cm or 7.62 by 0.76 by 0.28 cm) at various locations (Figs. 2*d* and 2*g*), or composites of these modifications (Figs. 2*e* to 2*h*). The traps tested were referred to as:

• C120	Standard Conibear 120 (Fig. 2*a*).
• C126	Standard Conibear 126 (Fig. 2*b*).
• C120 Mark II	Standard Conibear 120 frame with shortened Conibear 126 springs (Fig. 2*c*).
• C120 Mark III	Standard Conibear 120 frame with two 1.27 cm wide clamping bars welded to the same frame, on opposite jaws (Fig. 2*d*).
• C120 Mark IV	Standard Conibear 120 frame with shortened Conibear 126 springs and two 1.27 cm wide clamping bars welded to the same frame, on opposite jaws (Fig. 2*e*).
• C120 Mark V	Standard Conibear 120 frame with shortened Conibear 126 springs and one 1.27 cm wide clamping bar welded to each frame, on opposite jaws (Fig. 2*f*).
• C120 Mark VI	Standard Conibear 120 frame with shortened Conibear 126 springs and one 1.27 cm wide clamping bar welded to only one frame (Fig. 2*g*).
• C120 Mark VII	Standard Conibear 120 frame with shortened Conibear 126 springs and one 0.76 cm wide clamping bar welded to each frame such that they contact when the trap is closed (Fig. 2*h*).

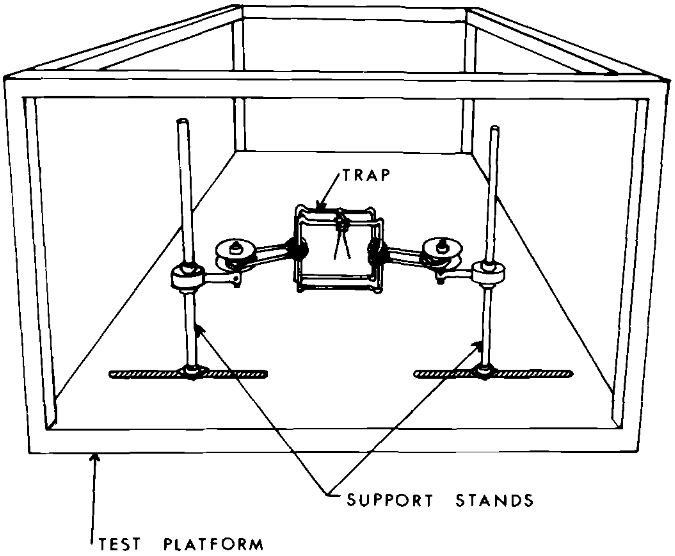

FIG. 1—*Diagram of test platform used for mechanical evaluation of rotating jaw traps.*

The momentum was calculated as

$$M = m_e V$$

where m_e is the equivalent mass of the trap at the strike location, and V is the velocity of the striking bar at a specified opening.

The momentum and clamping forces of these traps were plotted on a threshold graph where traps with killing potential must rate above a line given by [4]

$$y\,(\text{momentum [kg m/s]}) > -0.0058 \times (\text{clamping force [N]}) + 2.6$$

The intra-model variation of the traps was tested with a nonparametric Kruskal-Wallis one-way analysis of variance. The hypothesis tested was that for any given model, there were no differences among traps. Upon rejection of the hypothesis, differences among means were tested using analysis of variance (ANOVA) with a Student-Newman-Keuls range test [7]. The ANOVA model was

$$y_{ijk} = \mu + A_i + B_{ij} + e_{ijk}$$

where

y_{ijk} = an individual observation of the jth trap of the ith model,
μ = a general population mean,
A_i = fixed effect of the ith model, $i = 1, 2, \ldots, 8$,
B_{ij} = fixed effect of the jth trap within the ith model, $j = 1, 2, 3$, and
e_{ijk} = is the random error associated with each observation.

Results

When the average momentum values of the trap models were examined, it was found that all models except the C120 Mark IV and C120 Mark VII were significantly ($P < 0.05$) different (Table 1). The traps were ranked with the C120 having the lowest average momentum value and the C120 Mark VI the highest (Table 1). Except for the C126 and C120 Mark IV, there was a significant ($P <$

---

[2] Referred to as a clamping bar modification, a modification adopted by the Federal Provincial Committee for Humane Trapping [6] upon recommendation by trapper Ron Lancour and the British Columbia Trappers Association.

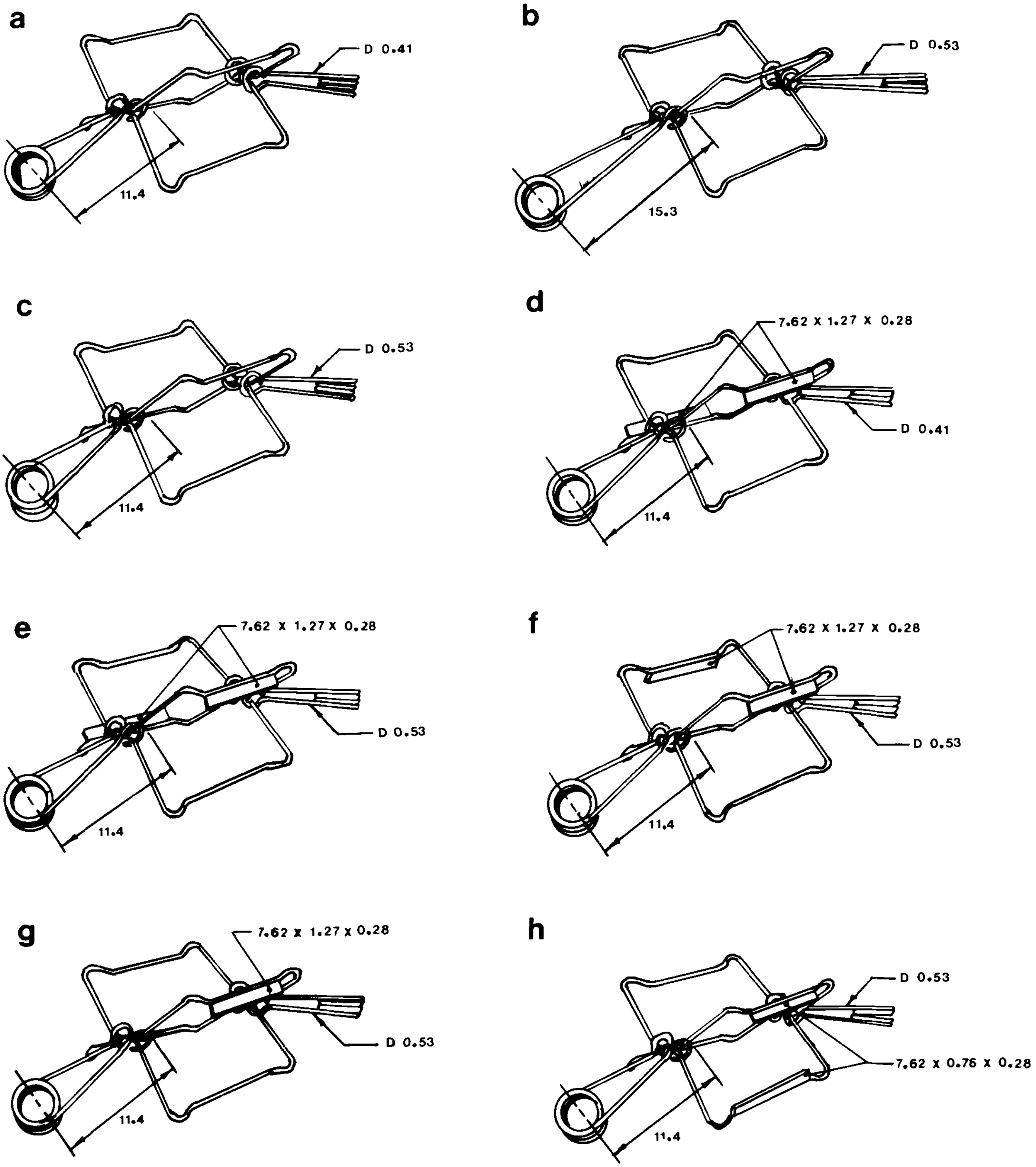

FIG. 2—*Diagrams of rotating jaw Conibear 120 trap and allies.* (a) *C120.* (b) *C126.* (c) *C120 Mark II.* (d) *C120 Mark III.* (e) *C120 Mark IV.* (f) *C120 Mark V.* (g) *C120 Mark VI.* (h) *C120 Mark VII. All diagram dimensions are in centimeters.*

TABLE 1—*Ranking of models and traps within models based on average momentum values recorded at HDISP.*

Model	Intra-Model Grouping[a] at HDISP[b]	Trap Number	Trap Momentum at HDISP (kg m/s)	Average Momentum at HDISP (kg m/s)	S.D.	Inter-Model Grouping at HDISP[c]
C120	A	1	0.5055			
	B	2	0.5479	0.5384	0.0310	A
	B	3	0.5618			
C126	A	3	0.5503			
	A	2	0.5609	0.5588	0.0354	B
	A	1	0.5652			
C120 Mark III	A	1	0.5668			
	AB	3	0.5891	0.5913	0.0410	C
	B	2	0.6179			
C120 Mark II	A	3	0.6567			
	A	1	0.6705	0.6883	0.0494	D
	B	2	0.7377			
C120 Mark V	A	3	0.7494			
	AB	1	0.7754	0.7721	0.0377	E
	B	2	0.7911			
C120 Mark IV	A	1	0.8076			
	A	3	0.8091	0.8114	0.0302	F
	A	2	0.8176			
C120 Mark VII	A	3	0.7659			
	B	2	0.8257	0.8255	0.0529	F
	C	1	0.8848			
C120 Mark VI	A	1	0.8333			
	B	3	0.8830	0.8672	0.0455	G
	B	2	0.8902			

[a] Traps within a model type that have same grouping letter are similar.

[b] HDISP denotes momentum when both jaws displaced halfway.

[c] Models that have same grouping letter are similar.

TABLE 2—*Clamping force (Newtons) of C120, C126, C120 Mark II, C120 Mark III, C120 Mark IV, C120 Mark V, C120 Mark VI, and C120 Mark VII.*

	Before Firing						After Ten Firings					
	Clamping Before Shake			Clamping After Shake			Clamping Before Shake			Clamping After Shake		
Trap	Range (N)	OMNC[a] (mm)	OMXC[b] (mm)	Range (N)	OMNC[a] (mm)	OMXC[b] (mm)	Range (N)	OMNC[a] (mm)	OMXC[b] (mm)	Range (N)	OMNC[a] (mm)	OMXC[b] (mm)
C120	0-214	5	25	0-224	5	25	0-200	5,10	30	0-228	5,10	30
C126	0-292	5,10	30	0-321	5,10	30	0-278	5,10	30	0-308	5,10	30
C120 Mark II	0-339	5,10	30	0-364	5,10	30	0-305	5,10,15	35	0-324	5,10,15	35
C120 Mark III	130-195	40	5	144-229	40	5	126-172	40	15	138-207	40	10
C120 Mark IV	234-326	40	10	254-353	40	10	58-296	5	15	64-324	5	20
C120 Mark V	238-320	40	10	261-355	40	10	113-301	5	15	119-331	5	15
C120 Mark VI	236-320	40	10	254-345	40	10	235-297	5	20	254-322	5	20
C120 Mark VII	227-312	40	10	245-339	40	10	173-294	5	15	188-319	5	15

[a] Opening at which minimum clamping force was observed.

[b] Opening at which maximum clamping force was observed.

0.05) intra-model variation in the momentum values of traps (Table 1).

Every modification to the C120 trap, except the C120 Mark III, resulted in an increase in the clamping force. The C120 Mark III had a clamping force lower than that of the C120 before firings and shaking (Table 2). After shaking the traps, and after firing the traps ten times, the C120 had the lowest clamping force and the C120 Mark V the highest. Overall there was an average increase in the clamping force range values of 22.39 N (±8.36 N) after shaking (Table 2).

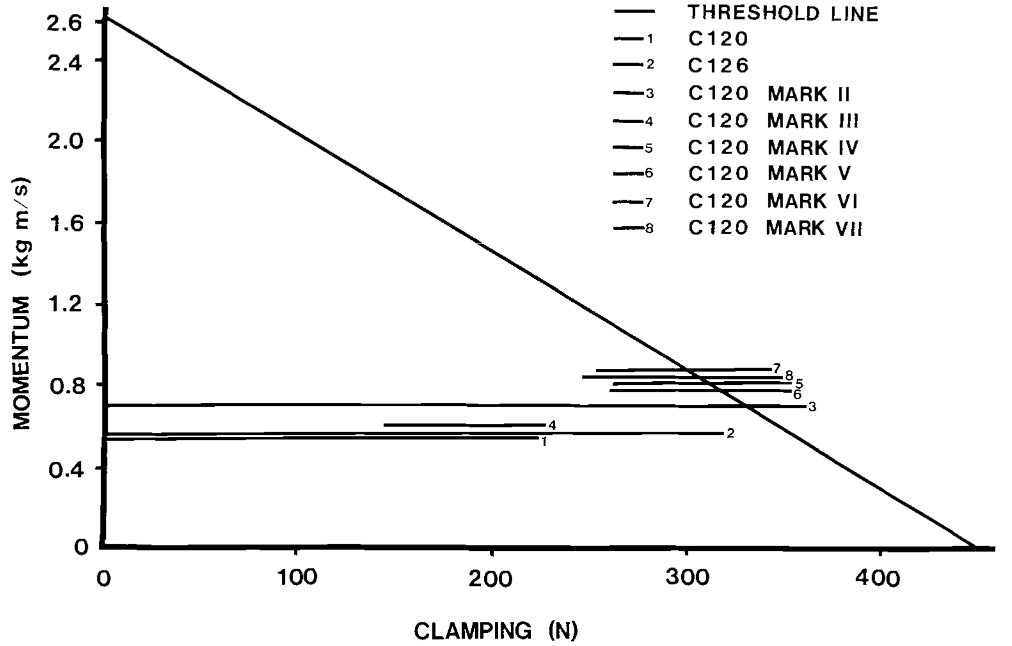

FIG. 3—*Plot of momentum of rotating jaw Conibear 120 trap and allies on threshold graph for mink and marten* [6].

The clamping forces of weaker spring and/or non-clamping bar traps (e.g., C120, C126, C120 Marks II and III) were significantly ($P < 0.05$) lower than that of other traps at the same openings, before and after shaking and firing the traps. Clamping bar traps with the strongest springs (e.g. C120 Marks IV, V, VI, and VII) were not statistically different ($P > 0.05$) from each other at the same openings, before and after shaking and firing the traps.

In most cases, there was a significant ($P < 0.005$) difference in the clamping force of traps before and after shaking and firings, provided there was clamping force being exerted (i.e. > 0 N). Generally, the lack of significant difference between pre- and post-shaking results occurred after firing the traps and measuring the clamping force at 5 and 10 mm openings. Since the trap had bent slightly and the springs were at or near the end of their possible motion, shaking the springs would not promote any further movement. In five instances, no significant difference was obtained between pre- and post-shake results; no explanation is available.

Before any firings, maximum clamping forces were recorded at the 25 to 35 mm openings of the non-clamping bar traps and at the 5 to 10 mm openings of the clamping bar traps (Table 2). After ten firings, maximum clamping forces were recorded in non-clamping bar traps at openings ≥ 30 mm and in clamping bar traps at 10 to 20 mm openings (Table 2). The minimum clamping force was recorded for all traps, except the C120 Mark III, at 5 mm. Clamping bar traps applied a clamping force at all openings, while non-clamping bar traps lacked any clamping force at openings ranging from 5 to 15 mm (Table 2). Most of the jaws, except those with a clamping bar, bent slightly at the accelerometer-mount weld but this did not affect the readings.

The C120, C126, and C120 Mark III fell below the threshold line (Fig. 3). While the C120 Mark II crossed the threshold line, its clamping force dropped off to 0 at 5 to 15 mm openings (Table 2). Since the Federal Provincial Committee for Humane Trapping [6] recommended that clamping force be applied with jaw openings of 40 to 5 mm, this trap would not qualify. All other traps (C120 Mark IV, C120 Mark V, C120 Mark VI, and C120 Mark VII) centered around the threshold line (Fig. 3).

Conclusions

The large amount of intra-model variation in trap momentum reflects the fact that torsion springs cannot be produced consistently. The development of effective trapping devices must therefore take into consideration this intra-model variation of trap momentum and clamping. The bending in the trap jaws at the accelerometer mount results from the heat of welding to attach the mount. This localized bending is not an indication of any weakness in the trap.

The shaking of the springs simulating the springs' vibration and the animal capture leads to greater but more realistic clamping forces. Although it is difficult to guarantee a complete standardization of the shaking process from tester to tester, this test should be retained in further assessments.

The results of this study indicate that the momentum and clamping of the basic C120 and C126 models can be enhanced with simple modifications. The shortening of the C126 springs created a smaller moment arm, thus more force was applied to the jaws, increasing the trap momentum. An increase in the effective mass of the jaw, by attaching a clamping bar, also increased the jaw's momentum. However, there is a limit to which the effective mass can be increased, without seriously compromising the velocity. The clamping bar eliminated the gap between the jaws and proved to be an effective way of increasing the clamping force of the trap. With these modifications, four traps (C120 Mark IV, C120 Mark V, C120 Mark VI, and C120 Mark VII) may have the potential to effectively kill marten and mink, even though they did not completely cross the threshold line. These traps should ultimately be subjected to a series of tests with anaesthetized and unanaesthetized animals to see if the inherent energies are capable of causing quick and irreversible loss of consciousness in animals struck in the head/neck region.

Acknowledgements

We would like to thank M. Barrett, P. Layte, and L. Lillie for reviewing this manuscript, A. Sharma for statistical help, C. Montandon for his technical assistance, and E. Rudyk and H. Schultz for their machine shop work.

References

[*1*] Johnston, N. C., "Humane Trap Evaluation," Master's thesis, McMaster University, Hamilton, Ontario, Canada, 1970, 240 pp.

[*2*] Tschope, H. P., "Humane Trap Optimization," Master's thesis, McMaster University, Hamilton, Ontario, Canada, 1972, 178 pp.

[*3*] Yi, Y. J., "Analysis and Optimization for Humane Trap Design," Master's thesis, McMaster University, Hamilton, Ontario, Canada, 1974, 298 pp.

[*4*] Canadian General Standards Board, "Animal Traps, Humane, Mechanically-Powered, Trigger Activated," Report CAN2-144.1-M84, Ottawa, 1984, 9 pp.

[*5*] Cook, S. R. and Proulx, G., "Use of a Digital Waveform Analyzer, Accelerometers, and a Load Cell to Measure Momentum and Clamping Forces of Killing Traps for Furbearers," *Journal of Testing and Evaluation*, Vol. 17, No. 3, May 1989, pp. 186-189.

[*6*] Federal Provincial Committee for Humane Trapping, "Report of the Federal Provincial Committee for Humane Trapping: Findings and Recommendations," 1981, 69 pp.

[*7*] Sokal, R. R. and Rohlf, F. J., *Biometry*, W. H. Freeman and Co., San Francisco, 1969, 776 pp.