FUR ANIMAL RESEARCH

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Introduction: Dr. Hugh Hildebrandt

Fur Commission USA and CMBA Ranch Service

Joint Mink Research Committee Adviser

In this edition of the research newsletter a number of practical on ranch studies and informational reports are featured. The hope is the information will help ranchers in not having to reinvent the wheel so to speak in reference to shelving and enrichments.

I would also like to thank Entomologist Patrick Liesch for his time and contribution of information about larder beetles. I was encouraged at the last joint research committee meeting to try and get some in depth information on these beetles and controlling the damage to wood and wood posts. I would also like to thank the log home industry contacts for additional information. The log home industry has the same concerns in protecting log cabins and houses made from whole logs as we do in protecting our shed posts. The common tidbit of information was to clean up all meat (feed) that the beetles feed on. This being difficult in the ranch setting hopefully the treatment information for both beetles and wood will be helpful.

In This Edition

All studies are available in their entirety at www.FurResearch.org, a free repository for academic research addressing health, welfare, and disease issues affecting the husbandry of fur bearing animals. Originally launched in 2005 by Fur Commission USA as an archive of the work done by the first generation of leading fur animal scientists in North America, we now include more recent material from sources across the globe, to be used as reference tools for current and future researchers, veterinarians, and fur farmers throughout the world. Fur Commission USA does not receive any compensation for this service.

How tall should a mink cage be? Using animals' preferences for different ceiling heights to improve cage design.

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Highlights

•We examine American mink preferences for cage ceiling height.
•Mink preferred to feed from lower heights regardless of age.
•We found no group-level preferences for height to perform other behaviors.
•Individual differences in standing upright predicted relative height preference in males.

Abstract

Regulations and guidelines assume that taller cages are better for mink, because they permit more diverse postures (e.g. standing upright) and freedom to move. New Canadian Codes of Practice therefore stipulate cage ceiling heights of at least 38 cm, while in Europe cages must be 46 cm or taller. However, minks' food is placed on the cage top. To eat, adults must therefore stand upright, and young mink must even climb (in great contrast to wild mink, who eat their prey on the ground). Furthermore, these new Codes overlook that some North American cages have 'drop-in' nest boxes that restrict vertical space *inside* the cage. We therefore investigated how ceiling heights affect welfare, testing the hypotheses that mink prefer lower cage ceilings to feed from (Experiment 1), but higher ceilings for performing other behaviors under (Experiment 2). Experiment 1 involved 64 2.5 month-old male-female pairs (in cages 75 L × 61 W cm). Cage height was 46 cm, except for a modified feeding area (15 L × 61 W cm) accommodating four heights: 25, 38, 46 or 53 cm (spanning the range used in Canada and Europe). After mink were habituated to feeding from each height, food was delivered onto all heights and feeding observed, a procedue repeated monthly until animals were adult body length (at 7 months ld). Experiment 2 gave 32 adults (half of each sex) free access to a compartment with a moveable ceiling (with one small covered patch mimicking the underside of a nest box). This was set to 13 cm (approximating the space under a drop-in nest box) for 16 animals, being progressively raised every 3 weeks by 13 cm; and to 51 cm for

16 mink, being progressively lowered every 3 weeks by 13 cm. How ceiling height affected compartment use was assessed. Experiment 1's results were clear: the highest feeding heights (from which mink could not eat while sitting) were always avoided by females, and by males once 5+ months old ($p < 0.01$ for all significant contrasts); less food was also apparently consumed from highest heights ($p < 0.01$ for all significant contrasts). Turning to other activities, Experiment 2's results were more complex: mink showed no overall preferences for any ceiling height, but individual males who tended to stand upright often also used the compartment permitting this posture relatively more ($F_{1,14} = 10.19$; $p < 0.01$); whereas females preferred the lowest, covered heights ($F_{1,14} = 7.66$; $p < 0.05$). These findings provide valuable information for designing and assessing housing systems from an animal-based perspective: important for mink welfare and the social sustainability of fur farming.

Applied Animal Behavior Science
Volume 192, July 2017, Pages 24-34
The complete study can be found at www.furresearch.org

Shelves, platforms and hammocks: Research background, and the Canadian Code of Practice requirements

Ontario Fur Breeders Association, Canada Mink Breeders Association, Fur Commission USA

- Research has shown that shelves, platforms or 'hammocks' (curved structures) have several benefits for mink, including creating preferred resting places; allowing mink to escape from cage-mates (e.g. allowing lactating mothers to escape from kits); and reducing kit mortality.
- The Code of Practice therefore requires that all pens with multiple mink must have a hammock, shelf or platform (except pens with jump up or drop in nest boxes, which are exempt).
- The area of this added structure counts as floor space, so it increases a pen's floor area*.
- Typically the shelf, platform or 'hammock' (hereafter 'shelf') should not fill more than 50% of the cage, because at least 50% of the cage area must meet minimum cage height requirements.

Figure 1: Measuring area of a shelf

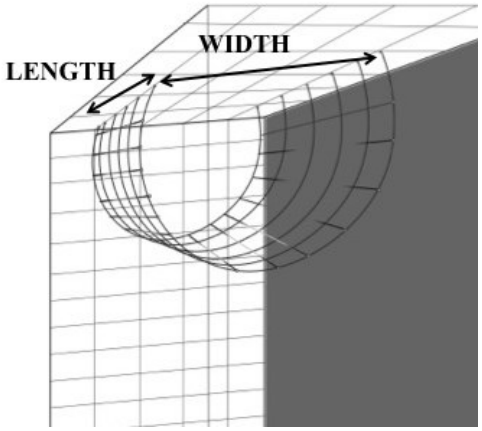

Figure 2: Measuring area of a hammock

What types of shelves are farmers using, and what are their experiences?

In a Canada-wide study, 44 ranches from 6 provinces were consulted about shelves, and the following benefits were reported:

- Apparently calmer animals
- Cleaner mink (when false bottoms are in place)
- In nursing mothers, less mastitis and nursing sickness, improved body condition at weaning, and lower mortality
- Less chewing in kits, and less fighting in juveniles
- Increased percentage of labeled pelts.

Some ranchers expected shelves to make catching difficult, but found it was actually easier (with the right design). Others were worried by mothers placing their kits onto shelves, but this has been rare. Others expressed concern that one mink will hide in the shelf during breeding, but this seems not to have been a problem on ranches permitting shelf access at this time.

Where and how to install: the basics

- Flat shelves are typically installed flush with the cage's back wall (though installing along a side wall is fine).

- Hammocks are commonly 8-9” long: longer hammocks require catchers to reach deeper in, while shorter hammocks do not offer full support for the mink.

Best materials to use

- Wire mesh is preferable to plastic (stronger, and easier to keep clean and dry).
- 0.5”x1” mesh may be best (0.5”x0.5” mesh is hard to keep clean; while kits and juveniles can get body parts stuck in larger mesh; see below).

Avoiding injuries or fur quality issues

- Kits and juveniles can get body parts stuck in mesh larger than 0.5”x1”, with the larger mesh sizes (1”x1.5” and 1”x2”) being especially problematic.
- All sharp edges should be smoothed before installation.
- Avoid small gaps between shelf and cage wall that can trap body parts.
- For flat shelves, any support wires running underneath should be offset from the edge by at least 1” to prevent toe injuries *(see image 3)*.
- For hammocks, wide forms *(see image 4)* are recommended over tight, narrow hammocks, as less likely to cause rubs in the pelt.
- Even though kits are very rarely observed in shelves until they are 5 to 6 weeks old, “kit guard” may be advisable if shelves are against cage walls, to prevent kits falling though the walls’ 2” x 1” mesh.

Design factors affecting catching the mink

- Catching is more difficult if there are two exits, or a large gap between shelf and wall: mink can run in circles through the shelf or wedge themselves in the gap.
- For hammocks, catching seems easier when these are installed lengthwise in the cage rather than widthwise.
- Catching is easier from loose, wide hammocks than from tight, narrow hammocks.

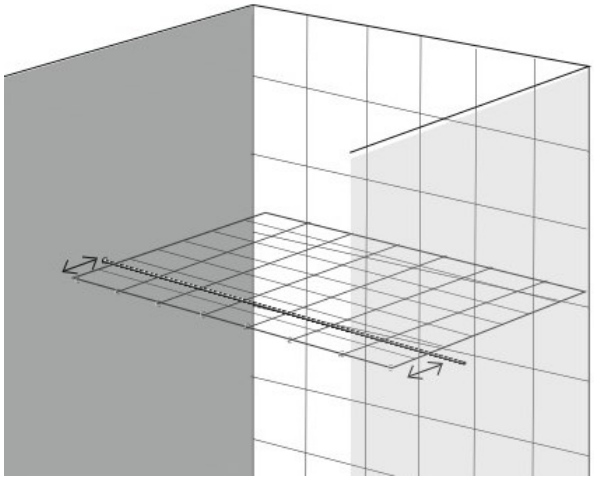

Figure 3: Support wire position

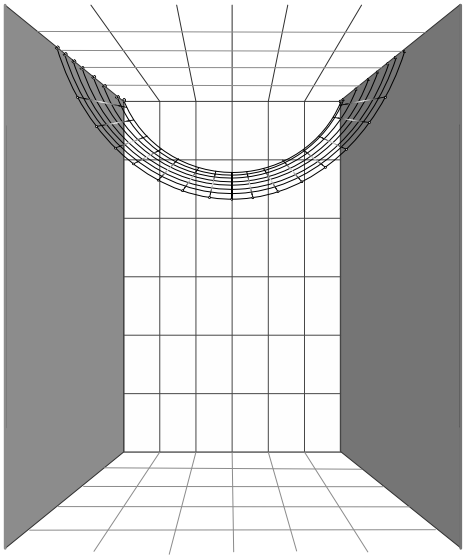

Figure 4: Wide form of hammock

[*] *To calculate the length of flat shelves spanning a cage, the cage width is counted as shelf length, even if there are small spaces at the shelf-ends (because the mink's body can spill into those spaces) (see image 1). To calculate the area of curved structures (hammocks) for width please measure the horizontal width of the hammock at its widest part (see image 2). For hammocks already installed (prior to January 1, 2018), width may be calculated as 1.25 times the horizontal width.*

Manipulable enrichment items ('toys' and PVC tubes): Research background, and the Canadian Code of Practice requirements

Ontario Fur Breeders Association, Canada Mink Breeders Association, Fur Commission USA

Studies show that tubes, balls, chains and other 'toys' to chase, carry or chew, offered in combination, can benefit mink: juveniles may be more playful, cages cleaner, and mink calmer with people (less aggressive or fearful). Fur-chewing and stereotypic behaviour (e.g. nodding) can reduce, as can rates of barrenness ('empties') in females. Pelt quality and weaning litter size may even improve.

The Code of Practice requires all pens to contain at least one manipulable item; and that once one is provided, access is maintained for the rest of that mink's life (although old items may be replaced with novel ones: good practice to avoid habituation).

The one exception: loose objects (e.g. balls) must be removed while false bottoms are in place, to help

cages stay clean and avoid harm to vulnerable newborns from objects carried to the nest-box.

What types of manipulable enrichment are farmers using, and what are their experiences?

- In a Canada-wide study, 44 ranches from 6 provinces were consulted on manipulable enrichments, and the following benefits were reported:
- Calmer mink: less aggressive when handled.
- Less fur-clipping.
- Less chewing (on each other) and fighting.
- Decreased chewing of wood nest boxes.

However, some items tried have proved unattractive to mink; many become less attractive over time; some are too fragile, especially with large males; and others are even dangerous. Superficially similar items also vary in robustness, depending on their source and the mink using them: some makes of wiffle ball are prone to break (then falling out the cage); as are some brands or grades of plastic chain, narrow cable ties, and some used balls from golf courses (especially with large males). Steel items can also stain pale mink. So, experiment with different items and suppliers, and recognize that what works best may differ with colour-type and between adult males, females and juveniles.

Hanging enrichments

Though potentially labour-intensive to install, these stay clean, never need removing (ideal for whelping pens), and are often highly attractive to mink.

What hanging items have farmers successfully used?

- Lengths of plastic chain (though, as noted, brands and grades vary in their durability).
- Lengths of metal chain (smaller-linked, flat 'furnace chain' seeming especially flexible, interactive, safe).
- Golf balls, suspended via wire through a wide drilled hole (allowing the ball to move; *see Figure 1)*
- Pieces of scrap plastic cage divider (*see Figure 2).*

- Cable ties (if durable [see above] and used safely [see below]).

Where and how to hang them?

6" or less from the cage floor seems to work well (chain cut much shorter can spring out of the cagetop, becoming inaccessible to the mink).

- Hog rings (two or more for males) provide more durable attachments than cable ties.
- If using cable ties, close them so that no loops are left that could tighten around minks' limbs
- Hanging items will be most effective, attracting the most sustained use, if attached:
  - ◊ in a way that maximizes their movement;
  - ◊ in high traffic locations (e.g. in front of the shelf or drop in nest box) *(see Figures 1,2,3);*
  - ◊ so as suspended across cages (e.g. draped over dividers), so that neighbours can pull on it;
  - ◊ to a wire running above each block of pens: this enhances attractiveness as they 'jiggle' when any mink in the block interacts with them *(see image 3)*.

<u>Loose objects on the floor</u>

Easy to install, some of these are attractive to mink and/or help keep cages clean (especially with pair-housed mink who keep them moving), but they can instead sit little used, so accumulate faeces.

What loose objects have farmers have successfully used?

- Golf balls (though, as noted, balls must be compatible with mink to avoid breakage).
- Lengths of PVC pipe (width 4" more): may attract sustained attention as multifunctional (can be chewed, carried and rested in). But MUST be much wider than the mink or have a >1" slit cut down the length (*see Figure 4*), to prevent mink getting stuck.
- River rocks – if small enough to be manipulable, but large enough to not settle into the wire mesh of the floor (ideally c.2"x2"), but may still go unused and attract faeces.
- Wood blocks, especially if hardwood (most durable), and rounded (so movable in the cage; flat, square blocks will likely sit unused and attract faeces.

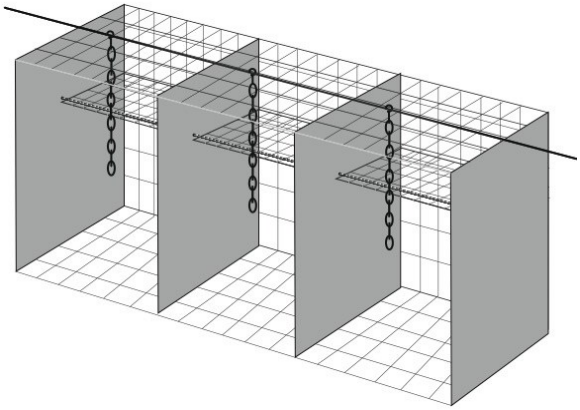

Figure 3: Suspended chain from a wire across pens

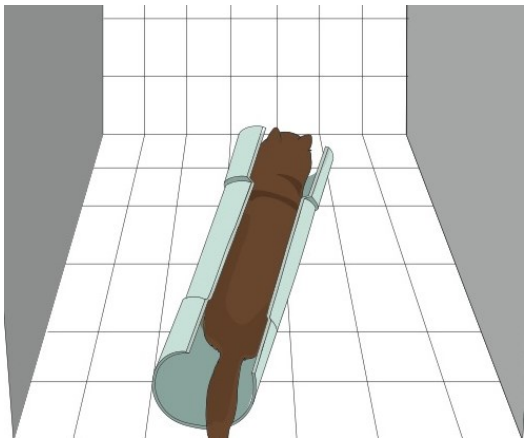

Figure 4: PVC pipe with slit down length

Practices to try

Using multiple enrichments at once may enhance their impact; while installing different enrichments in different cages (e.g. suspended objects in whelping pens vs. loose objects in furring pens) may reduce habituation, as mink experience different enrichments at different stages of their lifecycle.

Items to avoid

- Large wood blocks (e.g. 2"x4"): go unused and accumulate feces.
- Large rocks (e.g. 6" in diameter): not easily manipulated, so go unused.
- Aluminum cans (e.g. pop cans): quickly chewed to pieces, sharp edges pose risks of injury.
- Plastic bottles (e.g. water bottles): chewed to pieces in just a few days.
- Pieces of waterline or garden hose: attractive to mink, but not very durable.

Larder Beetles

Phil Pellitteri, University of Wisconsin Extension, Insect Diagnostic Lab

Adult larder beetles (Dermestes lardarius) are 1⁄3 inch long black beetles with a broad, pale tan, black spotted band across the front portion of the wing covers. Larder beetle larvae are reddish brown and densely covered with short and long hairs, and have two curved spines on the top of the tail end. Both adults and larvae feed on high protein food sources including cured and spoiled meats, dried fish, high protein pet food, dead insects such as cluster flies and boxelder bugs, furs, feathers, leath-

er, cheeses, dead rodents and birds in chimneys or wall partitions, and even rat or mouse poison baits. Larder beetles are a type of carpet beetle, but they only attack woolens that have been soiled with blood, fish oils, or other high protein stains. Close relatives of the larder beetle are used to clean the flesh from skeletons used in museums.

An adult larder beetle.

Life cycle: Larder beetles overwinter as adults in protected places. In spring adults are attracted to areas that have suitable food. Females can lay over 100 eggs, which take about two weeks to hatch. Larvae will feed for 40-50 days on high protein food before pupating (transforming) into adult beetles. The total larder beetle life cycle takes about two months.

When larvae are searching for a place to pupate they have a habit of boring into wood and other hard materials. One reason larvae seek such protected sites is to avoid cannibalism during the pupation period. Larvae can easily chew through paper, light plastic, cork, and tin, or into foam insulation. Structural problems have occurred in poultry and mink operations that have undisturbed, protein rich food sources.

Control: The first step in larder beetle control is to identify and dispose of the beetle's food source. Without a food source, larder beetles will not survive. An infested bag of dog food is easily cleaned up. However, finding the source of one or two beetles may be very difficult. Adult larder beetles are attracted to night-lights or may breed on a small food source such as a dead mouse. If larder beetles and their larvae are found in high numbers or have been a reoccurring problem, a large food source or a renewable food source, such as dead cluster flies (see UW-Extension bulletin A2090) or boxelder bugs (see University of Wisconsin Garden Facts X1100) in the walls, may be the underlying cause. Knowing why you have the problem will lead to a solution.

If the food source appears to be within a wall, letting the problem run its course is likely **the best solution. When the larder beetles have exhausted the food source they will disappear. If**

beetles and larvae fall through light fixtures into the living space, they can be vacuumed or swept up if numbers are small. Taping or screening access points will reduce this type of nuisance. Homes also can be sealed to prevent cluster flies and boxelder bugs from entering. Caulking, screening, and sealing openings will keep these insects out off wall voids and attics.

Cleanup of the food source is always the best approach to controlling larder beetles. However, if the food source cannot be identified, spraying baseboards, around electrical plates and other access points into walls with any indoor ant spray will kill the beetles that come into contact with the spray. Because larvae and adults migrate from the food source it is not always effective to just spray the site where insects have been found. For infestations located in foam insulation, dust or powder type insecticides are preferred. The solvents found in many liquids may melt insulation. Insect bombs are ineffective in controlling larder beetles, because they do not penetrate into walls. Sonic devices also do not work and there are no reliable repellents.

Heating objects to 130°F for two to three hours, or placing objects in a deep freeze at 0°F for 24 hrs, will kill larder beetle adults and larvae in objects or pet food. Storing pet food in tight fitting plastic container also will provide protection and help confine existing infestations.

A number of the synthetic pyrethroid insecticides can work against larder beetles (and many other insects due to their broad spectrum of activity). Active ingredients in this group include: bifenthrin, cyfluthrin, cypermethrin, lambda-cyhalothrin, deltamethrin, permethrin, and others. Many of the product labels will list larder beetles or other beetles from the same family (Dermestidae, or the "carpet beetle" family). This website (http://www.domyownpestcontrol.com/) happens to be a useful resource for browsing common products. If you browse under the "shop by pest" tab, there are a number of potential products listed under both "larder beetles" and "carpet beetles" (a general term for larder beetles and similar relatives). If you click on a given product, they have the product label (application instructions and other details) available.

There are also log home borate-based wood preservatives, which could be tried. Products such as Tim-

bor, Boracare, and similar are examples of such products. More are listed here: http://pestcontrol.domyownpestcontrol.com/search?view=grid&w=Borate+Wood+Treatments.

Borate Solution Applications

Application Equipment: Any type of pump-up compressed air sprayer is suitable for applying. Either a cone or fan spray tip will work. Do not attempt to use an airless sprayer. Airless sprayers put out a fine liquid mist that can be carried away with even a slight breeze. In addition, the high surface area of the small droplets allows the water contained in the solution to rapidly evaporate leaving behind a high concentration of borate and mixed glycols that form a sticky film on the surface of the wood rather than penetrating into the wood.

Step 1: Be sure the surface of the wood is clean and dry before starting. NEVER WET THE WOOD RIGHT BEFORE APPLYING A BORATE TREATMENT. If you do the wood cells will be saturated with water preventing the borate solution from absorbing into the wood.

Step 2: If you have an adjustable spray tip set it to either a fan or cone fairly coarse spray. If set to a fine spray it will be more susceptible to wind drift and it will take longer to complete the job.

Step 3: Start spraying the solution at the bottom of the wall and work your way up. Be sure to get some borate into all upward facing checks and fissures. If you miss a small spot (less than an inch in diameter) here and there don't worry about it, the solution will spread out in the top layer of wood.

Step 4: the surface will be ready for a second coat within a day or two. If for some reason there is a delay in applying a finish it's not a problem, the borate treatment will typically not have to be reapplied unless there is a torrential downpour within three days after the application. However, do not purposely wash the surface for at least a week after treatment. You run the risk of removing some of the active ingredient.

Step 5: After a treatment you must wait up to two weeks for the active ingredient to make its way into the wood and for the glycol constituents to dry before applying any sealants or a finish. Even then, there may still be enough glycols remaining on the surface to interfere with the adhesion of the finish.

Step 6: For long term protection exterior wood surfaces that have been treated with a borate solution should be coated with an exterior finish (old paint works fine). If the exterior surfaces are to remain bare a re-application should be made every six years regardless of which product is used.

Step 7: Wash hands, clothing and equipment with soap and water.

Homemade Borate Solution

Ingredients: 4 lbs. of 20 mule team borax
3 1/2 lbs. boric acid
1 gal. Propylene glycol (nontoxic antifreeze)
note: ethelyne glycol may be used but is toxic.

Heat propylene glycol and add borax, stir well.
Add boric acid and stir till mixture is dissolved.
Heat mixture to 260 degrees F stirring constantly to prevent crystallization.
This produces 1 gal of preservative concentrate, when ready to use mix very well with 1 gal of water and apply liberally with a garden sprayer.

Commercial Products

Timbor Treatment

A preservative that is highly toxic to wood-destroying insects and fungi, as well as preventing infestation when properly applied; yet treated wood is non-toxic to humans or animals. Tip: One 6-gal. pail of powdered concentrate makes up 27 gal. of mixed product, or enough to cover 1950 sq. ft. This is enough to coat the exterior of a log house about 30 ft. x 50 ft. with 9-1/2 ft. sidewalls.

Mix Tim-bor at the rate of 1 lb. (1 loosely packed quart) to 1 gal. water. Wood

must be clean and bare; free of dirt, wax, and surface finishes and above 40 F. (surface temperature). Apply Tim-bor at the rate of 1 mixed gal. per 50 sq. ft. of wood surface. Apply a second coat 4 to 25 hours later. Thoroughly soak cut ends. Coat the logs with a water-repelling finish after applying.

Liquid Bora-Care

This liquid solution helps to promote diffusion quicker and deeper in dryer wood. It treats the outer shell of the wood. Borates are not "fixed preservatives", they mobilize whenever the wood's moisture content is high enough to support the decay of fungi.

How does Bora-Care get into the wood?

When first applied, the Bora-Care solution coats the surface of the wood. Within minutes the active ingredient penetrates the surface of the wood. Bora-Care then begins to diffuse or move throughout the entire piece. How quickly diffusion occurs depends on wood species, moisture content and environmental conditions.

References to pesticide products in this publication are for your convenience and are not an endorsement or criticism of one product over similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law. Thanks to Karen Delahaut and Susan Mahr for reviewing this document.

Squid Hydrolysate; a Potential Replacement for Fish Meal and Phosphoric Acid/Sodium Bisulfate in Mink Feed

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ABSTRACT: New feed resources that benefit the mink industry are in short supply, particularly sources of aquatic proteins. Squid hydrolysate is a product that is fully predigested, but not denatured, and offers a maximum conversion rate into animal growth and development. The hydrolysate is shelf stabilized with approximately 3% phosphoric acid (weight/weight) to a pH of 3.0 at which no pathogens can survive. There are several potential beneficial nutritional and economic points associated with use of squid hydrol-

ysate as a ration component. Nutritionally, the predigested material could offer rapid and more complete nutrient absorption into the mink's relatively short and limited digestive system. Additionally, no expensive refrigeration or transportation by refrigerated truck is required as the product may be stored at ambient temperature for at least six months. This present study consisted of a 24-week growth trial (Trial 1) with a one-week feces and urine collection period to evaluate performance and protein digestibility of the squid hydrolysate compared to fish meal. Additionally, the efficacy of shelf-stabilized squid hydrolysate incorporated into mink feed as a feed preservative and as a replacement for phosphoric acid/ sodium bisulfate to minimize occurrence of urinary calculi were evaluated (Trial 2). Squid hydrolysate incorporated into mink feed as a complete replacement for fish meal (6% of the diet) increased the growth rate of female mink throughout the entire growth period, including the early, linear phase and the later growth, finishing phase. In male mink, the 3% squid hydrolysate diet increased growth rate during the linear phase of the growing period only. Overall, inclusion rates of 3 and 6% squid hydrolysate did not affect dietary protein digestibility in either sex. Inclusion of squid hydrolysate in mink feed at 3 or 6% as a partial or complete replacement for fishmeal had no significant effect on overall pelt quality in males or females, but control males had a significantly higher average nap score compared to males fed feed containing 6% squid hydrolysate. The results of Trial 2 suggest that sodium bisulfate is more effective than squid hydrolysate in retarding bacterial growth in feed and that inclusion of phosphoric acid or sodium bisulfate into feed to minimize urinary calculi would be more effective than relying on squid hydrolysate.

The complete study can be found at www.furresearch.org