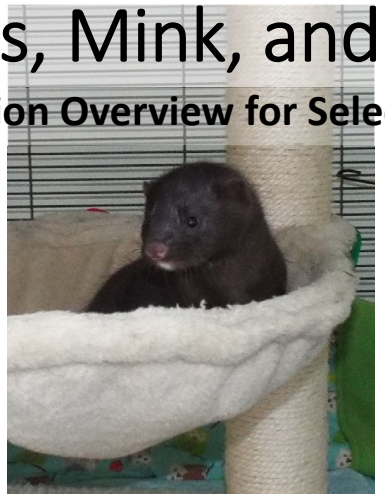
The Slinky Carnivores – Weasels, Mink, and Fishers

A Rehabilitation Overview for Select Mustelidae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A very general overview to provide the basics needed for rehabilitation, plus lots of resources for more information.

And my contact information – I welcome questions, feedback, requests for assistance and advice, and I love to hear accounts of your own experiences with these wonderful slinky, sassy carnivores!

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https://youtu.be/ikOgHwqKnoU

Gulo Gulo (Wolverine Song) by The Whizpops!

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Mustelids, especially [domestic] Mink, are considered both a SARS-CoV-2 *and* HPAI "species of concern" and appropriate PPE precautions should be taken. Mustelids in general are susceptible to human respiratory infections.

First known epidemic of highly pathogenic avian influenza H5N1 in farmed mink

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By Dr. Liji Thomas, MD — Jan 22 2023
Reviewed by Danielle Ellis, B.Sc.

Highly pathogenic avian influenza (HPAI) A(H5N1) is a strain of the avian influenza virus that primarily affects birds, particularly poultry. HPAI A(H5N1) is a highly contagious and deadly virus that can cause severe illness and death in birds, including chickens, ducks, geese, and turkeys. It has made a resurgence after many months of extremely low prevalence during the coronavirus disease 2019 pandemic (COVID-19). A recent report in the journal *Eurosurveillance* describes an outbreak from a mink farm in Spain caused by clade 2.3.4.4b.

gesting a potential severe acute respiratory syndrome coronavirus 2 transmission pathway to native wildlife.

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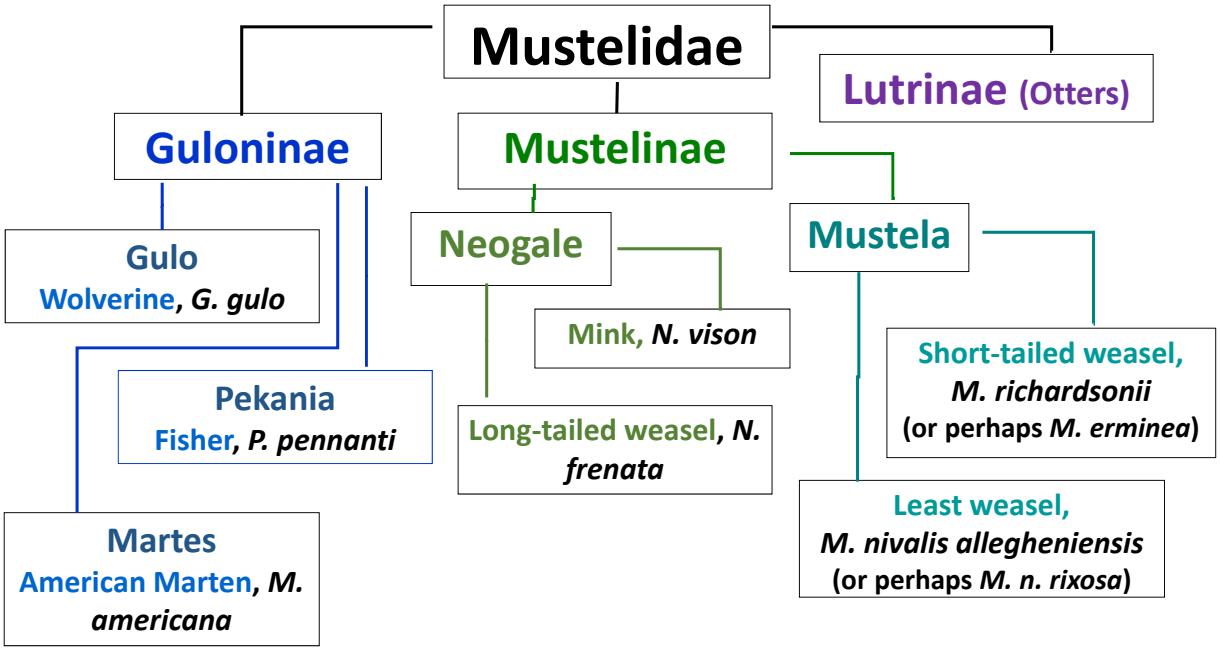

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Neogales – "New World". A 2021 study found this clade to have diverged from Mustela during the Late Miocene, between 11.8 - 13.4 million years ago, with all members within the clade being more closely related to one another than to any of the other species in Mustela, and gave it the name Neogale. They stayed in the Americas while the Mustela (least weasel and short-tailed weasel) were in Europe, the least and short-tailed weasels eventually crossing to North America through the Bering land bridge about 200,000 years ago.

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Mustelidae

Lutrinae (Otters)

- An adult North American river otter can weigh between 5.0 and 14 kg (11.0 and 30.9 lb). It is protected and insulated by a thick, water-repellent coat of fur, and is equally versatile in the water and on land. Coat becomes waterlogged and much of their time is spent on land drying off.
- Female North American river otters give birth in a burrow, usually close to the water's edge, producing litters of one to six young.
- After one month, the pup can leave the holt and after two months, it is able to swim. The pup lives with its family for approximately one year.
- Its usual source of food is fish, and where available, eels, but it may sample frogs, shellfish, and birds. They are not scavengers; they avoid consuming carrion.

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Gulo
Wolverine, *G. gulo*

Guloninae

Mustelidae

Mustelina

Lutrinae

- The wolverine is the largest land-dwelling species of the family Mustelidae. It is a muscular carnivore and a solitary animal. The wolverine has a reputation for ferocity and strength out of proportion to its size.
- They are found primarily in remote reaches of the Northern boreal forests and subarctic and alpine tundra of the Northern Hemisphere.
- Kits stay with the parents for up to 3 yrs.
- The adult wolverine is about the size of a medium dog. Males generally range in weight from 11–18 kg (24–40 lb), and females 6–12 kg (13–26 lb).
- The wolverine is primarily a scavenger, and has large non-retractable claws, large teeth, and powerful jaws to crush bones and eat frozen meat.

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Pekania
Fisher, *P. pennanti*

Mustelidae

Guloninae

Mustelinae

Lutrinae

- The fisher needs full forest canopy. Although an agile climber, it spends most of its time on the forest floor, where it prefers to forage around fallen trees. Can rotate hind feet, allowing head first descent.
- Feeds on a wide variety of small animals, dead deer, and occasionally on berries and mushrooms. Preferred prey is the snowshoe hare, and is one of the few animals able to prey successfully on porcupines. Despite its common name, it rarely eats fish.
- 3-4 kits are born in the spring. The kits separate at 5-6 months but remain in their natal territory until spring.
- They are comparable in size to a large domestic cat. Males generally weigh 3.5–6.0 kg (8–13 lb), and females 2.0–2.5 kg (4–6 lb).
- Claws are retractable but not sheathed.

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Martes
American Marten, *M. americana*

Mustelidae

Guloninae

Mustelinae

Lutrinae

- Marten are found in old growth, complex forest. They rely on deep snow and the subnivean environment to survive the winter. Can rotate hind feet, allowing head first descent.
- The diet varies by season, and may include berries, other fruit, and fungi, but relies chiefly on small mammals, especially voles. They require about 80 cal/day *while at rest*, the equivalent of about 3 voles
- A litter of 1–5 kits is born in the spring. Young stay with the mother in a constructed den until the fall; like mink, the kits are sexually mature by one year old.
- In northwestern Maine, kits were active but poorly coordinated at 7 to 8 weeks, gaining coordination by 12 to 15 weeks. Young reach adult body weight around 3 months.
- Males generally weigh 0.6-1.2 kg (1.3 -2.6 lbs), while females generally weigh 0.4-0.8 kg (0.9 -1.8 lbs)

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Mustelidae

Guloninae

Mustelinae

Neogale

Lutrinae (Otter)

Mink, *N. vison*

- Semi-aquatic, and usually found close to water.
- Solid colored brown fur with a white chin, fur is noted for its luster. White chin and chest markings are unique to the individual.
- Found throughout North America anywhere there is water, from Canada and Alaska to Florida, except in the SW desert.
- Weights vary with sex and season, with males being heavier than females. Males weigh 1–3 lb (0.5–1.6 kg) and females 0.9–2 lb (0.4–0.80 kg). Mink will bulk up for winter.
- They rely heavily on scent when foraging. Its eyesight is clearer on land than underwater. Its auditory perception is high enough to detect the ultrasonic vocalizations (1–16 kHz) of rodent prey.
- They are not scavengers and avoid consuming carrion.

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Mustelidae

Neogale

Mustelinae

Long-tailed weasel, *N. frenata*

- The long-tailed weasel is an obligate carnivore which prefers its prey to be fresh or alive.
- 85-267 g; average = ♀ 111g; ♂ 195g; juv ♂ 162 g
- Primary prey consists of mice, rats, chipmunks, moles and small squirrels & rabbits; will also take young birds.
- Habitat: forested, brushy, and open including farm land, preferably near water. Dens in abandoned burrows, often chipmunk, making a nest lined with hair from prey. Hunts mainly on the ground but will also climb trees.
- Most wide-spread carnivore in the Western Hemisphere.
- Active both day and night.
- Dark brown above, white, cream, or yellow below; brown tail with black tip. Feet are brown. Turns white in winter w/black tail tip in the northern part of range. In SW may have a mask.

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Mustelidae

Mustela

Mustelinae

Short-tailed weasel, *M. richardsonii*

- Habitat is open woodland, brushy areas, grasslands, wetlands, and farmland. Dens may be appropriated from chipmunks, often found in or beneath a log, stump, roots, brush pile, or stone wall. Also known to inhabit human residences.
- Known to live both solitary and in a group.
- Obligate carnivore, feeding primarily on mice and voles. Not scavengers.
- Also a prey species: Hawks, owls, house cats; also other carnivores. Dark brown above, white below; brown tail with black tip. Feet white. Turns white in winter w/black tail tip in the northern part of range.
- No chest markings, but infants have a distinctive "mane" as fur grows in.
- Often called ermine (white phase) or stoat (brown phase).
- 45 – 182 g, males twice the size of females

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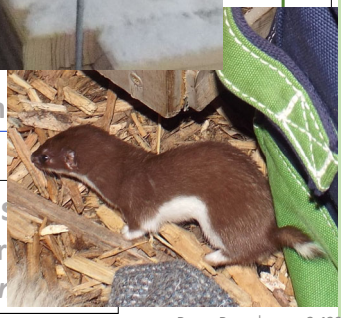

Mustelidae

Mustela

Mustelinae

Least weasel, *M. nivalis*

- They're so tiny! 6 ¾ – 8 ¼"; 37 – 50 g
- Dark brown above, white below. Tail very short and all brown. Feet white. Turns white in winter in the northern part of range.
- Active day and/or night, through all seasons. Very rarely seen as they stay undercover/underground.
- Habitat is grassy and brushy fields, marsh areas. May climb trees/brush/logs but active primarily underground and under vegetation following mouse/vole burrows; relies on subnivean layer in winter.
- Almost exclusively prey on voles/mice but may also consume insects, earthworms. Adults consume 40-100% BW/d over 5-10 meals.

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Think of them as furry raptors, or a weird bobcat-raptor hybrid. With a metabolism on overdrive.

Least weasel => American kestrel

Short-tailed weasel => merlin

Long-tailed weasel => Sharp-shinned hawk

Mink => osprey, northern goshawk

Marten => peregrine, red-tailed hawk

Fisher => bald eagle

Otter => golden eagle

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What mustelids are not is a squirrel or a raccoon

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A Note On Their Claws

Claws are large and very strong, but fairly blunt (between cat sharp and bear blunt). They are used for clinging, grasping, holding and positioning their prey, and digging in soft substrates (snow, mud, sand) rather than scratching, clawing, or disemboweling.

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Key Characteristics of Mustelidae

- Obligate Carnivore although fisher and marten, especially juveniles, may also eat berries and other seasonal fruit
- Classified as Fur bearer (trapped and managed for "harvest")
- Solitary as adults except otters and some weasels
- Long and lean – with an exceptionally high metabolism
- Young born in the spring and disperse in the late summer or fall – except least weasels, which may give birth in any season; and otter and wolverines disperse after first year.

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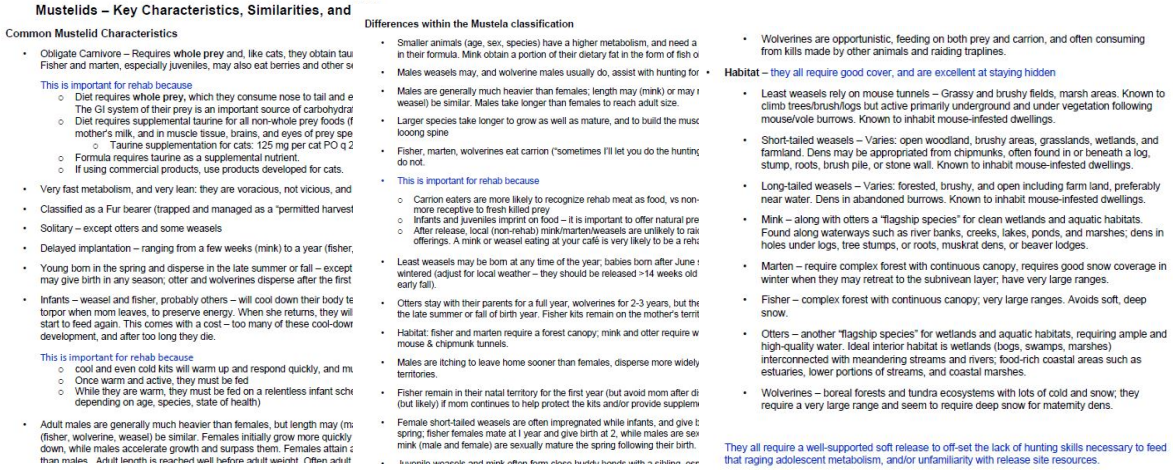
See handout[1] for a more complete list of Key Characteristics, Similarities, and Differences



Mustelids – Key Characteristics, Similarities, and

Common Mustelid Characteristics

- Obligate Carnivore – Requires **whole prey** and, like cats, they obtain tau
  Fisher and marten, especially juveniles, may also eat berries and other s
  This is important for rehab because
  - Diet requires **whole prey,** which they consume nose to tail and e
    The GI system of their prey is an important source of carbohydra
  - Diet requires supplemental taurine for all non-whole prey foods (f
    mother's milk, and in muscle tissue, brains, and eyes of prey spe
    - Taurine supplementation for cats: 125 mg per cat PO q 2
  - Formula requires taurine as a supplemental nutrient.
  - If using commercial products, use products developed for cats.
- Very fast metabolism, and very lean: they are voracious, not vicious, and
- Classified as a Fur bearer (trapped and managed as a "permitted harvest
- Solitary – except otters and some weasels
- Delayed implantation – ranging from a few weeks (mink) to a year (fisher,
- Young born in the spring and disperse in the late summer or fall – except
  may give birth in any season; otter and wolverines disperse after the first
- Infants – weasel and fisher, probably others – will cool down their body te
  torpor when mom leaves, to preserve energy. When she returns, they will
  start to feed again. This comes with a cost – too many of these cool-dow
  development, and after too long they die.
  This is important for rehab because
  - cool and even cold kits will warm up and respond quickly, and mu
  - Once warm and active, they must be fed
  - While they are warm, they must be fed on a relentless infant sch
    depending on age, species, state of health)
- Adult males are generally much heavier than females, but length may (m
  (fisher, wolverine, weasel) be similar. Females initially grow more quickly
  down, while males accelerate growth and surpass them. Females attain
  than males. Adult length is reached well before adult weight. Often adult

Differences within the Mustela classification

- Smaller animals (age, sex, species) have a higher metabolism, and need a
  in their formula. Mink obtain a portion of their dietary fat in the form of fish o
- Males weasels may, and wolverine males usually do, assist with hunting for
- Males are generally much heavier than females; length may (mink) or may
  weasel) be similar. Males take longer than females to reach adult size.
- Larger species take longer to grow as well as mature, and to build the musc
  looong spine
- Fisher, marten, wolverines eat carrion ("sometimes I'll let you do the hunting
  do not.
- This is important for rehab because
  - Carrion eaters are more likely to recognize rehab meat as food, vs non-
    more receptive to fresh killed prey
  - Infants and juveniles imprint on food – it is important to offer natural pre
  - After release, local (non-rehab) mink/marten/weasels are unlikely to rai
    offerings. A mink or weasel eating at your café is very likely to be a reh
- Least weasels may be born at any time of the year; babies born after June
  wintered (adjust for local weather – they should be released >14 weeks old
  early fall).
- Otters stay with their parents for a full year, wolverines for 2-3 years, but the
  the late summer or fall of birth year. Fisher kits remain on the mother's territ
- Habitat: fisher and marten require a forest canopy; mink and otter require w
  mouse & chipmunk tunnels.
- Males are itching to leave home sooner than females, disperse more widely
  territories.
- Fisher remain in their natal territory for the first year (but avoid mom after di
  (but likely) if mom continues to help protect the kits and/or provide supplem
- Female short-tailed weasels are often impregnated while infants, and give b
  spring; fisher females mate at I year and give birth at 2, while males are sex
  mink (male and female) are sexually mature the spring following their birth.
- Juvenile weasels and mink often form close buddy bonds with a sibling, ass

- Wolverines are opportunistic, feeding on both prey and carrion, and often consuming from kills made by other animals and raiding traplines.
- **Habitat** – they all require good cover, and are excellent at staying hidden
  - Least weasels rely on mouse tunnels – Grassy and brushy fields, marsh areas. Known to climb trees/brush/logs but active primarily underground and under vegetation following mouse/vole burrows. Known to inhabit mouse-infested dwellings.
  - Short-tailed weasels – Varies: open woodland, brushy areas, grasslands, wetlands, and farmland. Dens may be appropriated from chipmunks, often found in or beneath a log, stump, roots, brush pile, or stone wall. Known to inhabit mouse-infested dwellings.
  - Long-tailed weasels – Varies: forested, brushy, and open including farm land, preferably near water. Dens in abandoned burrows. Known to inhabit mouse-infested dwellings.
  - Mink – along with otters a "flagship species" for clean wetlands and aquatic habitats. Found along waterways such as river banks, creeks, lakes, ponds, and marshes; dens in holes under logs, tree stumps, or roots, muskrat dens, or beaver lodges.
  - Marten – require complex forest with continuous canopy, requires good snow coverage in winter when they may retreat to the subnivean layer; have very large ranges.
  - Fisher – complex forest with continuous canopy; very large ranges. Avoids soft, deep snow.
  - Otters – another "flagship species" for wetlands and aquatic habitats, requiring ample and high-quality water. Ideal interior habitat is wetlands (bogs, swamps, marshes) interconnected with meandering streams and rivers; food-rich coastal areas such as estuaries, lower portions of streams, and coastal marshes.
  - Wolverines – boreal forests and tundra ecosystems with lots of cold and snow; they require a very large range and seem to require deep snow for maternity dens.

They all require a well-supported soft release to off-set the lack of hunting skills necessary to feed that raging adolescent metabolism, and/or unfamiliarity with release site resources.

[1]Mustelids9_Popp_Mustelids-key similar-dif

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Key Characteristics Pertinent to Rehab

- Obligate Carnivore – *requires taurine in food*
- **Fast Metabolism**
- Start eating solids early, but wean late – studies show some are still nursing shortly before dispersal.
- High activity level, and high need for cover
- Curious and clever; fearless, yet cautious
- Solitary avoid crowding, watch for inter- and intraspecies aggression
- Low evidence of problems with disease or parasites in wild populations

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A Note On Delayed Implantation

If a mustelid comes into care in the fall or winter, the adult females have probably already been impregnated, on schedule to give birth in the spring. Embryos implant about 4 weeks before birth.

Short-tailed weasels mate early in the summer, giving birth the following spring. What is special about STW is that the infant females are also bred at the same time as the mother, before their eyes even open.

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A Note On Mustelidae Metabolism

- It is *very* fast!
- Maintenance Energy Requirement (MER), kcal/day: 70 x body wt $(kg)^{0.75}$ x 4 for mustelids; weasel MER is higher than other mustelids (up to x8 for Least Weasels) but all mustelids have a high MER due to their long & slender body shape.
- Smaller species and younger animals have a higher metabolism rate than larger and older animals, females have a higher rate than males
- GI Transit time is generally less than 3 hours

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What are the challenges?

- Easily Stressed
- That high metabolism
- An “uncanny ability to escape”

Hint: ½” mesh/gaps, double lock doors

- Requires appropriate pre-release conditioning and a soft release

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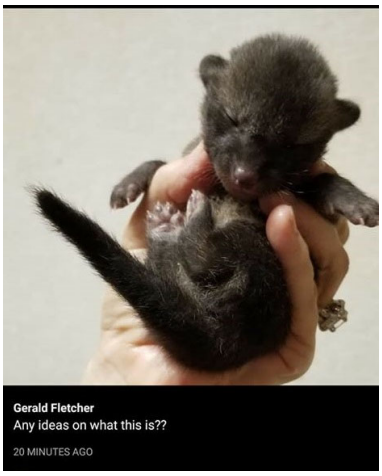
Orphan Calls



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Orphan Calls

- Mustelids nest in dens: if an infant is found outside the den with no parent in sight, it needs help. ASAP
- If a juvenile is found without a parent nearby, it needs help. ASAP
- Mustelids are clear exceptions to the “watch and wait” rule. They need help. As quickly as possible.

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Another Note on Metabolism

Regarding infants - Mom has to leave the den to forage, for herself and them, but the infant metabolism is relentless. Infants – weasel and fisher, probably others – will cool down their body temp and go into a slight torpor when mom leaves, to conserve energy. When she returns, she will quickly warm them up and they will start to feed. This comes with a cost – too many of these cool-downs will impeded development, and after too long they die.

This is important for rehab because

1. cool and even cold kits may warm up and activate quickly, and then must be fed – quickly
2. Once warm and active, they must be fed
3. While they are warm, they must be fed on a relentless infant schedule (every 0.5-3 hrs, depending on age, species, state of health)

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Upon Admission

- Assume starvation, if not emaciation
- Consider poison, environmental toxins
- Assess evidence of disease
- Capture myopathy concerns

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Because they are long and lean, and
Because their fur is so rich and dense

There isn't much difference in the appearance of a healthy wild mustelid and a [literally] starving mustelid

28

- Assume they are very hungry
- Assume they are very stressed

⇒ HANGRY

- Warm them up and feed them!

29

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Start with frequent, over-diluted, easy to digest protein. Dehydration is usually less of an issue than starvation.

Initial offerings should be well diluted (4:1), to a cream soup consistency.

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A note on mustelids and toxins …

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Three routes for exposure to rodent poison -

- Primary, by eating poisoned whole prey, including stomach contents with poisoned bait
- Secondary, by eating the poisoned rodent (mouse, vole, rat, muskrat)
- Tertiary, by eating another animal poisoned by a poisoned rodent

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Mink and otters are extremely sensitive to contaminated waterways and environmental toxins such as

- Heavy metals (lead, cadmium, mercury, methyl mercury)
  - Lead from environmental exposure and land and aquatic prey
  - Cadmium and mercury, usually from aquatic prey
  - Methyl mercury most toxic
  - Bioaccumulation in small rodents
- PCBs – jaw lesions, swollen gums, loose teeth (note for rehab exam, as indicates PCB exposure). Mink and otters are both particularly sensitive to PCB exposure, and are exposed through contact with contaminated environment and consumption of contaminated aquatic prey.

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A note on mustelids and stress …

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Mustelids hunt by responding – rapidly! - to stimuli such as light, sound, new smells, and movement. Each of these stimuli will increase the stress of an already stressed animal. Isolate, with food, in a dark, quiet space until they are comfortable in their new surroundings, and provide a minimum number of consistent caregivers.

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Signs of Stress

- “Poofing” (discharge of anal glands)
- Vocalization
- Fear behaviors

37

Signs of Stress

- “Poofing” (discharge of anal glands)
- Vocalization
- Fear behaviors

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Contrary to popular belief, mustelids are not naturally, and should not be, smelly. An animal that is “poofing” is a stressed animal, and the source of stress should be identified and addressed.

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Signs of Stress

- “Poofing”
- Vocalization
  - Squeaks
  - Screams
  - Shrill cries
- Fear behaviors

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Signs of Stress

- "Poofing"
- Vocalization
- Fear behaviors
  - Cowering/hiding/backing away
  - Fear aggression

41

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It probably needs to be fed, and left alone.

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Medical Considerations

- Fast GI Transit time (< 3hrs)
- Vaccinations and Antibiotics - use
  1) ferret,
  2) cat/kitten guidelines
- See handouts on Disease and Medical Protocols

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Infant Care

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Feeding – eyes closed infants

- Mustelid milk is high in protein (26-40%), high in fat (31-45%), and low in carbohydrates (8-21%)
- Taurine is found at particularly high levels in the milk of obligate carnivores (cats and mustelids). Feline supplementation at 125 mg per cat per day.
- Canines[1] appear long before the eyes open – solids can and should be added to the diet, but formula feedings should *not* be reduced
- Avoid over-heating – aquarium with a heating pad on low and stacks of fleece layers works well, and allows self selection of temperature.
- Consistent caregiver is important – infants are very sensitive to changes, especially scent, prior to their eyes opening.

[1] Weasels and mink; fisher teeth erupt around the time the eyes open

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Feed ad lib and often – they CANNOT over eat.

* THEY ARE NOT SQUIRRELS *

Bloat may indicate lactose intolerance; lactase drops in the formula and/or before each feeding, heat, and tummy massage may help

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Adding solids for infants

Once the canines come in, start adding solids (ad lib) *without reducing the formula feedings* – except maybe extend the interval for one or two night feedings, once all are eating from the dish.

- Have fresh water available at all times (small, flat dish).
- All mustelids can start out with mice (cut open, whole mice). Mink could also be offered raw fish tidbits; fisher can have rabbit and venison.
- I supplement with commercial raw **cat** food (poultry, fish, rabbit)
- Frequent, small meals. Food should *always* be available.

  => A well fed mustelid is a less stressed mustelid

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Mink of all ages need fish oil – a LOT of fish oil. It is very important to prevent dry skin.

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Feeding Juveniles

- **Whole mice**, sized and prepared (minced, quartered, halved, or whole) as appropriate, *and exposure to other natural foods*. Mink also get raw fish and fish oil; fisher get rabbit & venison. Food should *always* be available
- Fresh moist or frozen (thawed) raw **cat** food, ad lib
- Formula in a dish (2x/day, or as per individual)
- Fresh water in a dish (a water bottle *may* work – monitor for use, preferably use a dish along with a water bottle)

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Food habits – Described for martens, but typical of weasels, mink, and fisher, too.

The pair [of juvenile martens] fought over any food that was put into the cage, even though there was more than both could handle at one time. They nearly always carried food into the nest box; otherwise some cover would be sought under which to eat. A few times live animals were given to them and it was always the female that made the kill by biting the head and neck. Usually the mouse or other victim was dragged into the nest box even before it was dead. This behavior may be one reason why few evidences of marten kills are found while tracking them in the snow; wild martens may also prefer to eat under cover, even though prey may have been caught in the open.

The first bite on small animals (alive or dead) was always at the head or neck. The martens consumed hair, bones, entrails, and feathers, as well as the flesh of mice, small birds, and other small animals. (p. 68)

Food Habits, Growth, and Behavior of Two Captive Pine Martens, Author: Jack D. Remington
Source: Journal of Mammalogy , Feb., 1952, Vol. 33, No. 1 (Feb., 1952), pp. 66-70; Published by: American Society of Mammalogists; https://www.jstor.org/stable/1375642

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Housing and Enrichment

- **Housing**
  - As much space as possible
  - Lots of Stuff
  - Use the air space! Provides enrichment *and* cover
  - Minimum Standards – I have edits!
  - Mustelids desire to hide, especially when sleeping
  - ½ inch hardware cloth, or bar spacing

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Some observations –

Larger mustelids take longer to become coordinated than smaller species. The back end takes the longest to be brought under control.

- Weasels are agile and lightning fast by 2 months.
- Mink and marten are 3-4 months old before gaining good control over their movements, especially their hindquarters.
- Fisher may be 4-5 months before they are fully coordinated.

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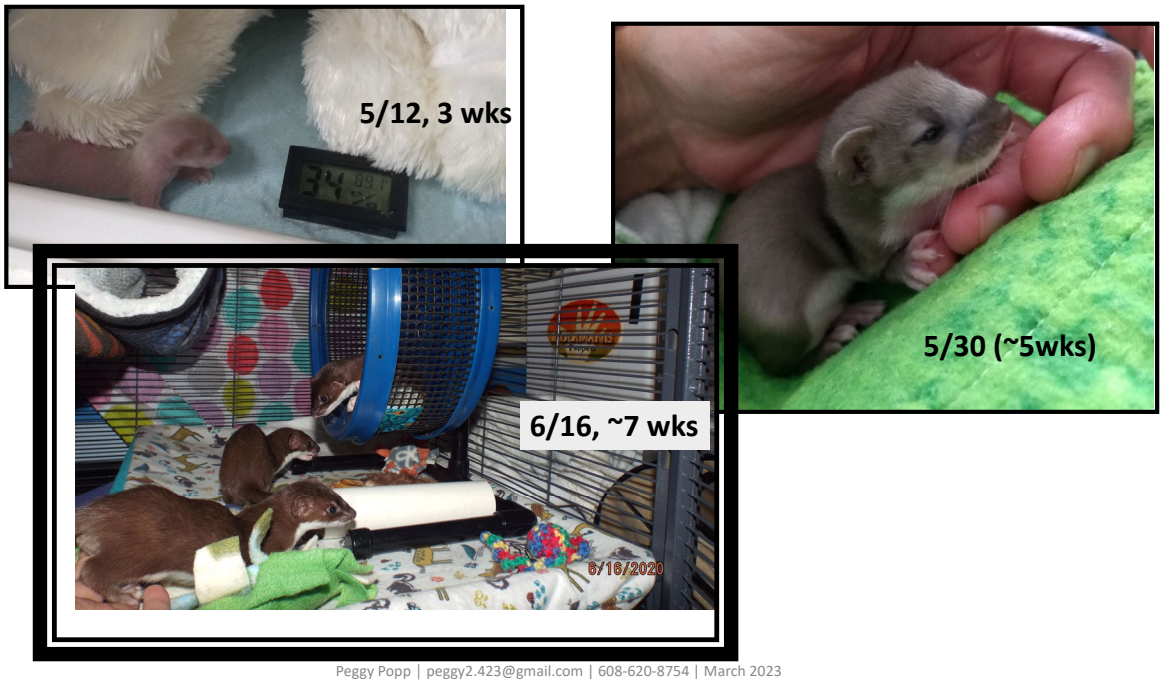

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58

This is important for rehab because a juvenile coming into your care may be wobbly or uncoordinated due to injury, but it could also just be due to age and immaturity.

59

More observations

Much like other juveniles they become independent very fast, and quickly stop following and start going off to explore. There is an important transition period prior to this where they are hesitant to explore or play without their "mother" – i.e., you – providing guidance and safety, especially with singles. Think of yourself as a grade school playground supervisor ☺

It's important to provide this "safe time" of supervised play.

60

“Habituation” is not a problem, even for singles.

61

Housing and Enrichment

Housing

- Their space and enrichment needs increase rapidly
- Mink (but not weasels, fisher, or martens) require access to water for swimming
- Need predation opportunities

62

Housing and Enrichment

- **Housing**
  The new Standards have come out.

  See the handouts for my recommended edits, especially for mink.

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Handout: Mustelids 14

Table 11.1a Minimum Housing Size Guidelines for Young Mammals (US Customary Units)

This table is not intended to be used independently; it should be used only in conjunction with the information in Chapter 11.
All sizes here are depicted as MINIMUM and use rectangular area for ease of calculation. Larger sizes and / or alternative shapes may be more suitable.

Order *Family* Species	Neonate/Infant W x L x H	Max#	Codes	Pre-release Conditioning W x L x H	Max#	Codes	Release Conditioning W x L x H	Max#	Codes
Mustelidae									
~~Martens~~	~~10 in x 20 in x 12 in~~	~~4~~	~~H, P, S~~	~~3 ft x 3 ft x 3 ft~~	~~4~~	~~D, N, S~~	~~4 ft x 8 ft x 8 ft~~	~~4~~	~~B, C, D, E, S, W~~
My recommendation Martens	10 in x 20 in X 12 in	4	H, N, P, S	2 ft x 6 ft x 6 ft	4^	C, D, L, N, S, T, Z	6 ft X 12 ft X 8 ft	2^	C, D, L, E, S, T, Z
~~Fishers~~	~~10 in x 20 in x 12 in~~	~~4~~	~~H, P, S~~	~~3 ft x 3 ft x 3 ft~~	~~4~~	~~D, N, S~~	~~6 ft x 8 ft x 8 ft~~	~~3~~	~~B, C, D, E, S, W~~
My recommendation Fishers	12 in x 24 in X 16 in	4	H, N, P, S	2 ft x 6 ft x 6 ft	4^	C, D, L, N, S	6 ft X 12 ft X 8 ft	2^	C, D, E, S
~~Weasels, minks~~	~~10 in x 20 in x 12 in~~	~~6~~	~~H, P~~	~~3 ft x 3 ft x 3 ft~~	~~6~~	~~D, N~~	~~6 ft x 8 ft x 8 ft~~	6	~~B, C, D, E, F, S, Sm, T, Z~~
My recommendation ~~Weasels,~~ mink	10 in x 20 in x 12 in	4	H*, N, P, S, Z	2 ft x 6 ft x 6 ft	4^	Bp, C, D, L, N, P, S, T, Z	6 ft x 8 ft X 8 ft	4^	C, D, E, L, S, T, W, Z
My recommendation Weasels~~, mink~~	10 in x 20 in x 12 in	6	H*, N, P, S, Z	2 ft x 6 ft x 6 ft	6^	C, D, E, L, N, P, S, T, Z	6 ft x 8 ft X 6 ft	6^	C, D, E, L, S, T, Z
River otters	12 in x 24 in x 16 in	3	H, P	6 ft x 12 ft x 6 ft	3	D, N, W	10 ft x 20 ft x 8 ft	3	B, D, E, T, W
Wolverines	12 in x 24 in x 16 in	3	H, S	3 ft x 3 ft x 3 ft	3	D,S	20 ft x 36 ft x 8 ft	3	B, C, D, E, S
Badgers	12 in x 24 in x 16 in	3	H, P, S	3 ft x 3 ft x 3 ft	3	D, N, S	12 ft x 16 ft x 8 ft	3	B, C, D, E, S, T
Mephitidae									
Skunks	12 in x 24 in x 16 in	6	H, P, S	2 ft x 4 ft x 3 ft	6	D, N, S	10 ft x 12 ft x 8 ft	6	B, C, D, E, F, L, S, Sm, T

* Heat source until no longer used
^ Watch closely for signs of sibling aggression and be prepared to separate as necessary

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Housing and Enrichment

Enrichment – there are three primary forms

- Exploratory
- Ranging
- Predation

For most juvenile play, enrichment offers opportunities to learn essential survival skills. Focus less on the source ("natural" vs not) and more on the skill outcome.

65

Housing and Enrichment

- **Enrichment**
  - Exploratory – discover and learn
    - Toys
    - Tunnels
    - Water Features (Mink)
  - Ranging
  - Predation

66

Housing and Enrichment

- **Enrichment**
  - Exploratory
  - Ranging – large muscle development
    - Shelves
    - Climbing structures
    - Wheels – sugar glider or cat wheels
  - Predation

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Housing and Enrichment

- **Enrichment**
  - Exploratory
  - Ranging
  - Predation – develop coordination
    - Hunt
    - Chase – use cat wands!
    - Random feeding times and locations

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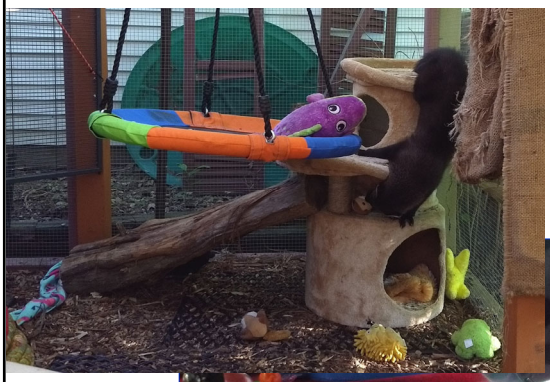

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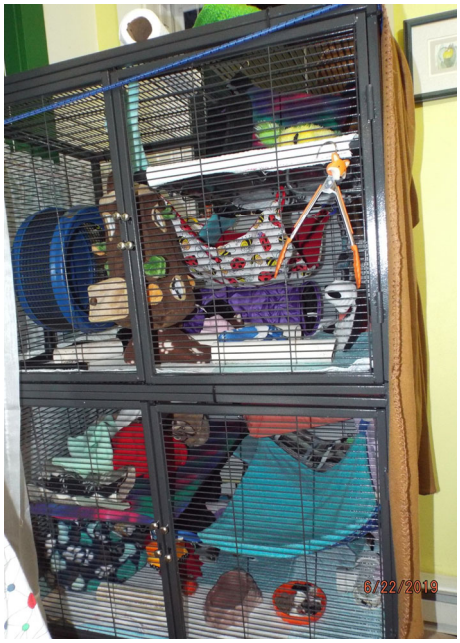

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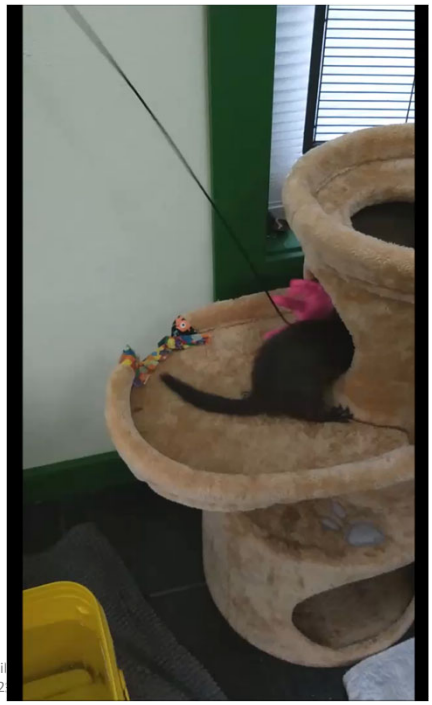

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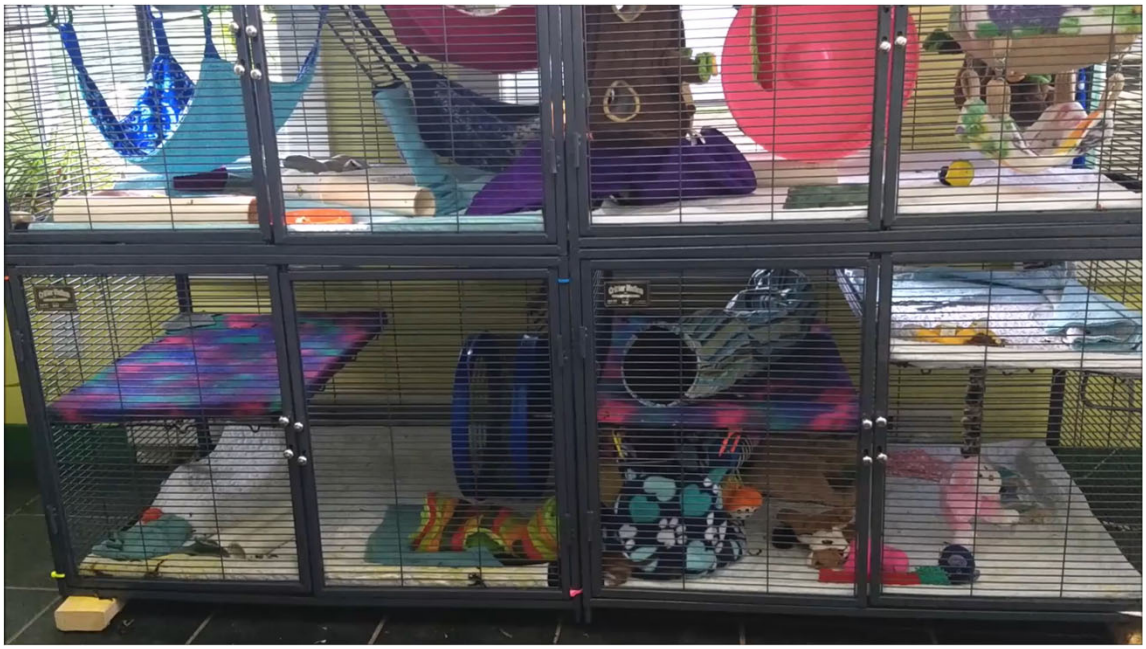

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Pre-release Conditioning

- Exposure to Natural Prey
- Hunting Skills
- Agile and Active
- Concealment
- Mink: waterproof coat

75

- Killing technique is instinctive, but efficiency improves with practice
- FINDING prey and hunting is a learned skill, and there may be a window of opportunity, as well as limited time before starving, to learn the technique.

76

Desperate attempts to escape and “cage rage” indicates stress, and a need for more space and more enrichment, not that the animal is ready for release.

77

Habituation does not make them non-releasable

They’re actually pretty hard to tame, once the time for separation sets in. Especially if you don’t handle them post-weaning.

78

Release

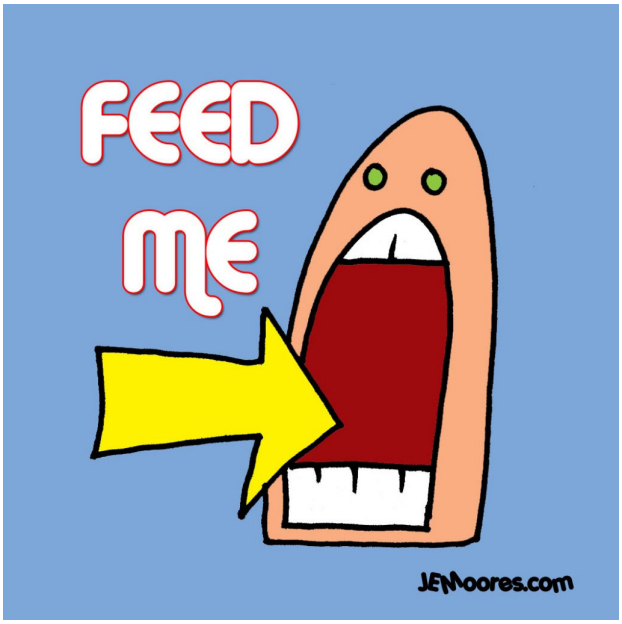
- Release in late summer or early fall
- Control stress during capture
- One animal per carrier (except weasels)
- Control stress during transportation
- Soft release in suitable habitat
- Minimum 2 weeks of post-release support

79

Release

- Soft release in suitable habitat with plenty of cover and abundant prey (see handouts for what constitutes “suitable habitat”).
- Provide supplemental food for at least 2 weeks post-release. In my experience they often go a few, or several, days without taking the food, then are back frequently as easy prey vanishes and real hunger sets in.

80



81

- Don’t worry about presence or absence of others of the same species, but minimize known overlap.
- Habitat, predators, and available prey and cover are much more important considerations.

82

Monitor release with a trail camera, if possible.

This will let you know who is taking the food, what other animals or potential threats are around, if tweaks are needed in the way food is provided or to the camera placement and settings, and most important, if your rehab baby is still around.

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84

85

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HANDOUTS

Name

- Mustelids1_Popp_A Rehabilitation Overview for Mustelids-2 slide pdf
- Mustelids2_Popp_A Rehabilitation Overview for Mustelids-3 slide pdf
- Mustelids3_Popp_Captive_PineMartens_Remington_1952
- Mustelids4_Popp_Comparison Chart_8x11
- Mustelids5_Popp_Diseases- Handout
- Mustelids6_Popp_Mink Chow Recipe
- Mustelids7_Popp_Mustelid Diseases_AZA
- Mustelids8_Popp_Mustelid Enrichment_AZA
- Mustelids9_Popp_Mustelids-key similar-dif
- Mustelids10_Popp_Orphan Mink Care
- Mustelids11_Popp_Orphan Weasel Care
- Mustelids12_Popp_Outcomes Chart_Mink
- Mustelids13_Popp_Resources and References
- Mustelids14_Popp_Standards-Mustelid caging mod
- Mustelids15_Popp_Vaccine and Sedation Protocols for Weasels and Mink

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QUESTIONS? DISCUSSION?

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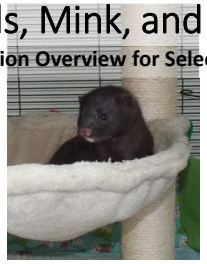
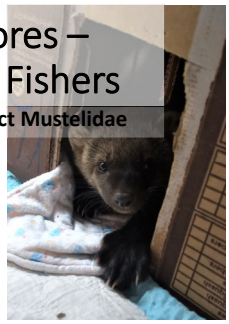
The Slinky Carnivores – Weasels, Mink, and Fishers

A Rehabilitation Overview for Select Mustelidae

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1

A very general overview to provide the basics needed for rehabilitation, plus lots of resources for more information.

And my contact information – I welcome questions, feedback, requests for assistance and advice, and I love to hear accounts of your own experiences with these wonderful slinky, sassy carnivores!

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2

https://youtu.be/ikOgHwqKnoU

Gulo Gulo (Wolverine Song) by The Whizpops!

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3

Mustelids, especially [domestic] Mink, are considered both a SARS-CoV-2 *and* HPAI "species of concern" and appropriate PPE precautions should be taken. Mustelids in general are susceptible to human respiratory infections.


First known epidemic of highly pathogenic avian influenza H5N1 in farmed mink

Download PDF Copy

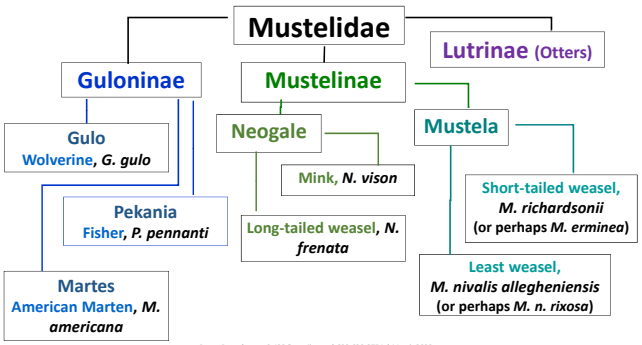
By Dr. Liji Thomas, MD — Jan 22 2023

Reviewed by Donald Ellis, B.Sc.

Highly pathogenic avian influenza (HPAI) A(H5N1) is a strain of the avian influenza virus that primarily affects birds, particularly poultry. HPAI A(H5N1) is a highly contagious and deadly virus that can cause severe illness and death in birds, including chickens, ducks, geese, and turkeys. It has made a resurgence after many months of extremely low prevalence during the coronavirus disease 2019 pandemic (COVID-19). A recent report in the journal Eurosurveillance describes an outbreak from a mink farm in Spain caused by clade 2.3.4.4b.

gesting a potential severe acute respiratory syndrome coronavirus 2 transmission pathway to native wildlife.

4



5

Neogales – "New World". A 2021 study found this clade to have diverged from Mustela during the Late Miocene, between 11.8 - 13.4 million years ago, with all members within the clade being more closely related to one another than to any of the other species in Mustela, and gave it the name Neogale. They stayed in the Americas while the Mustela (least weasel and short-tailed weasel) were in Europe, the least and short-tailed weasels eventually crossing to North America through the Bering land bridge about 200,000 years ago.

6

Mustelidae

Lutrinae (Otters)

- An adult North American river otter can weigh between 5.0 and 14 kg (11.0 and 30.9 lb). It is protected and insulated by a thick, water-repellent coat of fur, and is equally versatile in the water and on land. Coat becomes waterlogged and much of their time is spent on land drying off.
- Female North American river otters give birth in a burrow, usually close to the water's edge, producing litters of one to six young.
- After one month, the pup can leave the holt and after two months, it is able to swim. The pup lives with its family for approximately one year.
- Its usual source of food is fish, and where available, eels, but it may sample frogs, shellfish, and birds. They are not scavengers; they avoid consuming carrion.

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Gulo
Wolverine, *G. gulo*

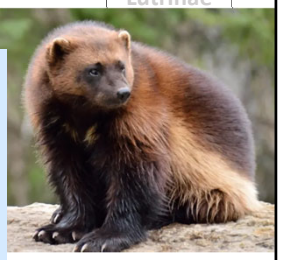
Guloninae

Mustelidae

Lutrinae

Mustelina

- The wolverine is the largest land-dwelling species of the family Mustelidae. It is a muscular carnivore and a solitary animal. The wolverine has a reputation for ferocity and strength out of proportion to its size.
- They are found primarily in remote reaches of the Northern boreal forests and subarctic and alpine tundra of the Northern Hemisphere.
- Kits stay with the parents for up to 3 yrs.
- The adult wolverine is about the size of a medium dog. Males generally range in weight from 11–18 kg (24–40 lb), and females 6–12 kg (13–26 lb).
- The wolverine is primarily a scavenger, and has large non-retractable claws, large teeth, and powerful jaws to crush bones and eat frozen meat.



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8

Pekania
Fisher, *P. pennanti*

Guloninae

Mustelidae

Lutrinae

Mustelinae

- The fisher needs full forest canopy. Although an agile climber, it spends most of its time on the forest floor, where it prefers to forage around fallen trees. Can rotate hind feet, allowing head first descent.
- Feeds on a wide variety of small animals, dead deer, and occasionally on berries and mushrooms. Preferred prey is the snowshoe hare, and is one of the few animals able to prey successfully on porcupines. Despite its common name, it rarely eats fish.
- 3-4 kits are born in the spring. The kits separate at 5-6 months but remain in their natal territory until spring.
- They are comparable in size to a large domestic cat. Males generally weigh 3.5–6.0 kg (8–13 lb), and females 2.0–2.5 kg (4–6 lb).
- Claws are retractable but not sheathed.

| March 2023

9

Martes
American Marten, *M. americana*

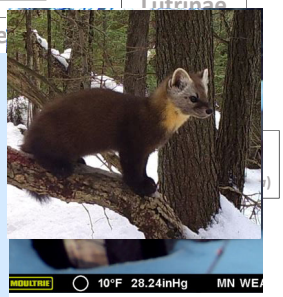
Mustelidae

Guloninae

Mustelinae

Lutrinae

- Marten are found in old growth, complex forest. They rely on deep snow and the subnivean environment to survive the winter. Can rotate hind feet, allowing head first descent.
- The diet varies by season, and may include berries, other fruit, and fungi, but relies chiefly on small mammals, especially voles. They require about 80 cal/day *while at rest*, the equivalent of about 3 voles
- A litter of 1–5 kits is born in the spring. Young stay with the mother in a constructed den until the fall; like mink, the kits are sexually mature by one year old.
- In northwestern Maine, kits were active but poorly coordinated at 7 to 8 weeks, gaining coordination by 12 to 15 weeks. Young reach adult body weight around 3 months.
- Males generally weigh 0.6-1.2 kg (1.3 -2.6 lbs), while females generally weigh 0.4-0.8 kg (0.9 -1.8 lbs)



10

Mustelidae

Guloninae

Mustelinae

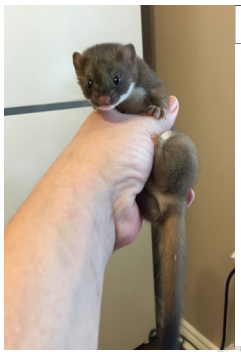
Neogale

Lutrinae
(Otter)

Mink, *N. vison*

- Semi-aquatic, and usually found close to water.
- Solid colored brown fur with a white chin, fur is noted for its luster. White chin and chest markings are unique to the individual.
- Found throughout North America anywhere there is water, from Canada and Alaska to Florida, except in the SW desert.
- Weights vary with sex and season, with males being heavier than females. Males weigh 1–3 lb (0.5–1.6 kg) and females 0.9–2 lb (0.4–0.80 kg). Mink will bulk up for winter.
- They rely heavily on scent when foraging. Its eyesight is clearer on land than underwater. Its auditory perception is high enough to detect the ultrasonic vocalizations (1–16 kHz) of rodent prey.
- They are not scavengers and avoid consuming carrion.

11



Mustelidae

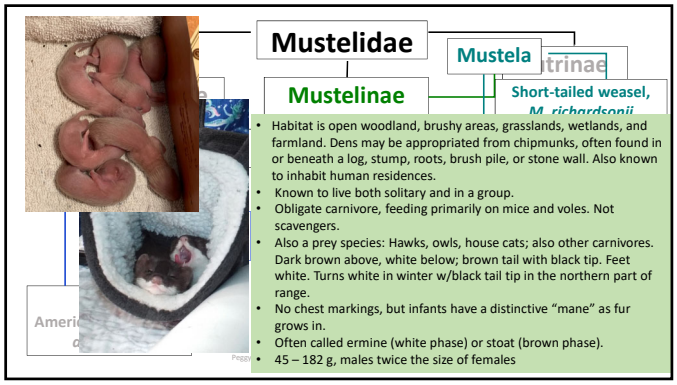
Neogale

Mustelinae

Long-tailed weasel, *N. frenata*

- The long-tailed weasel is an obligate carnivore which prefers its prey to be fresh or alive.
- 85-267 g; average = ♀ 111g; ♂ 195g; juv ♂ 162 g
- Primary prey consists of mice, rats, chipmunks, moles and small squirrels & rabbits; will also take young birds.
- Habitat: forested, brushy, and open including farm land, preferably near water. Dens in abandoned burrows, often chipmunk, making a nest lined with hair from prey. Hunts mainly on the ground but will also climb trees.
- Most wide-spread carnivore in the Western Hemisphere.
- Active both day and night.
- Dark brown above, white, cream, or yellow below; brown tail with black tip. Feet are brown. Turns white in winter w/black tail tip in the northern part of range. In SW may have a mask.

12



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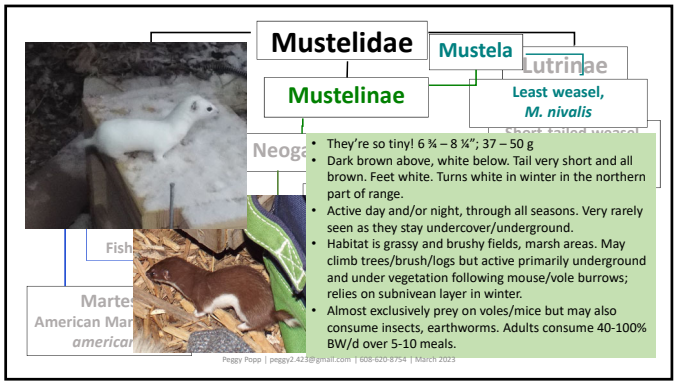

14

Think of them as furry raptors, or a weird bobcat-raptor hybrid. With a metabolism on overdrive.

Least weasel => American kestrel

Short-tailed weasel => merlin

Long-tailed weasel => Sharp-shinned hawk

Mink => osprey, northern goshawk

Marten => peregrine, red-tailed hawk

Fisher => bald eagle

Otter => golden eagle

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15

What mustelids are not is a squirrel or a raccoon

16

A Note On Their Claws

Claws are large and very strong, but fairly blunt (between cat sharp and bear blunt). They are used for clinging, grasping, holding and positioning their prey, and digging in soft substrates (snow, mud, sand) rather than scratching, clawing, or disemboweling.

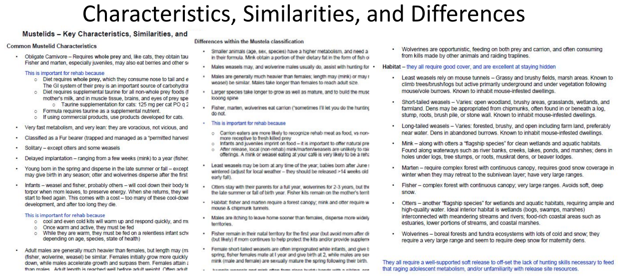
17

Key Characteristics of Mustelidae

- Obligate Carnivore although fisher and marten, especially juveniles, may also eat berries and other seasonal fruit
- Classified as Fur bearer (trapped and managed for "harvest")
- Solitary as adults except otters and some weasels
- Long and lean – with an exceptionally high metabolism
- Young born in the spring and disperse in the late summer or fall – except least weasels, which may give birth in any season; and otter and wolverines disperse after first year.

18

See handout[1] for a more complete list of Key Characteristics, Similarities, and Differences



Mustelids – Key Characteristics, Similarities, and

Common Mustelid Characteristics

- Obligate Carnivore – Requires **whole prey** and, like cats, they obtain tau
  Fisher and marten, especially juveniles, may also eat berries and other s

  This is important for rehab because
  - Diet requires **whole prey**, which they consume nose to tail and e
    The GI system of their prey is an important source of carbohydra
  - Diet requires supplemental taurine for all non-whole prey foods (f
    mother's milk, and in muscle tissue, brains, and eyes of prey spe
    - Taurine supplementation for cats: 125 mg per cat PO q 2
  - Formula requires taurine as a supplemental nutrient.
  - If using commercial products, use products developed for cats.
- Very fast metabolism, and very lean: they are voracious, not vicious, and
- Classified as a Fur bearer (trapped and managed as a "permitted harvest
- Solitary – except otters and some weasels
- Delayed implantation – ranging from a few weeks (mink) to a year (fisher,
- Young born in the spring and disperse in the late summer or fall – except
  may give birth in any season; otter and wolverines disperse after the first
- Infants – weasel and fisher, probably others – will cool down their body te
  torpor when mom leaves, to preserve energy. When she returns, they wil
  start to feed again. This comes with a cost – too many of these cool-dowr
  development, and after too long they die.

  This is important for rehab because
  - cool and even cold kits will warm up and respond quickly, and mu
  - Once warm and active, they must be fed
  - While they are warm, they must be fed on a relentless infant sche
    depending on age, species, state of health)
- Adult males are generally much heavier than females, but length may (m
  (fisher, wolverine, weasel) be similar. Females initially grow more quickly
  down, while males accelerate growth and surpass them. Females attain a

Differences within the Mustela classification

- Smaller animals (age, sex, species) have a higher metabolism, and need a
  in their formula. Mink obtain a portion of their dietary fat in the form of fish o
- Males weasels may, and wolverine males usually do, assist with hunting for
- Males are generally much heavier than females; length may (mink) or may n
  weasel) be similar. Males take longer than females to reach adult size.
- Larger species take longer to grow as well as mature, and to build the musc
  looong spine
- Fisher, marten, wolverines eat carrion ("sometimes I'll let you do the hunting
  do not.
- This is important for rehab because
  - Carrion eaters are more likely to recognize rehab meat as food, vs non-
    more receptive to fresh killed prey
  - Infants and juveniles imprint on food – it is important to offer natural pre
  - After release, local (non-rehab) mink/marten/weasels are unlikely to rai
    offerings. A mink or weasel eating at your café is very likely to be a reha
- Least weasels may be born at any time of the year; babies born after June
  wintered (adjust for local weather – they should be released >14 weeks old
  early fall).
- Otters stay with their parents for a full year, wolverines for 2-3 years, but the
  the late summer or fall of birth year. Fisher kits remain on the mother's terri
- Habitat: fisher and marten require a forest canopy; mink and otter require w
  mouse & chipmunk tunnels.
- Males are itching to leave home sooner than females, disperse more widely
  territories.
- Fisher remain in their natal territory for the first year (but avoid mom after di
  (but likely) if mom continues to help protect the kits and/or provide supplem
- Female short-tailed weasels are often impregnated while infants, and give b
  spring; fisher females mate at I year and give birth at 2, while males are sex
  mink (male and female) are sexually mature the spring following their birth.

- Wolverines are opportunistic, feeding on both prey and carrion, and often consuming
  from kills made by other animals and raiding traplines.
- **Habitat** – they all require good cover, and are excellent at staying hidden
  - Least weasels rely on mouse tunnels – Grassy and brushy fields, marsh areas. Known to
    climb trees/brush/logs but active primarily underground and under vegetation following
    mouse/vole burrows. Known to inhabit mouse-infested dwellings.
  - Short-tailed weasels – Varies: open woodland, brushy areas, grasslands, wetlands, and
    farmland. Dens may be appropriated from chipmunks, often found in or beneath a log,
    stump, roots, brush pile, or stone wall. Known to inhabit mouse-infested dwellings.
  - Long-tailed weasels – Varies: forested, brushy, and open including farm land, preferably
    near water. Dens in abandoned burrows. Known to inhabit mouse-infested dwellings.
  - Mink – along with otters a "flagship species" for clean wetlands and aquatic habitats.
    Found along waterways such as river banks, creeks, lakes, ponds, and marshes; dens in
    holes under logs, tree stumps, or roots, muskrat dens, or beaver lodges.
  - Marten – require complex forest with continuous canopy, requires good snow coverage in
    winter when they may retreat to the subnivean layer; have very large ranges.
  - Fisher – complex forest with continuous canopy; very large ranges. Avoids soft, deep
    snow.
  - Otters – another "flagship species" for wetlands and aquatic habitats, requiring ample and
    high-quality water. Ideal interior habitat is wetlands (bogs, swamps, marshes)
    interconnected with meandering streams and rivers; food-rich coastal areas such as
    estuaries, lower portions of streams, and coastal marshes.
  - Wolverines – boreal forests and tundra ecosystems with lots of cold and snow; they
    require a very large range and seem to require deep snow for maternity dens.

They all require a well-supported soft release to off-set the lack of hunting skills necessary to feed
that raging adolescent metabolism, and/or unfamiliarity with release site resources.

[1]Mustelids9_Popp_Mustelids-key similar-dif

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Key Characteristics Pertinent to Rehab

- Obligate Carnivore – *requires taurine in food*
- **Fast Metabolism**
- Start eating solids early, but wean late – studies show some are still nursing shortly before dispersal.
- High activity level, and high need for cover
- Curious and clever; fearless, yet cautious
- Solitary avoid crowding, watch for inter- and intraspecies aggression
- Low evidence of problems with disease or parasites in wild populations

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A Note On Delayed Implantation

If a mustelid comes into care in the fall or winter, the adult females have probably already been impregnated, on schedule to give birth in the spring. Embryos implant about 4 weeks before birth.

Short-tailed weasels mate early in the summer, giving birth the following spring. What is special about STW is that the infant females are also bred at the same time as the mother, before their eyes even open.

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A Note On Mustelidae Metabolism

- It is *very* fast!
- Maintenance Energy Requirement (MER), kcal/day: 70 x body wt (kg)$^{0.75}$ x 4 for mustelids; weasel MER is higher than other mustelids (up to x8 for Least Weasels) but all mustelids have a high MER due to their long & slender body shape.
- Smaller species and younger animals have a higher metabolism rate than larger and older animals, females have a higher rate than males
- GI Transit time is generally less than 3 hours

22

What are the challenges?

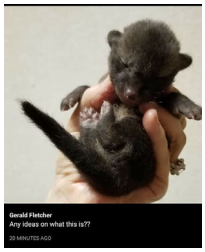
- Easily Stressed
- That high metabolism
- An "uncanny ability to escape"

Hint: ½" mesh/gaps, double lock doors

- Requires appropriate pre-release conditioning and a soft release

23

Orphan Calls



24

Orphan Calls

- Mustelids nest in dens: if an infant is found outside the den with no parent in sight, it needs help. ASAP
- If a juvenile is found without a parent nearby, it needs help. ASAP
- Mustelids are clear exceptions to the "watch and wait" rule. They need help. As quickly as possible.

25

Another Note on Metabolism

Regarding infants - Mom has to leave the den to forage, for herself and them, but the infant metabolism is relentless. Infants – weasel and fisher, probably others – will cool down their body temp and go into a slight torpor when mom leaves, to conserve energy. When she returns, she will quickly warm them up and they will start to feed. This comes with a cost – too many of these cool-downs will impeded development, and after too long they die.

This is important for rehab because

1. cool and even cold kits may warm up and activate quickly, and then must be fed – quickly
2. Once warm and active, they must be fed
3. While they are warm, they must be fed on a relentless infant schedule (every 0.5-3 hrs, depending on age, species, state of health)

26

Upon Admission

- Assume starvation, if not emaciation
- Consider poison, environmental toxins
- Assess evidence of disease
- Capture myopathy concerns

27

Because they are long and lean, and
Because their fur is so rich and dense

There isn't much difference in the appearance of a healthy wild mustelid and a [literally] starving mustelid

28

- Assume they are very hungry
- Assume they are very stressed

⇒ HANGRY

- Warm them up and feed them!

29

30

Start with frequent, over-diluted, easy to digest protein.
Dehydration is usually less of an issue than starvation.

Initial offerings should be well diluted (4:1), to a cream soup consistency.

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A note on mustelids and toxins …

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Three routes for exposure to rodent poison -

- Primary, by eating poisoned whole prey, including stomach contents with poisoned bait
- Secondary, by eating the poisoned rodent (mouse, vole, rat, muskrat)
- Tertiary, by eating another animal poisoned by a poisoned rodent

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Mink and otters are extremely sensitive to contaminated waterways and environmental toxins such as

- Heavy metals (lead, cadmium, mercury, methyl mercury)
  - Lead from environmental exposure and land and aquatic prey
  - Cadmium and mercury, usually from aquatic prey
  - Methyl mercury most toxic
  - Bioaccumulation in small rodents
- PCBs – jaw lesions, swollen gums, loose teeth (note for rehab exam, as indicates PCB exposure). Mink and otters are both particularly sensitive to PCB exposure, and are exposed through contact with contaminated environment and consumption of contaminated aquatic prey.

34

A note on mustelids and stress …

35

Mustelids hunt by responding – rapidly! - to stimuli such as light, sound, new smells, and movement. Each of these stimuli will increase the stress of an already stressed animal. Isolate, with food, in a dark, quiet space until they are comfortable in their new surroundings, and provide a minimum number of consistent caregivers.

36

Signs of Stress

- "Poofing" (discharge of anal glands)
- Vocalization
- Fear behaviors

37

Signs of Stress

- "Poofing" (discharge of anal glands)
- Vocalization
- Fear behaviors

38

Contrary to popular belief, mustelids are not naturally, and should not be, smelly. An animal that is "poofing" is a stressed animal, and the source of stress should be identified and addressed.

39

Signs of Stress

- "Poofing"
- Vocalization
  - Squeaks
  - Screams
  - Shrill cries
- Fear behaviors

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Signs of Stress

- "Poofing"
- Vocalization
- Fear behaviors
  - Cowering/hiding/backing away
  - Fear aggression

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It probably needs to be fed, and left alone.

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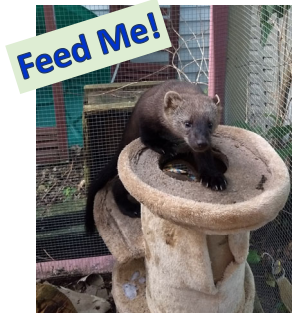


44

Medical Considerations

- Fast GI Transit time (< 3hrs)
- Vaccinations and Antibiotics - use
  1) ferret,
  2) cat/kitten guidelines
- See handouts on Disease and Medical Protocols

45

Infant Care

46

Feeding – eyes closed infants

- Mustelid milk is high in protein (26-40%), high in fat (31-45%), and low in carbohydrates (8-21%)
- Taurine is found at particularly high levels in the milk of obligate carnivores (cats and mustelids). Feline supplementation at 125 mg per cat per day.
- Canines[1] appear long before the eyes open – solids can and should be added to the diet, but formula feedings should *not* be reduced
- Avoid over-heating – aquarium with a heating pad on low and stacks of fleece layers works well, and allows self selection of temperature.
- Consistent caregiver is important – infants are very sensitive to changes, especially scent, prior to their eyes opening.

[1] Weasels and mink; fisher teeth erupt around the time the eyes open

47

Feed ad lib and often – they CANNOT over eat.

* THEY ARE NOT SQUIRRELS *

Bloat may indicate lactose intolerance; lactase drops in the formula and/or before each feeding, heat, and tummy massage may help

48

Adding solids for infants

Once the canines come in, start adding solids (ad lib) *without reducing the formula feedings* – except maybe extend the interval for one or two night feedings, once all are eating from the dish.

- Have fresh water available at all times (small, flat dish).
- All mustelids can start out with mice (cut open, whole mice). Mink could also be offered raw fish tidbits; fisher can have rabbit and venison.
- I supplement with commercial raw **cat** food (poultry, fish, rabbit)
- Frequent, small meals. Food should *always* be available.
  => A well fed mustelid is a less stressed mustelid

49

50

Mink of all ages need fish oil – a LOT of fish oil. It is very important to prevent dry skin.

51

Feeding Juveniles

- **Whole mice**, sized and prepared (minced, quartered, halved, or whole) as appropriate, *and exposure to other natural foods*. Mink also get raw fish and fish oil; fisher get rabbit & venison. Food should *always* be available
- Fresh moist or frozen (thawed) raw **cat** food, ad lib
- Formula in a dish (2x/day, or as per individual)
- Fresh water in a dish (a water bottle *may* work – monitor for use, preferably use a dish along with a water bottle)

52

53

Food habits – Described for martens, but typical of weasels, mink, and fisher, too.

The pair [of juvenile martens] fought over any food that was put into the cage, even though there was more than both could handle at one time. They nearly always carried food into the nest box; otherwise some cover would be sought under which to eat. A few times live animals were given to them and it was always the female that made the kill by biting the head and neck. Usually the mouse or other victim was dragged into the nest box even before it was dead. This behavior may be one reason why few evidences of marten kills are found while tracking them in the snow; wild martens may also prefer to eat under cover, even though prey may have been caught in the open.

The first bite on small animals (alive or dead) was always at the head or neck. The martens consumed hair, bones, entrails, and feathers, as well as the flesh of mice, small birds, and other small animals. (p. 68)

Food Habits, Growth, and Behavior of Two Captive Pine Martens, Author: Jack D. Remington
Source: Journal of Mammalogy , Feb., 1952, Vol. 33, No. 1 (Feb., 1952), pp. 66-70; Published by: American Society of Mammalogists; https://www.jstor.org/stable/1375642

54

Housing and Enrichment

- **Housing**
  - As much space as possible
  - Lots of Stuff
  - Use the air space! Provides enrichment *and* cover
  - Minimum Standards – I have edits!
  - Mustelids desire to hide, especially when sleeping
  - ½ inch hardware cloth, or bar spacing

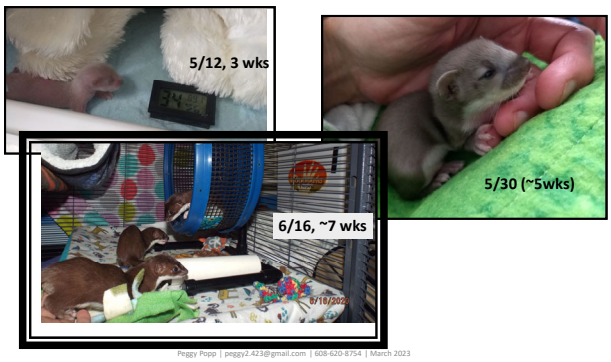
55

Some observations –

Larger mustelids take longer to become coordinated than smaller species. The back end takes the longest to be brought under control.

- Weasels are agile and lightning fast by 2 months.
- Mink and marten are 3-4 months old before gaining good control over their movements, especially their hindquarters.
- Fisher may be 4-5 months before they are fully coordinated.

56



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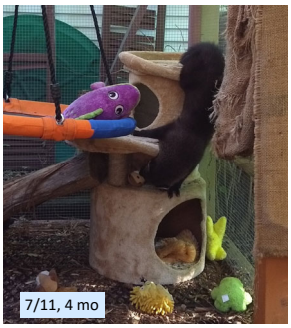

58

This is important for rehab because a juvenile coming into your care may be wobbly or uncoordinated due to injury, but it could also just be due to age and immaturity.

59

More observations

Much like other juveniles they become independent very fast, and quickly stop following and start going off to explore. There is an important transition period prior to this where they are hesitant to explore or play without their "mother" – i.e., you – providing guidance and safety, especially with singles. Think of yourself as a grade school playground supervisor ☺

It's important to provide this "safe time" of supervised play.

60

"Habituation" is not a problem, even for singles.

61

Housing and Enrichment

Housing

- Their space and enrichment needs increase rapidly
- Mink (but not weasels, fisher, or martens) require access to water for swimming
- Need predation opportunities

62

Housing and Enrichment

- **Housing**
  The new Standards have come out.

  See the handouts for my recommended edits, especially for mink.

63

Handout: Mustelids 14

Table 11.1a Minimum Housing Size Guidelines for Young Mammals (US Customary Units)

This table is not intended to be used independently; it should be used only in conjunction with the information in Chapter 11.
All sizes here are depicted as MINIMUM and use rectangular area for ease of calculation. Larger sizes and / or alternative shapes may be more suitable.

Order *Family* Species	Neonate/Infant W x L x H	Max#	Codes	Pre-release Conditioning W x L x H	Max#	Codes	Release Conditioning W x L x H	Max#	Codes
Mustelidae									
~~Martens~~	~~10 in x 20 in x 12 in~~	4	~~H, P, S~~	~~3 ft x 3 ft x 3 ft~~	4	~~D, N, S~~	~~4 ft x 8 ft x 8 ft~~	4	~~B, C, D, E, S, W~~
My recommendation Martens	10 in x 20 in X 12 in	4	H, N, P, S	2 ft x 6 ft x 6 ft	4^	C, D, L, N, S, T, Z	6 ft X 12 ft X 8 ft	2^	C, D, L, E, S, T, Z
~~Fishers~~	~~10 in x 20 in x 12 in~~	4	~~H, P, S~~	~~3 ft x 3 ft x 3 ft~~	4	~~D, N, S~~	~~6 ft x 8 ft x 8 ft~~	~~3~~	~~B, C, D, E, S, W~~
My recommendation Fishers	12 in x 24 in X 16 in	4	H, N, P, S	2 ft x 6 ft x 6 ft	4^	C, D, L, N, S	6 ft X 12 ft X 8 ft	2^	C, D, E, S
~~Weasels, minks~~	~~10 in x 20 in x 12 in~~	6	~~H, P~~	~~3 ft x 3 ft x 3 ft~~	6	~~D, N~~	~~6 ft x 8 ft x 8 ft~~	6	~~B, C, D, E, F, S, Sm, T, Z~~
My recommendation ~~Weasels,~~ mink	10 in x 20 in x 12 in	4	H*, N, P, S, Z	2 ft x 6 ft x 6 ft	4^	Bp, C, D, L, N, P, S, T, Z	6 ft x 8 ft X 8 ft	4^	C, D, E, L, S, T, W, Z
My recommendation Weasels, ~~mink~~	10 in x 20 in x 12 in	6	H*, N, P, S, Z	2 ft x 6 ft x 6 ft	6^	C, D, E, L, N, P, S, T, Z	6 ft x 8 ft X 8 ft	6^	C, D, E, L, S, T, Z
River otters	12 in x 24 in x 16 in	3	H, P	6 ft x 12 ft x 6 ft	3	D, N, W	10 ft x 20 ft x 8 ft	3	B, D, E, T, W
Wolverines	12 in x 24 in x 16 in	3	H, S	3 ft x 3 ft x 3 ft	3	D,S	20 ft x 36 ft x 8 ft	3	B, C, D, E, S
Badgers	12 in x 24 in x 16 in	3	H, P, S	3 ft x 3 ft x 3 ft	3	D, N, S	12 ft x 16 ft x 8 ft	3	B, C, D, E, S, T
Mephitidae									
Skunks	12 in x 24 in x 16 in	6	H, P, S	2 ft x 4 ft x 3 ft	6	D, N, S	10 ft x 12 ft x 8 ft	6	B, C, D, E, F, L, S, Sm, T

* Heat source until no longer used
^ Watch closely for signs of sibling aggression and be prepared to separate as necessary

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Housing and Enrichment

Enrichment – there are three primary forms

- Exploratory
- Ranging
- Predation

For most juvenile play, enrichment offers opportunities to learn essential survival skills. Focus less on the source ("natural" vs not) and more on the skill outcome.

65

Housing and Enrichment

- **Enrichment**
  - Exploratory – discover and learn
    - Toys
    - Tunnels
    - Water Features (Mink)
  - Ranging
  - Predation

66

Housing and Enrichment

- **Enrichment**
  - Exploratory
  - Ranging – large muscle development
    - Shelves
    - Climbing structures
    - Wheels – sugar glider or cat wheels
  - Predation

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Housing and Enrichment

- **Enrichment**
  - Exploratory
  - Ranging
  - Predation – develop coordination
    - Hunt
    - Chase – use cat wands!
    - Random feeding times and locations

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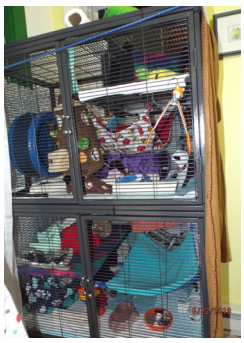

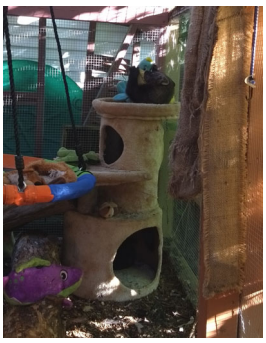

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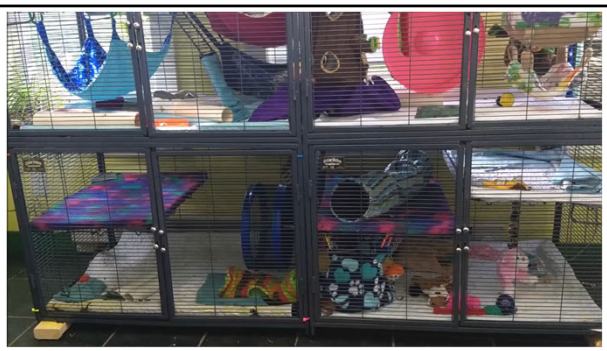

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Pre-release Conditioning

- Exposure to Natural Prey
- Hunting Skills
- Agile and Active
- Concealment
- Mink: waterproof coat

75

- Killing technique is instinctive, but efficiency improves with practice
- FINDING prey and hunting is a learned skill, and there may be a window of opportunity, as well as limited time before starving, to learn the technique.

76

Desperate attempts to escape and “cage rage” indicates stress, and a need for more space and more enrichment, not that the animal is ready for release.

77

Habituation does not make them non-releasable

They’re actually pretty hard to tame, once the time for separation sets in. Especially if you don’t handle them post-weaning.

78

Release

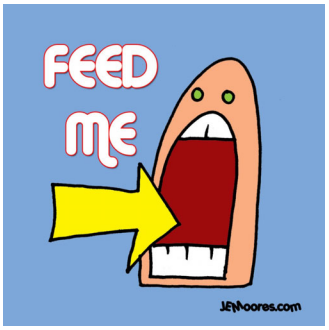
- Release in late summer or early fall
- Control stress during capture
- One animal per carrier (except weasels)
- Control stress during transportation
- Soft release in suitable habitat
- Minimum 2 weeks of post-release support

79

Release

- Soft release in suitable habitat with plenty of cover and abundant prey (see handouts for what constitutes “suitable habitat”).
- Provide supplemental food for at least 2 weeks post-release. In my experience they often go a few, or several, days without taking the food, then are back frequently as easy prey vanishes and real hunger sets in.

80



81

- Don’t worry about presence or absence of others of the same species, but minimize known overlap.
- Habitat, predators, and available prey and cover are much more important considerations.

82

Monitor release with a trail camera, if possible.

This will let you know who is taking the food, what other animals or potential threats are around, if tweaks are needed in the way food is provided or to the camera placement and settings, and most important, if your rehab baby is still around.

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85

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HANDOUTS

Name

- Mustelids1_Popp_A Rehabilitation Overview for Mustelids-2 slide pdf
- Mustelids2_Popp_A Rehabilitation Overview for Mustelids-3 slide pdf
- Mustelids3_Popp_Captive_PineMartens_Remington_1952
- Mustelids4_Popp_Comparison Chart_8x11
- Mustelids5_Popp_Diseases- Handout
- Mustelids6_Popp_Mink Chow Recipe
- Mustelids7_Popp_Mustelid Diseases_AZA
- Mustelids8_Popp_Mustelid Enrichment_AZA
- Mustelids9_Popp_Mustelids-key similar-dif
- Mustelids10_Popp_Orphan Mink Care
- Mustelids11_Popp_Orphan Weasel Care
- Mustelids12_Popp_Outcomes Chart_Mink
- Mustelids13_Popp_Resources and References
- Mustelids14_Popp_Standards-Mustelid caging mod
- Mustelids15_Popp_Vaccine and Sedation Protocols for Weasels and Mink

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QUESTIONS? DISCUSSION?

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FOOD HABITS, GROWTH, AND BEHAVIOR OF TWO CAPTIVE PINE MARTENS

By Jack D. Remington

About June 15, 1950, a little girl was attracted to a rock pile near Rabbit Ears Pass, north-central Colorado, by the barking of her dog. She investigated, dug out two small martens, *Martes caurina origenes* Rhoads, took them home and placed them in a cage. A wild marten, presumably the mother of the two captives, was seen near the cage on numerous occasions during the first few days, after which it disappeared and was not seen again. During the next two weeks the young animals were fed various things, and were found to be especially fond of candy and other sweet foods.

Tourists and others saw the young martens daily, and they were variously misidentified as "little foxes," "honey bears," etc. Colorado Game Warden C. A. Hurd of Steamboat Springs advised the family that they were martens, and since they were protected fur animals they could not be legally held in captivity. Mr. Hurd called Dr. Lee E. Yeager of the Colorado Cooperative Wildlife Research Unit and asked if the martens would be useful for study. On June 30, 1950, Dr. Yeager assigned them to the writer, who was working on a marten investigation in Colorado.

Description of capture site.—The writer examined the rock pile about six weeks after the martens had been removed. The location was within 50 yards of U. S. Highway 40 and about 75 yards from a well-used public camp ground. The general vegetative type of the area was Engelmann spruce–alpine fir with a mixture of lodgepole pine. The rock pile was in a moist, open draw next to a willow thicket, and covered a circular area only 10 or 15 feet in diameter. There were no holes that appeared deep enough or extensive enough to house a family of martens. It is not certain that a litter had been born and reared there; if so, the site had been abandoned by the mother and any remaining young ones. Among the rocks were hairs and bones of a snowshoe hare, *Lepus americanus*, and a few feathers from a woodpecker, probably the three-toed form, *Picoides tridactylus*.

Caging and handling techniques.—The martens (a male and female, Pl. I) were kept together in a cage outside the writer's headquarters cabin near Lake Agnes, Jackson County, Colorado. The elevation was 10,500 feet, and exposure and temperature factors approximated those in the surrounding spruce–fir forest. Later, the animals were moved to Trappers Lake, Garfield County, Colorado, and kept under comparable conditions.

The cage was about 4 by 4 feet, and 6 feet high. The roof and floor were of rough lumber and the sides enclosed with ordinary wire screening. The cardboard nest box, which enclosed some felt padding as bedding, had to be held down with a large rock; otherwise it would have been turned over and torn up by the active martens. The water pan was nailed down for the same reason.

The martens were handled with bare hands for the first three weeks. After that, well-padded mittens were necessary. They violently resisted handling,

and would scratch and bite constantly. A small, spring-type scale was used for weighing them; weights were taken in grams. The procedure was to catch one of the martens, push it into a sugar sack (later one of wire mesh), and hang the sack on the scale. It was possible to obtain a reading to the nearest 5 grams between jumps of the animal.

Food habits.—After the writer assumed custody of the martens they were fed as natural a diet as possible, but it was found that they would eat almost anything put into the cage. The only exceptions were a live toad and a live salamander. The female started to gnaw on the toad, but soon gave up, spitting and hacking as if the toad had a very bad taste. Neither marten would touch the salamander.

PLATE I

Young martens, about eleven weeks old. Note shape and contours of head and neck (left), and plantigrade front foot and dark tip of tail (right)

During the month of July, 1950, they were fed twice a day and after that usually once a day. On one occasion it was necessary to leave them for five days. Enough food and water for the entire period was put into the cage, but it is assumed that it was eaten during the first two or three days. When the writer returned, the martens were active and in good condition, but very hungry.

The pair fought over any food that was put into the cage, even though there was more than both could handle at one time. They nearly always carried food into the nest box; otherwise some cover would be sought under which to eat. A few times live animals were given to them and it was always the female that made the kill by biting the head and neck. Usually the mouse or other victim was dragged into the nest box even before it was dead. This behavior may be one reason why few evidences of marten kills are found while tracking them in the snow; wild martens may also prefer to eat under cover, even though the prey may have been caught in the open.

The first bite on small animals (alive or dead) was always at the head or neck. The martens consumed hair, bones, entrails, and feathers, as well as the flesh of mice, small birds, and other small animals. They left the feet and large bones of marmots and rabbits. These martens caught and ate flies and moths that got into the pen. They also ate grasshoppers, indicating that insects are one source of food in the wild. Droppings were left in the same spot in the pen; never in the nest box.

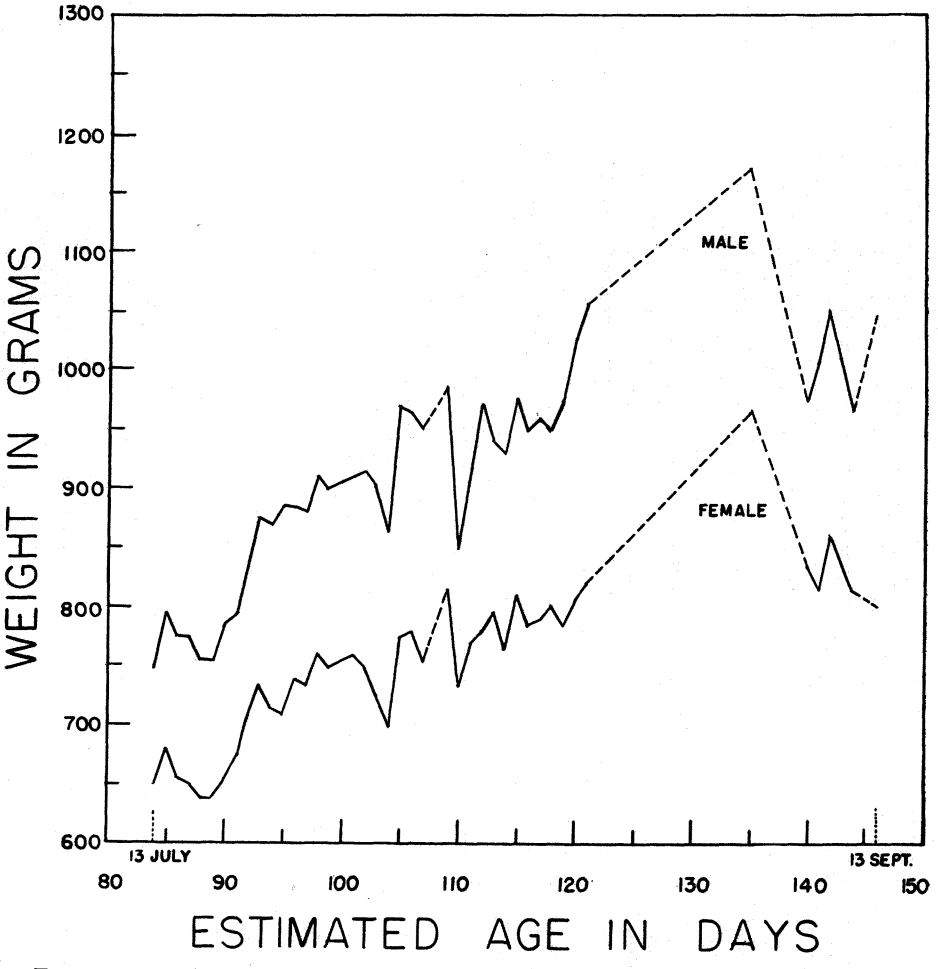

FIG. 1.—Growth rate of two captive martens. Dashed line indicates discontinuous record.

Food items preferred by the martens were: mice (alive or dead), ground squirrels, chipmunks, marmots, jack rabbit, small birds, cooked wheat cereal, gooseberries, raisins, and candy. Items less readily eaten were: shrews, venison (raw or cooked), beef (raw or cooked), ham (cooked), gravy (beef or ham), and pancakes (with or without syrup). Items eaten only when hungry were: trout (raw or cooked), grasshoppers, spaghetti, bread, celery, and lettuce.

Growth.—Between July 13 and August 19, 1950, the martens were weighed each day (except August 6) before the first meal. After that they were weighed seven times until September 13, 1950. A record of all weights is given in Figure 1.

Assuming April 15, 1950, as the birth date of the animals, they were about 12 weeks old when weighing began. The male, at the beginning, weighed 100 grams more than the female, and exceeded her weight by more than 200 grams when weighing ceased two months later. The weight figures were analyzed statistically by Mr. Jack R. Grieb of the Colorado Cooperative Wildlife Research Unit. He concluded that there was a strong direct correlation (correlation coefficient r = .9631) between the two weight gains, revealing that the martens grew at the same rate during the recorded period.

Sanderson (Jour. Mamm., 30: 412–415, 1949) recorded weights of seven males and one female in a litter of long-tailed weasels. He said the female never weighed as much as the lightest male, and that her rate of gain continued about the same as that of the males until the animals reached approximately eight weeks of age. After that time she attained her peak weight at a slower rate than did the males.

Behavior.—The young martens were active most of the night and especially at dusk and dawn. They moved around some during daylight hours, but seldom between 10:00 A. M. and 3:00 P. M. After feedings (during which they fought, sometimes viciously) they would roll and play like kittens. Their play was very rough, but they never seemed to hurt each other. They snarled and growled often, the growl resembling that of a raccoon.

When a person approached the pen, the martens would take a quick look, then dive for cover. When the writer cleaned the cage, they would retreat as far as possible, sit watchfully, and growl. They liked to climb up on anything available and jump off. One accomplishment was to hang from objects, using either the front or hind legs alone. They slept curled up together, presumably for warmth, under any available cover.

The female was more nervous and more curious than the male. She made all kills of live animals put into the cage, and resisted handling more violently. She was also the one to attempt escape and succeed. Luckily she stayed near the pen in the surrounding woods. To recapture her, the writer constructed a trip mechanism which would drop the trap door when the bait (a piece of meat) was pulled from inside the cage. Within an hour the marten was recaptured.

On September 12, 1950, the two martens were moved to Fort Collins, Colorado, which is at an elevation of 5000 feet and about 50 miles from the closest marten habitat. In spite of the change in environment they seemed at first to thrive.

On October 2, 1950, the male was found dead in the cage, apparently the victim of the female's viciousness. The head and two front legs were torn from the carcass, but only the heart and lungs were missing. The female was retained, and during the last week of October became so weak that she lost interest in

food and even allowed persons to pet her. On October 31, 1950, she died from what appeared to be a respiratory infection.

[A contribution from the Colorado Cooperative Wildlife Research Unit, Colorado A and M College, the Colorado Game and Fish Department, The Wildlife Management Institute, and the U. S. Fish and Wildlife Service, cooperating]

Fort Collins, Colorado. Received April 2, 1951.

THE OCCURRENCE AND SIGNIFICANCE OF EXTRA MOLAR TEETH IN RODENTS

By David H. Johnson

The presence of an additional tooth at the posterior end of the molariform series in rodents is comparatively rare, judging from the few such instances that have been recorded. If the customary theory, that the three cheek teeth of the normal tooth row in muroid rodents are true molars, is to be accepted, this additional tooth must be considered a fourth molar. It has been suggested on the basis of other evidence by several authors (Major, 1872; Hinton, 1910, p. 490; Kellogg, 1922, pp. 249–255; Hinton, 1923) that among rodents the anterior tooth in the series is homologous with the fourth deciduous premolar of other mammals (but not with the permanent premolar that usually replaces it), and that the remaining two teeth correspond to the first and second molars. If this is true, an occasional vestige of the lost third molar might be expected to appear at the posterior end of the tooth row. There is substantial evidence in favor of the latter theory, and it might have come into general acceptance long ago except for the awkward matter of altering the terminology of rodent teeth. The question has not been settled, however, and it seems worth while to put on record any new evidence that bears on the subject.

The specimen that stimulated the present comment is a subadult male of the large arboreal rat *Mesembriomys gouldi gouldi* (U. S. National Museum no. 284349). It was collected on September 10, 1948, at Gove, near Yirrkala, on the northeastern coast of Arnhem Land, Northern Territory of Australia. The dentition is fully irrupted and only slightly worn. The three usual cheek teeth of each upper and lower row are normal in size, position, and configuration. The additional tooth appears at the posterior end of the right maxillary row (Plate I, upper). There is no trace of a similar tooth in the left maxillary or in either mandibular series, nor is it present in any of five other skulls of the same species from Arnhem Land.

The tooth projects 1.4 mm. beyond the rim of the alveolus, thus reaching about to the level of the greatest expansion of the crown of the preceding molar. Its surface is unworn, and it appears that in life the tooth was still covered by the tissue of the gum. The greatest diameter of the crown is 1.8 mm., transverse to the axis of the tooth row. The anteroposterior diameter is 1.0 mm. In cross-section the crown is kidney-shaped with the concavity on the anterior side. A large external cusp makes up most of the bulk of the crown; it has a bulbous

FAMILY: Mustelidae Also M. (Putorius) nigripes (Black-footed Ferret)	**Least Weasel** *Mustela nivalis* (Previously *M. rixosa*)	**Short-tailed Weasel** *Mustela erminea*	**Long-tailed Weasel** *Neogale (was Mustela) frenata*	**American Mink** *Neogale (was Neovison) vison* (Previously *M. (Lutreola) vison*)
Length, total Length, head+body Length, tail tail, relative to body Weight (smaller in northern parts of range)	6 ¾ – 9 ¾" 5 ⅞–7 ¼ "[1]; 5–10"[2] ⅞– 1 ¼" 10– 15% 28 – 84 g ♂ (<9.8") larger than ♀ (<8.8")	7 ½ – 13 ½ " 5 ⅞–11"[1]; 7–13"[2] 1 ⅝– 3 ½ " ~ 25% 45 – 182 g ♂ 2x size of ♀	11 – 22 " 7 ⅞–15 ⅝ "[1]; 9–10"[2] 3 ⅛ – 6 ⅜ " 50 – 100% 85 – 267 g ♂ 2x size of ♀ $\bar{x}$ = ♀ 111g; ♂ 195g; juv ♂ 162 g	19 ⅜ – 22" 13 ⅛–14 ⅜ "[1]; 14–22"[2] 6 ¼ – 7 ⅝ " 38 - 50% 700 – 1,600 g Weight varies with season ♂ 2x larger than ♀
Physical Description	Tiny. Dark brown above, white below. Tail very short and all brown. Feet white. Turns white in winter in the northern part of range. Often has an individually distinct brown spot on chest at 18 days which disappears after 4 months of age.	Dark brown above, white below; brown tail with black tip. Feet white. Turns white in winter w/black tail tip in the northern part of range. No chest markings.	Brown above, white to deep yellow below. Brown tail with black tip. Feet brown-ish. Tail often equal to head+body length. Turns white in winter w/black tail tip in northern part of range. Some individuals have spot/s on chest developing at 35 days. SW US and FL may have lt facial markings.	Lustrous chocolate brown to black fur, white spotting on chin and throat. Tail long and somewhat bushy. (note: no white underparts) No color change to white. Semi-aquatic; incompletely adapted to aquatic life (between marten and otter)
Breeding	Mates year round *with no delayed implantation*; young born after $\bar{x}$=35-day gestation. ♂ and ♀ are sexually mature at 3-4 months although they seldom breed until > 10 mo	Mates in June-July *with delayed implantation*. Young are born following April after 27-day active gestation ♂ are sexually mature at 14 mo and ♀ at 2-5 mo; ♀ is often bred by same male breeding with her mother, giving birth the following spring.	Mates mid-summer *with delayed implantation*; young are born the following spring after 23-24 day active gestation. ♂ mature during 2nd summer; ♀ at 3-4 months.	Mates January – April, *with a short delayed (8-45d) implantation*. *shorter gestation in warmer months*Mink are not monogamous, and littermates may have different fathers. ♂ mature @ 18 mo; ♀ at 1 year
Litter, size & description Larger litters are more common in the northern part of range.	Up to 3 litters per year of 1-6+ young ($\bar{x}$=4-5); usually born in early spring and mid-summer, often in abandoned burrows of another animal. Documented births (in the wild) in every month.	1 litter of 4-9 young ($\bar{x}$ =6); born in late spring; blind with fine hair. Mane present at birth and continues to develop as fur comes in (14 days). Male and female may care for the young.	Litter size $\bar{x}$=6-7 but wide range (<4 to >9). Born blind and nearly naked in late spring.	Litter of 1 – 10 ($\bar{x}$ =3-5) born blind and [nearly] naked in fur-lined nest in April or May. A male often eventually lives with one female and helps with the young.
Weight at birth	$\bar{x}$ =1.4 g	$\bar{x}$ =1.7 g	~3 g	6 or 8-10 g

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Hair appears	@ 4 days covered with fine white hair.[4]	Fine white hair within first day.	Born with a few sparse long white hairs on back and head. >1 day covered with fine white hair.[4]	Fine, silver-white hair within first day.
Begins to crawl	4 days	"early"	14 days (♂), 14-21 days (♀)	3 weeks
Brown dorsal fur appears	18 days Hair comes in fast; at 18 days has brown/white coloring.	21 days @7 days demarcation apparent; @14-21 days heavy mane contrasts with "scantily white furred animal"[4]	28-35 days @ 3 weeks dark line of demarcation and tail tip is black. @ 5 weeks brown top and bottom light (white – yellow/tan)	Brown by 2-3 weeks; water-proofing present @ ~8 weeks
Ears open Often concurrent with eyes opening	21-28 days[4]	35 days[4]	28 days[4]	25-35 days Quiets down after ears open :-)
Eyes open	26-30 days[4]	35 days (blue at first) [4] 36-41 day, ♀ before ♂[5]	35-37 days[4]	25-35 days
Black tail tip appears	N/A	45 days (in England)[4]	21 days[4]	N/A
Weaning Continues limited nursing until dispersal	@14 days begins to suck and chew on pieces of mouse; Eating solid food > 18 days[4] Weaning Initiated at 32 days and continues until 42-56 days[4]. Disperse at 4 mo.	Consumes meat at 21-28 days and by 35 days is eating >50% BW in meat (continues to nurse until dispersion)[4] Juveniles begin hunting at 10-12 weeks.	Consumes meat at 21 days and by 36 days are eating ½ to nearly their own weight in meat/day.[4] At 7-8 weeks the ♂ are already larger than their mother.	35-45 days, after eyes and ears open and concurrent with increased mobility. Weaning is gradual. Young remain with their mother until the family disperses in early fall.
First kills prey	6-7 weeks At 40 d mother begins training, and young are adept at 42-45d. Orphans 1st become adept at killing at 50-60 days.[1]	80 days (Europe)		> 56 days
Growth complete Disperses at 13-18 weeks	Reaches adult length at 8-12 weeks and adult weight at 12-15 weeks. Adult male consumes >40% BW/day		♀ slows growth ≥ 8 wks.; both sexes at adult size ≥ 12 wks. Consuming 28-38% BW/day	1 year? Weights vary with sex and season. Max heaviness occurs in autumn. Domestic mink are much larger (4-6+ lbs)

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Kills prey by =========> Killing move is instinctive but efficiency improves with training/experience.	Grabs prey by the nape then bites through the base of the skull and/or throat area, often wrapping body and legs around the prey. Eats the entire animal (skin, intestines, bones, etc.). Prefers head/brains, then inner organs and muscles, and will eat those first (which is useful to know for medicating purposes – inject the brain of the prey food).			Biting back of the neck. Marks hunting territory with fetid musk > skunk but short-lived.
Activity Killing technique is instinctive but hunting is a learned behavior.	Day and/or night, all seasons. Very rarely seen as they stay undercover.	Active both day and night. Hunts mainly on the ground but can climb and even pursues prey into the water.	Most wide-spread carnivore in the Western Hemisphere. Active both day and night. Hunts mainly on the ground but can climb.	Able to dive to depth > 16 feet, the mink is an accomplished swimmer and spends much time hunting in ponds and streams. Adapts activity to prey. Also climbs.
Vocalization	Murmurs, chirps, purrs. When disturbed may give a shrill squeaking call, and may also hiss when threatened.	Grunts, murmurs, hisses, chatters, shrill (and very loud) alarm call. Purrs when content	Screech and squeal, rapid trill, and purr when content.	If angered or alarmed (or trapped) may hiss, snarl, or scream, and discharge its anal glands. Purrs when content.
Habitat The range of the male is generally larger than the range of the female; larger ranges in wooded environment vs open. All require fresh water within their home range.	Grassy and brushy fields, marsh areas. Known to climb trees/brush/logs but active primarily underground and under vegetation following mouse/vole burrows. - Unlikely to dig their own tunnels unless soft substrate but will take abandoned burrow of another small mammal, adding mouse hair to the dried grass lining the nest. - Solitary as adults. - Home range 7-24 acres[2] - Home range < 2 acres[1] - Usually found ≤ 60 yards from burrow	Varies: open woodland, brushy areas, grasslands, wetlands, and farmland. Dens may be appropriated from chipmunks, often found in or beneath a log, stump, roots, brush pile, or stone wall. Readily climbs trees and other objects; will swim if necessary. Also known to inhabit human residences. - Known to live both solitary and in a group. - 2-5 favorite denning sites and 3-10 daytime resting places. - Home range 2.5-12 acres in open grassland; ♂: 17-37 acres in woods, and ♀: 2.5-10 acres in woods[2]	Varies: forested, brushy, and open including farm land, preferably near water. Dens in abandoned burrows, making a nest lined with hair from prey. Will climb trees when chasing prey. - Solitary except males *may* assist with providing food for young (probably in exchange for breeding rights). - 2-5 favorite denning sites and 3-10 daytime resting places. - Home range 2.5-12 acres in open grassland; ♂: 17-37 acres in woods and ♀: 2.5-10 acres in woods[2] - Presence of water primary factor $\bar{x}$ distance from den: 100yds, max distance from den: 220 yds	Males have large home ranges that extend for a half mile or more along waterways and overlap with the smaller home ranges of several females. Mink dens typically consist of long burrows along river banks, creeks, lakes, ponds, and marshes; holes under logs, tree stumps, or roots; and hollow trees. Dens in openings in stream banks, 4” wide, usually appropriated from muskrats; also beaver lodges, hollow log, or digs own. It may continue along for 10–12 feet and at a depth of 2–3 feet Moves often.

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Prey The size of the weasel heavily influences ability to take different prey. Largest males take the largest prey.	Almost exclusively prey on voles/mice. Males esp. will occasionally eat shrews, moles, birds, and insects if mice are scarce. Consumes ~40% BW/d over 5-10 meals.	Mice and voles are preferred prey but diet may also include rats, chipmunks, shrews, baby rabbits, birds, frogs, lizards, and insects.	Mice and voles are preferred prey but diet may also include rabbits, shrews, chipmunks, rats, birds & poultry, and occasional insect or worm.	Muskrat, rats, and fish are preferred prey but will also take other rodents, birds & eggs, crustaceans, amphibians, and young snapping turtles
Predators	Cats, hawks, owls, fox – anything that kills mice.	Hawks, owls, cats; also other carnivores. Humans (trappers and cars).	Hawks, owls, cats, foxes. Humans (trappers and cars).	Foxes, bobcats, lynx, alligators, and great horned owls. Humans (trappers and cars).

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Misc Notes	- Smallest living carnivore; does not appear to be common in any part of its range. Considered a "species of concern" in MN. - May have at most few black hairs on the extreme tip of tail. - So. ranges may have delayed or incomplete molt. - Can run very fast, up to 6 mph. - After four weeks of age becomes more difficult to handle (once eyes open). - European LW 2-2.5x larger than American LW - *BW can fluctuate 5-10 g/day depending on timing and amount of last meal.* - At 4 weeks ♂ gradually gain weight faster than ♀ & by 6 wks. 2x size of ♀; @ 8 wks. ♀ have a growth spurt. - Juveniles unable to kill prior to 38-42 days old.[4] - High mortality in first year; #1: predators, #2: starvation. - frozen prey is carried into fur-lined den to thaw, and fresh killed brought in to prevent freezing. - skulls in midwest frequently showed signs of nematode (roundworm) infestation in lesions of frontal sinuses[3]	- Often called ermine (white phase) or stoat (brown phase). - May release strong musk when alarmed, enraged, or excited by mating urge. - Defensive behavior includes loud screeching and holding their ground/charging adversary. - *>4 ½ weeks mother would no longer retrieve if out of the nest.* - Did not play outside the nest until > 7 wks. - STW has the greatest size variation between subspecies of the three weasels (location matters!). Smallest subspecies are found in the northwest mountain ranges; smallest females in WA, smallest males (m. erminea muricus) in CA, CO, ID, MT - Seems to have a fatal fascination for attacking spinning wheels (car tires), perhaps the motion triggers a prey response. -Hunts under the snow in winter. -Dens in ground burrows, under stumps, and in and under rock piles and old buildings -I had three male short tailed weasels (mane as infants, tail ~50% body length) that were 250-300g at release. Littermates were much smaller.	- Color change seems to be triggered by length of daylight but is also genetic. A northern weasel captured and taken south turned white during winter while a southern weasel taken north stayed brown. - May release powerful malodorous musk when alarmed, enraged, or excited by mating urge. - **Immobilization** using IM injection (25G x 16mm needle) of ketamine HCl (25 mg/kg) + xylanzine HCl (2 mg/kg), as recommended for ferrets. - ear tags used for tracking study were size 1 Monel tag, National Band and Tag Company, Newport, KY - Winter white weasel of either sex is sexually inactive. - distance traveled (♂): 3-4 mi, $\bar{x}$=2mi Tracking studies of 11 ♂ and 10 ♀: ♂, $\bar{x}$ = 704 ft (60-2535 ft) ♀, $\bar{x}$ = 346 ft (20-1420 ft) - those in open timber traveled much greater distances than those in brushland and dense stands of trees. - Prey: ♂ - small mammals up to rabbit size; ♀ - mice and chipmunks. Rabbits are pursued and nipped, with bites both weakening the animal and allowing a blood trail which facilitates tracking. Known to hunt in preferred coverts but rarely the same one on consecutive nights	- Both sexes are hostile to same-sex intruders and may fight viciously with one another. **In good habitat, density may be 9-22 per sq. mile** - Mink require water depth >1.2', allowing them swimming room. Highly susceptible to methylmercury toxicity (increasing acidity increases methylation of Hg). - Can swim >3 hr. in warmer water but may die in <30 min in cold water. - Farmed mink have 20% smaller brain, 28% smaller spleen (=> immune system and bodily fluids balance), and 8% smaller heart than wild American. They are much larger, come in a variety of colors, and the fur is short and very dense (like plush velvet). - European mink are much smaller (1-1½ lbs, 12"-15") and more closely related to the polecat than the American Mink - Vocalizations of kits are suggested to play a role in the maternal care and kit survival. Kits begin to vocalize immediately after birth. When a young mink kit is isolated from its mother it starts vocalizing loudly and almost continuously. Vocalizing decreased dramatically from 100% for newborns to only 15 % as eyes opened. >6.5 wks., none of the kits being studied produced any sound, when isolated from the mothers.

General Notes:

Research has centered on three major areas of study: (a) physiology of delayed implantation; (b) physiology of coat color changes (weasels); and (c) economic importance as fur bearers.

Mustela as a rule show little or no avoidance behavior although they become more alert in the presence of predators. Weasels in particular are the epitome ADD in the animal kingdom: high energy, very curious, easily distracted, and unintimidated by larger creatures (including humans).

Defensive behavior follows set vocal and movement patterns which begin when the eyes open. If caught in the open follows similar pattern to skunks: stamp feet and charge. Size of adversary is irrelevant. Curious and unafraid, including of humans.

They are remarkable for their length and slenderness. As a comparison, the length of a raccoon spine = length of the hind leg; for weasels the spine = 1.75x hind leg. Mink are chunkier but still slender enough to follow prey (especially muskrat) into burrows. Marten are similar in size to mink, while fisher are about 4x larger than mink and marten.

Delayed implantation: Most are northern animals, high in the ecological food chain, and not a rapid turnover (i.e., short life expectancy) so no need for multiple litters in a year. Mating in spring/summer is beneficial to the adults while an early spring birth benefits the young (longer time to grow up before winter sets in). There is evidence that at least sometimes the male is around to help raise the young because the female weasel goes into estrus soon after giving birth. It also serves as a means of population control for such an efficient predator. In the case of Least Weasels, the need to have more offspring out trumps the climate pressure for delay due to the shorter life expectancy. Mink mate in the early spring with a short-delayed implantation (8-45d) depending on the conditions, and young are born 30-32d after implanting, in May or June.

Exposure to natural light and natural light cycles is important as it has been shown to regulate behaviors, hormones, and molt cycles.

The young mustelids are called “kits”. At birth the front limbs are much stronger and better coordinated than the rear limbs. Newborns are surprisingly strong, lifting their heads high and briefly supporting on fore legs. They react with loud(!) vocalization when disturbed or separated from the mother. This diminishes rapidly as they get older and generally ends by the time their ears open. It takes quite a while for the back limbs to become strong and coordinated.

Depending on the information source, neonates should be kept at a temperature between 80 – 85°F; young animals die very quickly if they are kept at too high a temperature or set incubators at 85-90°F and 50-60% humidity. The temperature should be gradually reduced to room temperature (70-75°F) over the course of about 3 weeks (unless the neonate becomes ill). If the ambient temperature is too high it may cause hair loss. Most will feel more secure if burrowed in layers of towels, flannel, or fleece; this also aids in keeping them warm. Singles will do much better with a heartbeat/Snuggle Pet.

Important to successful rearing: 1) **Keeping kits warm and offering them a choice of temperature** (heating pad; or incubator for neonates); 2) **provide hiding places** (layers of small fleece or flannel pieces, pieces of pvc pipe, paper tubes, etc.); 3) **consistent staff, limited to the fewest individuals** (kits with their eyes closed can react aggressively to strange smells, and unfamiliar caregivers considerably stress the animals); and 4) **frequent feedings (**10 – 14x/24 hrs. until supplementing with solids then gradually reducing frequency to 8-10x/24hrs but maintaining regular intervals with night feedings). Remember that they require 50-100% BW/day. After the eyes open formula can be offered in a shallow dish.

Mustelid Adult Maintenance Energy Requirement (MER), kcal/day: 70 x body wt. $(kg)^{0.75}$ x a factor of 4 (mink) – 8 (least weasel) depending on size. Smaller => Faster metabolism

Weasels and mink are obligate carnivores; fisher and marten are known to also eat berries. Baby teeth, as well as the permanent teeth, are specialized for meat. The least weasel rarely eats anything other than small mice and voles and will often starve if the rodent population crashes. The long-tailed weasel has the most varied diet of the weasels, and the larger species (mink and fisher) are even more opportunistic. Evidence indicates they imprint on their food while young. This is important for rehab because older juveniles and adults may not recognize unfamiliar food (such as commercial pet food) as food, and it also indicates the young animals should be exposed to multiple appropriate natural food, including insects, in part to minimize starvation if the preferred prey is unavailable. Feeding cat kibble may encourage them to forage at feral and outdoor cat feeding stations, leaving animals more susceptible to predation and human conflict.

If feeding "people" meats, fish, and eggs, raw is better than cooked, because the cooking may cause key nutrients to be less available. They are evolved to eat their proteins raw. All supplements/ commercial products should be animal-based, not plant-based, as they cannot absorb or metabolize the plant-based forms. If not fed whole prey then the diet should mimic whole prey, including skin, organs, and bones.

Because of their high metabolism young Mustela require frequent small meals; for weasels this means 5-10 small meals per day spaced 2 - 3 hours apart. Mink can be fed less often, but should always have access to food. They cannot consume more quantity/meal (i.e., gorging) or eat more frequently even if underfed. Smaller animals require more food relative to size than larger ones. LW > STW > LTW; ♀ > ♂; young>old. Mink are born with <1% body fat but will bulk up in the fall; weasels do not have body fat => very little reserves if food is unavailable, while juvenile mink are not yet full grown when released, in addition to needing addition bulk for winter survival.

Young LTW must eat 50-100% BW/day while adults require 25-30%/day. STW and LW require more, and adult male LW require 40% BW/day.

Mustelid Maternal Milk Composition: High protein, high fat, low carbohydrate, low fiber. Of the documented mustelid maternal milks, the range for proteins is 26-40%, for fat it is 31-45%, and for carbohydrates it is 8-21%. Mink is 33% fat, 26% protein, 21% carbs on a dry weight basis and contains 3.8% lipids, 6.2% protein, 4.6% lactose and 10.66% mineral salts as is. Zoologic states mink milk is 26% protein, 33% fat, 21% lactose, 21.7% solids. Weasels appear to need higher fats and proteins (and less carbs) than mink. Mink require a fish oil supplement.

>>> Goat milk: 27.7% protein, 31.5% fat, 34.6% carbs

I have used KMR: Multi Milk:H_20, 3:1:6; I am currently using 4 parts FV 32/45 (skunk) : 1-part KMR : ½ -part MultiMilk : 8 parts water for weasels. The mink should have the multi-milk eliminated and instead be supplemented with fish oil once a day. I prefer KMR and FV Kitten over the non-cat equivalent because it is more likely to have adequate taurine. Larger species of weasels may require less of a fat boost than smaller ones.

Re: taurine: All mustelids, like felids, are required to get taurine (an essential amino acid) from their food, as their body cannot produce it. Muscle meat is high in taurine, as are spiders, many insects, and (apparently) brains and eyeballs. Chicken baby food, chicken dark meat, clams/clam juice, tongue, and heart are good sources of taurine. Kitten formula is recommended because of the need for taurine (note: Nick said he now adds taurine to each of his FV formulas). Taurine is present in the colostrum and milk of many mammals, and is present at particularly high levels in the milk of obligate carnivores. The recommended taurine supplementation for [adult] *felids* is 125 mg/animal/day. I have not been able to find a minimum daily requirement for any mustelid species. Note that taurine is considered nontoxic, with no known adverse effects, even at mega-doses.

Taurine deficiency causes alterations in excitable tissues in all species; retinal degeneration, myocardial failure/dilated cardiomyopathy (DCM), and reproductive issues are the most common in cats, but also seen in other species if depleted. Common ways cat owners cause taurine deficiency and related conditions are feeding dog food, feeding boiled poultry, and feeding boutique diets without adequate taurine – this would also apply to mustelids.

Formulas based on goat's milk may be beneficial because small carnivores cannot efficiently absorb the fat globules in cow's milk. Straight up goat's milk is too high in carbs and too low in fat and protein for mustelids and taurine level is unknown. Goat Milk KMR is now available but I have not yet had an opportunity to use it.

It is important to offer moist solids (cut up or pureed whole mouse, fresh or frozen-thawed raw feline diet, or high quality [no grains, veg, or fruits!] soaked kitten kibble) from a very early age (2 weeks) and to continue offering formula on the 2/2.5/3 hr., 24/7 feeding schedule as they begin eating solids. Once their eyes open it often becomes difficult to hand feed with a syringe because they do not want to be held. Formula should then be offered in a dish for as long as the animal will take it. This will help to ensure the young animal is receiving adequate nutrition, esp. calcium and fluids, and also sufficient calories. It is hard for them to eat enough calories in a day without the formula, especially when very young. Kibble, if used, should be fed moist, as they need the water to digest the food. Body weights of weasels can vary by as much as 20% depending on how recently they last ate.

Syringe feed only if the kit is warm and vigorous. Weak kits may be hypothermic, dehydrated, and/or hypoglycemic. Do not offer anything by mouth until the body temperature is within the normal range for its age. Offer diluted carnivore critical care food or baby food chicken if it will accept, or give oral or SQ fluids if weak or dehydrated. Be very cautious about administering sub-Q fluids, as it easy to overwhelm their system. Oral fluids are preferred. Rub Karo syrup, maple syrup, or molasses on gums or offer 2.5% or 5% dextrose to raise glucose level, if necessary. Be extremely cautious about tube feeding, as the danger of over-feeding is high.

Housing:

They are all escape artists! If a mouse can get in or out, so can a weasel. Mink are very strong and clever at finding (or creating) escape routes. Adult mink are capable of biting through chicken wire and hardware cloth, and have been known to bend the bars of ferret and critter nation cages. Critter/ferret nation cages should have all sections/walls/top panel zip tied together; the doors should be secured with a carbineer and zip tie system.

Do not house mustelids with other species, including/especially other mustelids (with the possible exception of skunks and smaller weasels), as they are all in a predator-prey relationship with each other.

Maintain in a cool environment (<70 °F) and use heat lamps, heating pads, hot rocks, fleece bedding, etc. to provide warm areas.

The mustelids are all scent markers and sensitive to scents. To minimize stress clean or replace 25% bedding and enrichment at a time rather than "clean sweep". They tend to have corner "latrine" areas which facilitates spot cleaning. Also, be aware they cache food, often in a tunnel system (toilet paper tubes, pvc pipes, etc.). They are very sensitive to essential oils and many essential oils are toxic at low levels (including ones like tea tree and eucalyptus). Avoid using or wearing scented products in their area.

Use natural substrates such as dry sphagnum moss, hay, soil, pine needles, leaves, sand, mulch or bark, etc. with good cover and abundant climbing, foraging, and resting sites. Chopped grass forage (Triple Crown Grass Forage) with a tunnel system of paper tubes (indoor caging) or narrow (1-3") pvc pipe (outdoor caging) is nice base for small weasels, with branches, logs, rocky screes, nest boxes, and hiding spots. Hammocks, cat trees, trampolines, saucer tree swing, and wall hangings are popular. Dense furnishings are necessary for psychological well-being.[2] Mink need a pool they can easily climb in and out of with enough space to swim and dive, as well as a drying off area. Weasels will extensively use a sugar glider exercise wheel (e.g., Stealth Wheel) and larger animals (long-tailed weasel and mink) will use a cat wheel; this is an excellent outlet for energy and stress, and to help meet the need for exploration and ranging.

Mustelids are sensitive to photoperiods. Natural photoperiods should be maintained when housed indoors. This is especially important for adult animals as photoperiods are known to indirectly control both molt and some changes in the sexual cycle.

Survival after release greatly enhanced if housed in a simulated natural environment (lots of cover and tunnels) and opportunity to track and hunt prey. Sufficient space is necessary to facilitate and encourage predator avoidance tactics (run fast; hide). Optimal release window is late summer/early fall; the lowest survival is when release is from late fall to early spring.

Large litters (more than 6 weasels, more than 4 mink) may be divided after weaning by size. Even with ad lib food available the larger animals may prevent the smaller ones from getting sufficient nutrition. There may also be increased aggression, especially with mink. Watch for pair bonds and try to respect their "favorite buddy" choice.

Wild Mink vs Domestic (Farmed) Mink

Domestic mink should not be released back into the wild – after 100s of generations of selective breeding for coat and temperament they are no longer equipped to survive well in the wild, and by interbreeding with wild mink they diminish the wild mink population. They also compete directly with the wild mink for resources, may introduce disease to the wild population, and with their larger size drive the wild mink out. There is a rescue organization for rehoming escaped farm mink called M.I.R.R. (Mink International Rescue and Recovery, minkrecoveryteam@gmail.com or minkinternationalrescueandrecovery.com) which will offer advice and assistance for domestic mink. Some key distinguishing features are 1) color – anything other than dark brown is probably a farm mink or hybrid; 2) size – domestic mink are often as much as 2x larger, more if overfed (unlike wild mink, domestic mink do not portion control their eating, and will overeat); tail is often thicker on the domestic mink; and the fur of the domestic mink is short and velvet smooth while the wild mink has the long guard hairs and may have a shaggier, unkempt appearance. Domestic mink are less territorial. Escaped farm mink may react with violent aggression to the sight of leather gloves while being calm, curious, and even friendly otherwise.

Emerging Disease

Farmed mink are known to be susceptible to both SARS-CoV-2 and HPAI; mustelids in general are susceptible to human respiratory infections. Biosecurity precautions should be taken, appropriate PPE should be worn, and good air circulation/filtration is important.

Vaccines (AZA recommendations):

Canine Distemper: recommended to use the canarypox vectored CDV vaccine (PUREVAX Ferret Distemper Vaccine, Merial Inc., Athens, Georgia). Vaccinate every 3-4 weeks beginning at two weeks of age.

Least Weasel case study: vaccinated for canine distemper and hepatitis with two 0.2 mL sub-Q injections at two-week intervals.

Rabies: *Only a killed rabies vaccine product should be used*. The most commonly used is ImRab3 (Merial). Vaccinate at 16 weeks.

Adverse reactions: Animals experiencing an adverse reaction to a vaccine should be administered an antihistamine (e.g., diphenhydramine hydrochloride, 0.5-2mg/Kg IV or IM) or for severe reactions, epinephrine (20 µg/Kg IV, IM, subQ, or intra-tracheally), and supportive care.

Medications (inject oral medications into the brains of food mice):

Stomach protectants should be given in conjunction with antibiotics. Omeprazole (Prilosec): 0.5-1 mg/kg PO once daily or famotidine (Pepcid): 1 mg/kg PO once daily

- Panacur (50 mg/kg PO sid) can be used for treatment of hookworms
- Carafate (sucralfate suspension) 0.1 mL of 1g/100mL solution via food mice used to treat stress-induced ulcers until stool returned to normal.
- Fleas treated with feline/kitten Advantage (single application, 0.05 mL)
- Possible Pasteurella infection treated with Clavamox orally 2x/day (25 mg/kg PO bid) via food mice
- Infected bite wounds treated with Orbifloxacin (for gram negative bacteria) and Clavamox

Cited references:

[1]*National Audubon Society Field Guide to Mammals*, 1996 rev;
[2]*Mustelid (Mustelidae) Care Manual*, Association of Zoos and Aquariums, July 2008, revised January 2010;
[3]*American Weasels*, E. Raymond Hall, August 2015 (written over the past 25 yrs.);
[4]"The Least Weasel *Mustela nivalis* Linnaeus, Developmental Biology in Comparison with Other North American *Mustela*," Biological Series Volume 4, Number 7, Publications of the Museum, Michigan State University, Gary A Heidt, April 1970
[5]East and Lockie, Edinburgh

Additional References:

Professional Standards

- Current AVMA Guidelines for Euthanasia of Animals
- Current NWRA Wildlife Formulary
- Current NWRA/IWRC Standards for Wildlife Rehabilitation (2021 or later)
- NWRA Principals of Wildlife Rehabilitation (current edition)
- NWRA Wildlife Rehabilitators Code of Ethics (https://www.nwrawildlife.org/page/Code_of_Ethics_Rehab)
- GFAS Standards For Caniform2 Sanctuaries, 2018 or most recent version. https://www.sanctuaryfederation.org/
- One Health Initiative, https://onehealthinitiative.com/
- AZA Mustelid (Mustelidae) Care Manual (2010 or most recent version)
- Carpenters Exotic Animal Formulary

Academic texts and supplemental reading:

- The Natural History of Weasels and Stoats, Carolyn M. King and Roger A. Powell, 2nd edition, 2007
- The Fisher. Life History, Ecology, and Behavior, Roger A. Powell, 1st edition (1982) and 2nd edition (1993)
- Martens and Fishers (Martes) in Human-Altered Environments, edited by Daniel J. Harrison, Angela K. Fuller, and Gilbert Proulx, 2004
- Wild Mammals of North America, edited by George A. Feldhamer, Bruce C. Thompson, Joseph A. Chapman, 2nd edition, 2003
- Winter World, Bernd Heinrich, 2003 – and really, anything by Bernd Heinrich is worth reading
- The Lone Wolverine: Tracking Michigan's Most Elusive Animal, 2012, by Elizabeth Philips Shaw and Jeff Ford

Evidence of disease, and vet protocols (also see the AZA chart handout)

- **Sedation protocol –**
    - "My sedation protocol: 0.5 mg/kg midazolam, 0.3 mg/kg butorphanol and 0.05 mg/kg dexdormator (with an equal ml of antisedan to wake up). All as IM injections." (Cindy Petrauskas, DVM)
- **Human respiratory infections, including SARS-CoV-2 –**
    - Mink and ferrets are known to be susceptible to human respiratory infections, and ferrets are, in fact, often used as the animal model to develop and test human vaccines and treatments. Presumably the other mustelids are also susceptible. Symptoms, susceptibility, and outcomes are similar to those seen in humans and treatment is usually 1) prevention, and 2) supportive care.

      Use biosecurity measures commonly found during Covid outbreaks: distancing, masks, gloves, and good ventilation/air filtration and avoid exposing animals to humans who are sick or have been exposed to respiratory infections.

      AZA/ZAHP SARS-CoV-2 Considerations and Precautions for Small Carnivores, https://zahp.org/updated-sars-cov-2-considerations-and-precautions-for-small-carnivores/

      SARS-CoV-2 & Mink: Assessing the Threat. Pennsylvania Game Commission, Bureau of Wildlife Management & Penn Vet, Wildlife Futures Program Revised 06 January 2021; https://www.vet.upenn.edu/docs/default-source/research/pa-wildlife-futures-program/threat-assessment-reports/sarscov2-and-mink-threat-assessment-jan-2021.pdf?sfvrsn=ab2f0ba_4

      SARS-CoV-2 infections on French mink farms after one year of COVID-19, Preliminary scientific report. https://www.news-medical.net/news/20230203/SARS-CoV-2-infections-on-French-mink-farms-after-one-year-of-COVID-19.aspx Journal reference: Preliminary scientific report. Wasniewski, M. et al. (2023). Investigations on SARS-CoV-2 and other coronaviruses in mink farms in France at the end of the first year of COVID-19 pandemic. bioRxiv preprint. doi: https://doi.org/10.1101/2023.02.02.526749. https://www.biorxiv.org/content/10.1101/2023.02.02.526749v1
- **HPAI –**
    - Farm mink in Spain were found to have been infected by HPAI, suspected to have been infected by wild sea birds found sick in the area. The sick animals showed signs such as anorexia, dribbling, drooling of saliva, low energy, bleeding from the snout, and tremors or loss of balance and coordination, indicating the involvement of the nervous system. Mortality was high.

      First known epidemic of highly pathogenic avian influenza H5N1 in farmed mink, https://www.news-medical.net/news/20230122/First-known-epidemic-of-highly-pathogenic-avian-influenza-H5N1-in-farmed-mink.aspx

      Journal reference: Aguero, M. et al. (2023). Highly pathogenic avian influenza A(H5N1) virus infection in farmed minks, Spain, October 2022. Eurosurveillance. https://doi.org/10.2807/1560-7917.ES.2023.28.3.2300001, https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2023.28.3.2300001

(cont.)

- **Canine distemper-**
    - Abnormal mentation (often reported as "friendly" by finders), dehydration, diarrhea, ocular/nasal discharge (often so severe the eyes are crusted shut and finders report that animal is missing one or both eyes), seizures, self-mutilation. There is also a pretty distinct smell (Nicki Rosenhagen, DVM, personal communication)
    - Abnormal neuro signs (ataxia, tremors, seizures) (Renee Schott, DVM, personal communication)
    - In Ferrets: Ferrets are highly susceptible to infection with canine distemper virus, a member of the Paramyxoviridae family. Early signs of infection include lesions in the skin, lips, and footpads, respiratory system, and gastrointestinal tract. Ferrets may recover from the acute phase only to develop neurologic signs at a later date. Affected ferrets can develop tremors, seizures, and coma. *The disease is nearly invariably fatal* in ferrets. Diagnosis can be made through fluorescent antibody testing of blood smears and conjunctival scrapings and by PCR on whole blood. Euthanasia should be considered for seriously ill ferrets. *Vaccination is protective, but the availability of vaccines licensed for use in domestic ferrets is unpredictable at best. There is currently one canine distemper virus vaccine licensed by the USDA for use in domestic ferrets (PUREVAX Ferret Distemper Vaccine [recombinant canarypox vector vaccine], Merial, Duluth, GA), but it has limited and sporadic availability*. Some clinicians are using vaccines licensed for use in dogs in off-label fashion in ferrets (e.g., Nobivac Puppy-DPv [modified-live virus vaccine against canine distemper virus and parvovirus], Merck Animal Health, Madison, NJ). The benefits for the off-label use of vaccines, particularly modified live virus vaccines, must outweigh the risks for adverse reactions.

      From: Neurologic Diseases of Exotic Companion Mammals, Pacific Veterinary Conference 2016, Lauren V. Powers, DVM, DABVP (Avian Practice), DABVP (Exotic Companion Mammal Practice), Avian and Exotic Pet Service, Carolina Veterinary Specialists, Huntersville, NC, USA
    - Animals from the Canidae, Procyonidae, and Mustelidae families are reservoirs for this disease.

      In Ferrets: The respiratory system is the preferred location for viral replication. Virus spreads via aerosolization, direct contact with urine, feces, skin, discharge from the conjunctiva or nasal cavity, or via contact with exposed fomites such as gloves and other tools.

      Shedding typically begins 7 days after exposure. *Expect that all body secretions likely contain viral particles. The incubation period is 7–10 days but may be as long as 7 weeks* in some individuals.

      Papular dermatitis of the chin is usually the first sign seen. The inguinal area and anus may also be affected. Swollen and crusty lips may develop along with hyperkeratosis of the nasal planum and footpads. Other generalized signs include fever, anorexia, lethargy, pruritis, blepharospasm, photophobia, mucopurulent oculonasal discharge, and neurologic signs during prolonged illness. In ferrets, vomiting and diarrhea are uncommon presentations of this disease.

      From: Common Infectious and Parasitic Diseases of the Exotic Companion Mammal in the Shelter Setting, ABVP 2017, Tarah L. Hadley, DVM, DABVP (Avian Practice)

Canine distemper (continued)

- Distemper:

  Mink of all ages are susceptible to canine distemper virus (see Canine Distemper*). The incubation period is 9-14 days. The virus may be recovered from infected mink 5 days before clinical signs appear.* Recovered mink may continue to shed the virus for several weeks. Transmission may be direct (through contact or aerosol) or indirect.

  Clinical signs include nasal and ocular discharge; hyperemia, thickening, and crustiness of the skin on the muzzle, feet, and ventral abdominal wall; neurologic signs (convulsions and "screaming fits"); or a combination of these. Histologic ELISA, immunohistochemistry, or fluorescent antibody examination may reveal intracytoplasmic or intranuclear inclusions or distemper antigen in epithelial cells of the bladder, kidneys, bile ducts, intestine, lungs, trachea, and occasionally brain. Recent outbreaks have required PCR confirmation, because immunohistochemistry testing was negative.

  

  Swollen hyperkeratotic footpads, mink

  Viral Diseases of Mink – Exotic and Laboratory Animals – Veterinary Manual, by Hugh Hildebrandt, DVM, MSD (Merck Sharp & Dohme), 2018

- In Ferrets: On a worldwide scale canine distemper, caused by a paramyxovirus, is considered the most serious viral infection of ferrets in which *the outcome is almost always fatal*. Classical symptoms, in unvaccinated ferrets, *often start with dermatitis on the lips, chin and around the inguinal region 7-9 days after infection. Mucopurulent ocular and nasal discharge, pyrexia (over 40°C), sneezing, coughing and anorexia are other common signs*. Just as in dogs, ferrets can develop hyperkeratosis of the footpads (hardpad).

  From: What Every Veterinarian Should Know About Ferret Medicine, British Small Animal Veterinary Congress 2008, Nico J. Schoemaker, DVM, PhD, DECAMS, DABVP(Avian), Division of Avian and Exotic Animal Medicine, Utrecht University, Utrecht, Netherlands

- **Toxoplasmosis**

  - Toxoplasmosis can have a huge range of symptoms, including none (Nicki Rosenhagen, DVM, personal communication)

- **Leptospirosis**

    - a sick animal with a fever who has increased kidney +/- liver values (Nicki Rosenhagen, DVM, personal communication)
    - Leptospira interrogans is a spiral-shaped bacteria species. There are 180 serovars in 18 serogroups. There are a large number of reservoir hosts, including rats, cattle, dogs, horses, swine, deer, squirrels, foxes, skunks, raccoons, opossums, reptiles, frogs, mice, voles, shrews, and hedgehogs.

      Infection occurs by direct contact with infected animals and their urine, contact with contaminated soil, or ingestion of contaminated water. Contact may be through skin or mucosal surfaces. The incubation period is 2 days to 4 weeks.

      Symptoms in humans can range from asymptomatic to severe disease, including high fever, severe headache, chills, muscle aches, vomiting, jaundice, red eyes, abdominal pain, diarrhea, or a rash. If the disease is not treated, kidney damage, meningitis, liver failure, and respiratory distress may develop. In rare cases death can occur. Illness usually begins acutely with fever, chills, headache, muscle aches, vomiting, or diarrhea. The person may recover for a time but become ill again. If the second phase occurs, it is more severe - kidney or liver failure or meningitis (Weil's disease).

      Leptospirosis is treated with antibiotics, such as doxycycline or penicillin.

      From: Zoonotic Diseases of Wildlife, Wild West Veterinary Conference 2011, Kristian Krause, DVM, ABVP (Feline), Serrano Animal and Bird Hospital, Lake Forest, CA, USA

- **Canine heartworm**

    - In Ferrets: Ferrets are susceptible to Dirofilaria immitis infection and develop clinical disease similar to that in cats and dogs (Morrisey, Kraus 2012; Sasai et al. 2000; Schaper et al. 2007). Ferrets can be experimentally and naturally infected with Dirofilaria immitis, the causative agent of heartworm disease (Bradbury et al. 2010; Sasai et al. 2000; Schaper et al. 2007; Supakorndej et al. 1995; Wagner 2014). Ferrets living in endemic areas are most susceptible to infection (Morrisey, Kraus 2012).

      Clinical signs are similar to those in cats and dogs, although the clinical presentation more often resembles that of cats (Morrisey, Kraus 2012). Clinical signs include sneezing, anorexia, lethargy, and dyspnea (Sasai et al. 2000). Supportive evidence can be found on thoracic radiographs. In

      the author's practice, pleural effusion is a common finding. Angiography has been reported but can be technically challenging to perform (Di Girolamo et al. 2012). A tentative diagnosis can be made through echocardiography (Sasai et al. 2000). Microfilaremia is not a consistent finding and is only present in about 50% of cases (Sasai et al. 2000). Antigen testing (e.g., ELISA) is advised but is often negative as worm burdens are often low (Morrisey, Kraus 2012; Sasai et al. 2000).

      The prognosis for ferrets with heartworm disease is guarded to poor. The current recommended treatment is ivermectin at 0.05 mg/kg SQ q30d until clinical signs resolve and microfilaremia is

- **Canine heartworm**

  absent (Morrisey, Kraus 2012; Wagner 2014). Prednisolone can be considered during the treatment period for its anti-inflammatory effects. Successful transvenous heartworm extraction of three worms was described in a ten-month-old ferret to caval syndrome (Bradbury et al.

  2010). Ivermectin is frequently used as a preventative treatment at 0.02 to 0.05 mg/kg PO or SQ monthly (Morrisey, Kraus 2012; Wagner 2014). Topical selamectin and oral milbemycin oxime are also effective preventative therapies (Morrisey, Kraus 2012). A commercial preparation of imidacloprid 100 mg/ml and moxidectin 10 mg/ml (Advocate for Cats, Bayer, Pymble, NSW) is labeled for the prevention of heartworm disease in ferrets. A similar product (Advocate, AdvantageMulti, Bayer, Leverkusen, Germany) was demonstrated as 100% effective against experimental infection in 12 ferrets when administered once at a target dose of 0.40 ml 30 days post infection (Schaper et al. 2007).

  From: Ferret Cardiology, AAVAC-UPAV 2018, Lauren V. Powers, DVM, DABVP, Avian and Exotic Pet Service, Carolina Veterinary Specialists, Huntersville, NC, USA

- **Canine parvovirus**

  - Young animals with vomiting/diarrhea and lethargy, weight loss/absent gain, depressed mentation, dehydration and of course an unusually low white blood cell if bloodwork is involved would indicate parvovirus. (Nicki Rosenhagen, DVM, personal communication)
  - abnormal neuro signs (ataxia, tremors, seizures) (Renee Schott, DVM, personal communication)

- **Pneumonia, other respiratory**
- **Tick-borne illnesses** as prevalent in the area (e.g., Lyme)
- **ADV (Aleutian disease virus) –** usually spread from area captive mink farms/ranches and highly contagious (and fatal) to other mustelid species.

  - In Ferrets: Aleutian disease is caused by a parvovirus, unrelated to the one causing bloody diarrhoea in dogs. *Of the Mustelidae the mink is most susceptible*, but ferret specific strains have been found. Aleutian disease is an immune complex-mediated disease, resulting in multiple organ failure. *Clinical signs in mink include wasting, hepato- and splenomegaly, melaena, recurrent fevers and, eventually, hindleg paralysis and other neurological signs. Most mink eventually die within 5 months.* Fortunately ferrets seldom develop such severe symptoms.

    Although serum countercurrent immunoelectrophoresis is necessary to confirm the diagnosis, a hypergammaglobulinaemia together with chronic wasting signs is suggestive of Aleutian disease. As with almost all viral infections there is no specific therapy, but antibiotics and steroids have been reported to give some relief.

    From: What Every Veterinarian Should Know About Ferret Medicine, British Small Animal Veterinary Congress 2008, Nico J. Schoemaker, DVM, PhD, DECAMS, DABVP(Avian), Division of Avian and Exotic Animal Medicine, Utrecht University, Utrecht, Netherlands

- **ADV (continued)**

    - In Ferrets: Aleutian disease is a parvovirus of ferrets that causes immune complex deposition of organs and hypergammaglobulinemia. Transmission of the virus is by aerosolization, contact with fomites, or direct contact with infected urine, blood, feces, and saliva.

      Clinical signs include a chronic wasting disease and central nervous system signs.

      From: Common Infectious and Parasitic Diseases of the Exotic Companion Mammal in the Shelter Setting, ABVP 2017, Tarah L. Hadley, DVM, DABVP (Avian Practice)

    - In Ferrets: Aleutian disease is caused by infection with Aleutian disease virus (ADV), a parvovirus that also infects mink (Neovison vison). Infection is associated with lymphocytic plasmacytic perivascular cuffing in the brain and spinal cord, disseminated nonsuppurative meningitis, astrocytosis, and focal malacia.

      Clinical signs range from mild incoordination to ataxia, ascending paresis, tremors, and quadriplegia. A hypergammaglobulinemia is common but not always present. Diagnostics include counterimmunoelectrophoresis (CIEP), PCR, and ELISA. *The prognosis is poor, and ferrets with confirmed or suspected infection should be isolated. There is no recommended treatment, and no licensed vaccine is available.* There appears to be no cross-antigenicity between ADV and other parvovirus vaccines.

      From: Neurologic Diseases of Exotic Companion Mammals, Pacific Veterinary Conference 2016, Lauren V. Powers, DVM, DABVP (Avian Practice), DABVP (Exotic Companion Mammal Practice), Avian and Exotic Pet Service, Carolina Veterinary Specialists, Huntersville, NC, USA

*** Note: all italics are mine- PPopp ***

~~Skunk~~ Mink Chow Recipe

angel@wildlifehotline.com, 1-855-945-3435 Ext 730
*** mink modifications by P Popp based on research and personal communication with Angel.

Ingredients:
(Links to ingredients to purchase online at end of document.)
3lb Ground Turkey* (NOT LEAN!)
6-8 cups of Quality Dry Puppy/Dog Food**

-or-

6-8 cups Quality Dry Puppy/Dog Food Mixed with Mazuri Ferret Food Grain Free Mix dog and ferret food at a 2 to 1 ratio with more dog food and less ferret food.**

1/2 cup Grizzly brand Salmon / Fish Oil
4 tablespoons Missing Link Feline Powder – important to add the necessary taurine!

or

2 tablespoons Platinum Performance Feline

or

1 tablespoon Exotic Nutrition's Skunk Vitamins

(Salmon oil plus ONE of the vitamin powders above will keep ~~skunk~~ skin supple and hydrated, hair silky and shiny, and it grows gorgeous, healthy ~~skunks~~ mink)

Mix all of the above ingredients together, including any runoff from cooking the ground turkey, and mix well. If you don't have any runoff from the turkey (happens when you can only find low-fat ground turkey) feel free to use some of the runoff from when you bake their chicken, or chicken stock is fine. You only need about 1 cup. (more for younger babies to soften the chow and less for older kits)

= After mixing, use a dry erase marker (wipes off easy) to mark your chow with today's date.

Chow keeps in refrigerator for approximately 1 week.

Feed ad lib

~~Possible / Optional~~ Toppings:
Top with the following delicious additions: fish, shrimp, clams, mussels, raw turkey and chicken, frog legs, mice, bunnies, squirrels, birds and their eggs, reptiles, aquatic insects, earthworms, and snails, etc.

EXPLANATION OF ASTERISKS:

*Look for ground turkey packaged in a roll (like sausage) and it should say 85/15 or 90/10 fat percentage. Do not use 97/3 lean ground turkey please. They need the fat and the taurine. It's cheaper in a roll anyway. Just make sure it only says ground turkey, not turkey sausage. **It should not contain any spices or salt.**

** Quality dog food doesn't mean just grain free. I use "Fromms Surf & Turf Dog Food" but it's expensive. You could use Merrick, Crave, Purina ProPlan, Canidae, Nutro, etc. Products labeled "puppy" have more calories and calcium typically. Some rehabbers like to mix ferret and dog chow together as the primary dry food. This is a choice. I used to do this but stopped about 3 years ago. I recommend that if you mix ferret and dog to mix it at a 2 to 1 ratio with 2-parts dog or puppy food to 1-part ferret chow. I like Mazuri Ferret Chow and Wysong, but both are pricey. Personally, I saw a benefit to doing it this way at one time in order to provide skunks with the fat to protein content they needed along with the correct cat, dog and ferret vitamins they needed as they grew up. After I discovered Platinum Performance Feline Powder, Missing Link Feline multivitamin or Exotic Nutrition Skunk Vitamins, I realized I could provide everything they need without spending copious amounts of money on multiple different foods. If you wish to do it the old way or use both, that's completely up to you.

LINKS TO PRODUCTS:

Ground Turkey
http://www.walmart.com/ip/Butterball-All-Natural-Fresh-85-15-Lean-Ground-Turkey-Family-Sized-3-lbs/15249535
Fromm's surf and turf dog food (what i use)
https://amzn.to/3yDfdvt
Nutro puppy food
https://smile.amazon.com/dp/B005VSUTDY/
Merrick puppy food
https://amzn.to/3yzTq8e
Crave puppy food (very high calorie!)
https://amzn.to/3hN9RHp
Mazuri Ferret food (mix with dog food at 1:2 ratio)
https://amzn.to/3ho6EPy
Dried soldier flies
https://amzn.to/3k8ALMT
Insect mix
https://amzn.to/3dXKotF
Grizzly Salmon oil
https://amzn.to/3hSui5Y
Missing Link powder
https://amzn.to/3yyKuQj
Platinum performance feline
https://www.platinumperformance.com/platinum-performance-feline/FPLAG.html
Exotic nutrition skunk vitamins https://www.exoticnutrition.com/Products/Vita-Skunk-Supplement-529-oz__346EN.aspx

Appendix M: Common Diseases Affecting Mustelids

This table is intended as a list of diseases observed in mustelids and associated clinical signs; it is not intended as a comprehensive table. For proper treatment and management the reader is referred to more extensive medicine texts such as: Fernandez-Moran (2003),[1] Lewington (2007),[4] and Oglesbee (2006).[6] For an extensive review on the infectious disease agents that affect NARO and may affect other mustelids refer to Kimber and Kollias (2000).[2]
The last column lists the species in which the disease has been reported; other species may also be susceptible. Adapted from Fernandez Moran (2003).[1]

Viral Diseases	Transmission	Clinical signs	Diagnosis	Species reported
Rabies	Contact of infected saliva with mucosal surface or open wound	In ferrets signs are usually mild and non-specific: anxiety, lethargy and posterior paresis. Should be considered in any animal with outdoor access with neurologic signs.	Can only be diagnosed definitively post mortem. Histopath on brain.	All warm blooded animals are susceptible
Canine Distemper	Aerosol exposure or direct contact with conjunctiva, nasal exudates, urine or feces	Anorexia, vomiting, diarrhea, weight loss, hyperemia of face and ears, hyperkeratosis of nasal planum and footpads, oculonasal discharge, neurologic signs	Immunofluorescent antibody test or PCR of conjunctival swab. Histopath exam of affected tissue. 100% fatal to ferrets	Domestic ferret, BFF, badgers, weasels, skunks minks, martens, Eurasian otter
Influenza (type A)	Inhalation of aerosolized droplets	Sneezing, conjunctivitis, otitis (unilateral), fever, photophobia, naso-ocular discharge	Clinical signs and presence of HI antibodies (hemo-agglutination inhibition test)	Domestic ferret and mink. Also one Stone marten reported to have been infected with H5N1.[3]
Aleutian Disease (*Parvoviridae*)	Infected	Weight loss, hypergamma-globulinemia, reproductive failure, hemorrhagic enteritis and immune mediated glomeruloeohritis.	Gammaglobulin >20% serum total protein, IFA test.	Mink, ferret, striped skunk (typically of farmed mink)
Ferret kit disease (*Rotavirus*)	Affects kits. Can become enzootic at a facility.	Watery diarrhea, anorexia and lethargy.	Identification of viral particles in fresh feces	Ferret
Infectious peritonitis (*Coronavirus*)	Unknown, recently reported disease	Diarrhea, granulomatous lesions	Biopsy, immunohistochemistry	Ferret[5]

Bacterial Disease	Transmission	Clinical Signs	Diagnosis	Species reported
Salmonellosis (*Salmonella spp*)	Associated with feeding uncooked meat. Can be found in some clinically normal animals	Hemorrhagic enteritis, dehydration, weight loss, fever, lethargy	Culture of fresh feces	Many species
Tuberculosis *(M. tuberculosis)*	Inhalation of aerosolized particles, ingestion of contaminated tissues	Weight loss, enlarged lymph nodes, chronic respiratory disease.	PCR, direct examination of tissue and culture	Usually only a problem in free-ranging badgers from the UK and in from free ranging ferrets in New Zealand.
Campylobacteriosis (*Campylobacter jejuni, C. coli*)	Raw meat diets carry some risk of infection, ferrets may be asymptomatic carriers	Diarrhea, tenesmus, fever anorexia vomiting, leukocytosis, abortion	Fecal culture	Ferret and mink
Botulism (*C. botulinum*)	Ingestion of contaminated food. Associated with capture stress in wild otters	Death, paralysis and dyspnea before dying. Enerotoxemia, acute gastric distension, cyanosis	Fecal Gram stain and toxin assay	Otter and black footed ferret.
Pneumonia (*various agents*)	Due to a number of organisms, concurrent infection with calici and picornavirus can predispose.	Thick yellowish nasal discharge, labored breathing, dyspea, cyanosis, fever, lethargy, anorexia	Increased lung sounds, complete blood count results, culture, cytology.	Most mustelids

Fungal Disease	Transmission	Clinical Signs	Diagnosis	Species reported
Dermatomycosis	Direct contact or fomite transmission. Exposure to cats	Lesions resemble those seen in other species (Young animals most at risk. Skin is thickened itchy and scaly). Ferrets are not prone to skin mycotic disease, but some species of dermatophytes could present a zoonotic risk.	Definitive diagnosis is done by culture.	Most species

Parasitic Disease	Transmission	Clinical Signs	Diagnosis	Species reported
Toxoplasmosis	Exposure to sporulated oocysts, ingestion of intermediate host or ingestion of uncooked infected meat.	Anorexia, lethargy, fever, lymphadenitis, spenomegaly, corneal edema, myocarditis, hepatitis, pneumonitis	Antibody titers	BFF highly susceptible. NARO reported to have had titers.
Coccidiosis (*Isospora, Eimeria spp*)	Fecal oral	Often asymptomatic. If affected lethargy, diarrhea, dehaydration, weight loss	Fecal examination	European otter,[7] Ferret, mink.[4]
Lungworm	Transmission can be direct, by ingestion of L1 in feces or sputum of infected animals or indirect by ingestion of the intermediate host depending on the species of lungworm involved.	Cachexia, anemia, coughing, dyspnea, hyperpnea, nasal discharge, neurological signs.	First stage infective larva in fecal exam	Mink, skunk, sable, Eurasian badger, otter, ermine.
Kidney worm	Lifecycle is complex and not completely known. Involves annelids as first intermediate host and freshwater crustaceans, mollusks and fish as second intermediate hosts.	Weight loss hematuria, polyuria and other signs associated with renal failure	Necropsy finding- usually in the right kidney	Mink, otter, weasel, ermine, marten, fisher, and grison.
Tapeworms and roundworms.	Mustelids may be susceptible to them, usually not a problem in *ex situ* situations with a regular endoparasite control program in place.		Fecal exams (sedimentation and floatation)	
Microfliaria spp	Bite from infected mosquito	Respiratory and cardiac signs. Not all microfilaria infections develop into clinical disease	Clinical signs, finding microfilaria in blood smears.	River otters
Sarcoptic mange	Exposure to infected animals	Scabs around head and neck, tail, feet.	Finding the mites in skin scrapings or biopsy	Most mustelids
Fleas	Fleas can transfer from other animals. Although fleas tend to prefer their specific host.	Signs may vary from asymptomatic to flea bite allergy. Pruritus, inflammation. In young or sick animals with heavy infestation also anemia. May what?	Finding fleas or flea dirt in the coat,	Most mustelids
Ticks	As with other mammals	Itching, May transmit other diseases.	Finding ticks on animals. Others in group may be affected	Many

Non-infectious Disease	Risk factors	Clinical Signs	Diagnosis	Species reported
Excertional myopathy	Recent stressful, capture,immobilization, transport of wild animals	May vary. Elevated temperature, dark colored urine (myoglobinuria), ataxia, weakness, depression, elevated muscle enzymes in serum.	Urinalysis, blood chemistry, physical exam.	Badger, otter, black footed ferret.
Teeth abscesses	Cage trauma (biting), tartar and calculus build-up	Decreased appetite, facial swelling, weight loss,	Radiographs, physical examination	Otters
Urolithiasis	Diet and genetics may play a role. Sterile urolithiasis, more common in domestic ferret, but UTI may predispose. Most common: struvite, cystine.	Signs depend on location, number, and size of urolith and may include asymptomatic, polakyuria, dysuria, hematuria, staining of perineal area, urine dribbling, signs of pain when obstructed	Abdominal radiographs, urinalysis (pyuria, hematuria, changes in pH),	Small-clawed otter is particularly susceptible. Also reported in mink, ferret, Eurasian otter, domestic ferrets
Amyloidosis	Was reported in a relatively large number of black footed ferrets and may point toward a genetic predisposition.	Relate to specific site of amyloidosis accumulation. Can include anorexia, lethargy, sign of renal disease	Histologic evaluation of tissues submitted	Black-footed ferrets
Thiamine (Vit B1) deficiency	Thiaminase present in some fish	Anorexia, salivation, ataxia, papillary dilation, sluggish reflexes	Response to treatment	Piscivorous species (mink on raw fish diet)
Post-estrous anemia	Estrus that persists for over one month	Non-regenerative anemia, ecchimoses, bleeding,	CBC- aplastic anemia, vulvar discharge	Ferrets
Pancreatic cancer (insulinoma)	High incidence in domestic ferrets.	Hind leg weakness, blank look, staring drooling, nausea, as the disease progresses seizures as well	Blood tests for fasting low blood sugar. See texts referenced above for test details and risks	Ferrets
Adrenal neoplasia (adrenocortical carcinoma).	High incidence in America ferrets	Alopecia, pruritus, vulvar swelling in sterilized jills, sexual behavior (aggression in males), weight loss,	Clinical signs, ultrasound, sometimes palpation is possible, abdominal exploratory surgery. Dexamethasone suppression test ACTH stimulation test not reliable in ferrets.	Ferrets
Lymphoma	Unknown, potentially viral origin	Lymphadenopathy, respiratory distress (if ay organs in the chest cavity are involved)	Histopathology of enlarged lymph nodes or other affected organs biopsied, cytology of fine needle aspirate of enlarged organs may be of limited value.	Ferrets

Reference List

1. Fernandez-Moran J. 2003. Mustelidae. 5th: 501 - 515.
2. Kimber KR, Kollias GV. 2000. Infectious and parasitic diseases and contaminant-related problems of North American river otters (*Lontra canadensis*). Journal of Zoo and Wildlife Medicine 31: 452 - 472.
3. Klopfleisch R, Wolf PU, Wolf C, Harder T, Starick E, Niebuhr M, Mettenleitern TC, and Teifke JP. 2007. Encephalitis in a stone marten (*Martes foina*) after natural infection with highly pathogenic avian influenza virus subtype H5N1. Journal of Comparative Pathology 137: 155 - 159.
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Appendix L: Mustelid Enrichment Ideas – AZA Member Institutions

The following lists provide examples of mustelid enrichment items. All items should be approved by facility management, including the appropriate curator, veterinarian, nutritionist, and horticultural staff.

Ferret/polecat Ferrets are very prone to eating small pieces of things & having intestinal blockages (rapidly kills if not cleared)

Sensory

- Crickets in escape-proof container
- Snake shed
- ~~Spices and scents~~
- Urine/trapping lures
- ~~Bath & Body Works lotions & sprays~~
- Diluted extracts
- ~~Perfume pages from magazines~~
- Paper, paint, stickers on outside of window
- Sun catcher outside enclosure
- ~~Diluted Eucalyptus oil (5 drops/gal. water)~~
- ~~Diluted essential oils~~
- Mirror mobile outside exhibit
- Audio tapes
- Baby mirrors (unbreakable)
- Hooves (monitor)
- Feathers (frozen for 30 days)
- Non-toxic bubbles
- Herbs, ~~spices~~
- Camel hair/wool (frozen for 30 days)
- Squirrel call
- Hand held or box fan (outside of exhibit)
- Pinwheels outside exhibit
- Disco ball outside exhibit

no essential oils !! (toxic)

Foods and feeding

- Cardboard box with
- Food inside
- Buster food cube
- Pinecone
- Egg carton puzzle feeder
- Small bones
- Wax worms in a feeder
- Bones (monitor)
- Crazy ball feeder
- Feed bag with diet (remove liners)
- Hay or leaves
- Boomer ball puzzle feeder
- PVC bug feeder
- Piñatas
- ~~Frozen fruit pops~~
- Nyla bones/Healthy edibles
- Kong toy with diet
- Carved pumpkin with diet ← pumpkin used for blockage protocol
- Burlap bag with insects
- Live fish in water tub
- ~~Applesauce smears~~
- ~~Coconut feeder~~
- ~~Peanut butter smears~~) no!

no fruit! (mustela)

Manipulative items/toys

- Balls with/without bells inside
- Kong toy
- Antlers
- Seashells
- Paper materials to shred
- Cardboard boxes/tubes
- Tennis ball
- Small boomer ball
- Pine cones
- Burlap pillows
- Phone books
- Wiggly giggly ball
- Fire hose
- Furry mouse cat toy - supervised
- Small stuffed animals with detachable parts ? no.
- Ferret ball

Physical environment

- Exercise inside/outside with supervision
- Straw bedding
- Large cardboard tubes to crawl through
- Exercise ball to crawl through
- 5" PVC pipe to crawl through
- Articles of clothing (sleeves, pant leg)
- Pool with small amount of water (supervised)
- Shredded paper
- Ferret hammock
- Varied substrate, soil
- mulch, etc.
- Snow, sod, sand
- Large hamster ball
- Linen bed sheets
- Frisbee swing suspended with twine

Behavioral/social

- Training programs
- View of decoy animals
- Taken around the zoo to see other animals
- Shredded paper for bedding

salt lamps can be toxic to many animals

Fisher

Sensory
- Bison fur
- Scents
- Feathers
- Sheep wool

Foods and feeding
- Tuna-sicles
- HB eggs
- Mice
- Cylinder feeder
- Quail

Manipulative items/toys
- Pumpkins
- Cardboard boxes
- Paper leaf bags
- Rope toys

Physical environment
- Pine trees
- Antlers
- Box of straw
- PVC tubes

Skunk

Sensory
- Crickets in escape proof container
- Snake sheds
- Scents
- Urine/trapping lures
- ~~Bath & Body Works lotions & sprays~~
- ~~Diluted extracts~~
- ~~Perfume pages from magazines~~
- Audio tapes
- Mirror (unbreakable)
- Hooves (monitor)
- Feathers (frozen 30 days)
- Squirrel call
- Sun catcher outside enclosure
- ~~Diluted essential oils~~
- Hand-held or box fan outside of exhibit
- Pinwheels outside exhibit
- Bird calls
- Mirror mobile outside exhibit
- Non-toxic bubbles
- Herbs, spices
- Camel hair/wool (frozen 30 days)

no fragrances or essential oils (toxic)!

Foods and feeding
- Cardboard box, ball, feeders with diet
- Buster food cube
- Pinecone
- Egg carton puzzle feeder
- Crazy ball feeder
- Feed bag with diet (liner removed)
- Peanut butter smears
- PVC insect feeder
- Piñatas
- Nyla bones/healthy edibles ← does not seem like a good idea
- Kong toy with diet ← no! eats.
- Carved pumpkins with diet ← blockage potocol
- Burlap bags with insects
- Live fish in tub
- Applesauce smears ← watch sugar intake
- Coconut feeder

Manipulative items/toys
- Kong toy
- Small stuffed animals with detachable parts
- Antlers
- Paper bags, paper to shred
- Tennis balls
- Small boomer ball
- Ferret ball
- Pine cones
- Burlap pillows
- Cardboard boxes/tubes
- Phone books
- Wiggle giggly ball
- Fire hose
- Klinker ball

Physical environment
- Exercised inside/outside with supervision
- Large drain pipe to crawl through
- Pool with small amount of water (supervised)
- Varied substrate – sand, shredded paper, sod, etc.
- Visual barrier
- Hammock

Behavioral/social
- Training programs
- View of decoy animals
- Taken around the zoo to see other animals

Wolverine

Sensory

- ~~Bengay ointment in a boomer ball~~
- Logs from other exhibits
- Urine scents, lures
- Spices ~~and extracts~~
- Burlap bags with scented straw
- Bison, pronghorn, moose, elephant feces
- ~~Deodorant spray~~
- Feathers
- Pig ears, cow hooves
- Reindeer antlers
- Pronghorn sheaths
- Hair from other species
- Education animals allowed to use exhibit while wolverines are in holding, then allowed back into exhibit after the animals has been removed

Foods and feeding

- Frozen mice, rats, fish hidden around exhibit
- Liver
- Rats and mice (dead)
- Rabbit (dead)
- Knuckle, shank & rib bones
- Super worms & crickets
- Live crayfish & fish
- ~~Pumpkins, apples, grapes, HB eggs~~
- Rat/Mouse sickles
- Blood popsicles
- Anchovy (fish) paste
- Tuna fish
- Beef heart
- Clams and krill
- ~~Hot dogs and chunk meat~~

Manipulative items/toys

- Paper towel/toilet paper rolls with food inside
- Paper bags with food inside
- Cardboard boxes with food inside
- Burlap bags with straw or treats
- Cornstalks
- Sod
- Snow piles
- Ice cubes
- Sleeping platforms
- Logs to climb on
- Wood box filled with stones/sod/straw to search for treats in
- Yellow pages, paper to shred
- Shredded paper, wood wool for bedding
- Hay from hoofstock exhibits
- Water tubs

Physical environment

- Sleeping platforms with bedding
- Digging boxes/pits
- Climbing structures
- Rock piles
- Deep dirt to tunnel in
- Hollow logs
- Stone piles
- Mud wallows

Behavioral/social

- Training programs
- Visual access to other species
- Climbing and digging opportunities

Reference List

1. Fernandez-Moran J. 2003. Mustelidae. 5th: 501 - 515.
2. Kimber KR, Kollias GV. 2000. Infectious and parasitic diseases and contaminant-related problems of North American river otters (*Lontra canadensis*). Journal of Zoo and Wildlife Medicine 31: 452 - 472.
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Mustelids – Key Characteristics, Similarities, and Differences

Common Mustelid Characteristics

- Obligate Carnivore – Requires **whole prey** and, like cats, they obtain taurine from their diet. Fisher and marten, especially juveniles, may also eat berries and other seasonal fruit..

  This is important for rehab because
  - Diet requires **whole prey,** which they consume nose to tail and *everything* in between. The GI system of their prey is an important source of carbohydrates.
  - Diet requires supplemental taurine for all non-whole prey foods (found at high levels in mother's milk, and in muscle tissue, brains, and eyes of prey species).
    - Taurine supplementation for cats: 125 mg per cat PO q 24 hr
  - Formula requires taurine as a supplemental nutrient.
  - If using commercial products, use products developed for cats.

- Very fast metabolism, and very lean: they are voracious, not vicious, and without fat reserves.

- Classified as a Fur bearer (trapped and managed as a "permitted harvest resource".)

- Solitary – except otters and some weasels

- Delayed implantation – ranging from a few weeks (mink) to a year (fisher, otter)

  This is important for rehab because
  - Overwintered female weasel orphans, or adult weasel, fisher, or marten females kept over the winter, are likely to already be pregnant and will give birth in the spring
  - Short-tailed weasel females are first bred as infants, before their eyes open.

- Young born in the spring and disperse in the late summer or fall – except least weasels, which may give birth in any season; otter and wolverines disperse after the first year.

- Infants – weasel and fisher, probably others – will cool down their body temp and go into a slight torpor when mom leaves, to preserve energy. When she returns, they will quickly warm up and start to feed again. This comes with a cost – too many of these cool-downs will impeded development, and after too long they die.

  This is important for rehab because
  - cool and even cold kits will warm up and respond quickly, and must be fed – quickly
  - Once warm and active, they must be fed
  - While they are warm, they must be fed on a relentless infant schedule (every 0.5-3 hrs, depending on age, species, state of health)

- Adult males are generally much heavier than females, but length may (marten, mink) or may not (fisher, wolverine, weasel) be similar. Females initially grow more quickly than males, then slow down, while males accelerate growth and surpass them. Females attain adult size more quickly than males. Adult length is reached well before adult weight. Often adult weight is reached after dispersal.

- Very lean for their body size, and only exceptionally fat animals display subcutaneous fat

  These two points are important for rehab because
  - They are still growing when released, and have that insane juvenile metabolism.
  - No body fat to sustain them while mastering their hunting techniques.
    - Underscores the importance of a sustained supported release.

- Rely heavily on sense of smell; scent marks often placed on stumps or other prominent structures

- Large range relative to size

- Claws are generally blunt, strong, and used for controlling and positioning prey, clinging, grasping, and digging *soft* substrates. Mink also use them to scratch open a hole in ice. Unlike cats, they are not used for scratching or disemboweling, and not used for tunneling.

Differences within the Mustela classification

- Smaller animals (age, sex, species) have a higher metabolism, and need a higher amount of fat in their formula. Mink obtain a portion of their dietary fat in the form of fish oil.
- Males weasels may, and wolverine males usually do, assist with hunting for the kits.
- Males are generally much heavier than females; length may (mink) or may not (fisher, marten, weasel) be similar. Males take longer than females to reach adult size.
- Larger species take longer to grow as well as mature, and to build the muscles that control their looong spine
- Fisher, marten, wolverines eat carrion ("sometimes I'll let you do the hunting for me!"); the others do not.
- This is important for rehab because
    - Carrion eaters are more likely to recognize rehab meat as food, vs non-carrion eaters being more receptive to fresh killed prey
    - Infants and juveniles imprint on food – it is important to offer natural prey
    - After release, local (non-rehab) mink/marten/weasels are unlikely to raid the soft-release food offerings. A mink or weasel eating at your café is very likely to be a rehab-released animal.
- Least weasels may be born at any time of the year; babies born after June should be over-wintered (adjust for local weather – they should be released >14 weeks old and no later than early fall).
- Otters stay with their parents for a full year, wolverines for 2-3 years, but the others disperse in the late summer or fall of birth year. Fisher kits remain on the mother's territory for the first year.
- Habitat: fisher and marten require a forest canopy; mink and otter require water; weasels require mouse & chipmunk tunnels.
- Males are itching to leave home sooner than females, disperse more widely, and have larger territories.
- Fisher remain in their natal territory for the first year (but avoid mom after dispersal). It's unclear (but likely) if mom continues to help protect the kits and/or provide supplemental food.
- Female short-tailed weasels are often impregnated while infants, and give birth the following spring; fisher females mate at I year and give birth at 2, while males are sexually mature when 2; mink (male and female) are sexually mature the spring following their birth.
- Juvenile weasels and mink often form close buddy bonds with a sibling, especially male/female. Fisher, on the other hand, display aggression towards each other around 3-4 mo, and must be separated by 5 mo. Mink must also be watched carefully for signs of intraspecific aggression between individuals and separated as necessary.
- Fisher, marten, mink, long-tailed weasels and short-tailed weasels are born in the spring and disperse in the late summer or fall. Least weasels may have multiple litters throughout the year.
- Weasel, mink, and martin canines erupt before eyes open and long before ready to wean; fisher teeth erupt after eyes open @ 6-8 wks. Eating solids starts when canines erupt.
- **Prey** – generally opportunistic predators, with prey dictated by size and location:
    - Least weasels primarily prey on mice, voles; may eat earthworms and insects
    - Short-tailed weasels primarily prey on mice, small/young chipmunks or ground squirrels; may also opportunistically consume young rabbits, birds, eggs
    - Long-tailed weasels primarily prey on mice, small/young (juvenile, small adult) chipmunks, ground squirrels, rats, rabbits; may opportunistically consume birds and eggs
    - Mink primarily prey on rodents (mice, rats, small/young muskrats), frogs, crayfish, fish; may opportunistically consume birds, eggs, and any other prey it can kill.

    - Marten primarily prey on voles, mice, pine (red) squirrels; also consume berries, fungi
    - Fisher primarily rely on porcupine, snowshoe hare, and venison from dead deer, also consume seasonal fruits and berries; where porcupines and hares are not readily available, they opportunistically forage on other small mammals, fungi, reptiles, and insects.
    - Otters primarily consume fish; opportunistically consume crayfish, amphibians, insects, birds, and mammals as necessary.
    - Wolverines are opportunistic, feeding on both prey and carrion, and often consuming from kills made by other animals and raiding traplines.
- **Habitat** – they all require good cover, and are excellent at staying hidden
    - Least weasels rely on mouse tunnels – Grassy and brushy fields, marsh areas. Known to climb trees/brush/logs but active primarily underground and under vegetation following mouse/vole burrows. Known to inhabit mouse-infested dwellings.
    - Short-tailed weasels – Varies: open woodland, brushy areas, grasslands, wetlands, and farmland. Dens may be appropriated from chipmunks, often found in or beneath a log, stump, roots, brush pile, or stone wall. Known to inhabit mouse-infested dwellings.
    - Long-tailed weasels – Varies: forested, brushy, and open including farm land, preferably near water. Dens in abandoned burrows. Known to inhabit mouse-infested dwellings.
    - Mink – along with otters a “flagship species” for clean wetlands and aquatic habitats. Found along waterways such as river banks, creeks, lakes, ponds, and marshes; dens in holes under logs, tree stumps, or roots, muskrat dens, or beaver lodges.
    - Marten – require complex forest with continuous canopy, requires good snow coverage in winter when they may retreat to the subnivean layer; have very large ranges.
    - Fisher – complex forest with continuous canopy; very large ranges. Avoids soft, deep snow.
    - Otters – another “flagship species” for wetlands and aquatic habitats, requiring ample and high-quality water. Ideal interior habitat is wetlands (bogs, swamps, marshes) interconnected with meandering streams and rivers; food-rich coastal areas such as estuaries, lower portions of streams, and coastal marshes.
    - Wolverines – boreal forests and tundra ecosystems with lots of cold and snow; they require a very large range and seem to require deep snow for maternity dens.

They all require a well-supported soft release to off-set the lack of hunting skills necessary to feed that raging adolescent metabolism, and/or unfamiliarity with release site resources.

Orphan Mink Care, Key Points

Feeding:
Mink are strict carnivores with a very high metabolism. **Formula must be high in protein, high in fat, low in carbohydrates, and contain taurine**. **Introduce food rapidly to new intakes** – for infants *start* with 25% formula/75% oral rehydrating solution (ORS), for juveniles start with over-diluted carnivore critical care (4 part water:1 part powder) and feed frequently (initially every 30-45 min) ad lib, increasing concentration of food/formula to 100% within 12-24 hrs, depending on the animal's response. They require **frequent feedings** (neonates every 60-90 minutes, infants every 2 hrs.) very gradually reducing frequency as they begin eating on their own. **Be alert for hypoglycemia** (cold, lethargic). **Feed as much as they want** (often 3-5% body weight (BW)/feeding but may vary from 2-10% BW). They will begin eating *supplemental* solid foods as soon as their teeth start coming in (~18 days) and well before their eyes open (28-35 days). Offer weaning diet as a supplement. *Weaning does not begin for another few weeks*. Continue to formula feed 8 -12 times per day, 24/7, until the eyes are open, with chopped supplemental food (chopped whole mouse, fish, and high-quality raw cat food or modified Mink Chow, all topped with salmon oil) always available. They will need to be offered formula at least every three hours until they consistently refuse the syringe. Formula (and water) can be offered in a dish once the eyes are open and they become difficult to hand feed. **Underfeeding is a much greater concern than over feeding**. They will not overeat when self-feeding and require constant access to food. Water bottles *may* work for mink, in addition to shallow, heavy dishes or containers secured to the cage. Flaking skin in the neck and shoulder area indicates dry skin, which is resolved by adding salmon oil to their daily diet (a few drops orally each day for infants, a squirt on food for juveniles).

My formula; I am currently using **4-parts FV 32/45 (skunk) powder: 1-part KMR powder: 8-parts water**. I have also used KMR or Zoologic 42/25: Multi Milk: water, 3:1:6, successfully. I prefer KMR, Zoologic 42/25, and FV Kitten over the non-cat equivalent because they are more likely to have adequate taurine. Zoologic has slightly more protein and fat than Fox Valley equivalents. The diet should be supplemented with daily salmon oil, especially if showing signs of dry skin. Spitting up formula was not uncommon, caused by a combination of eating too fast and an immature swallowing mechanism. **Bloating may indicate lactose intolerance; use lactase drops**. Infants must be stimulated (I do it before feeding) until their eyes open. Goat milk KMR is now available, and may be more easily digested, although I have not yet had an opportunity to try it.

The best weaning diet is natural prey, since they appear to imprint on their diet at an early age and early exposure to a variety of natural diet will enhance post-release survival: whole mice (chopped or slit open as necessary), fish (minnows, fresh, canned with no salt or seasoning, and/or frozen), and small rats. A high-quality frozen raw cat food or the modified Mink Chow is a practical supplement. I found the frozen raw cat food (e.g. Stella & Chewy's frozen raw dinner morsels; chicken, duck or rabbit) to be a good option. Also offer frog, mealworms and crickets, captured free range worms & bugs, and the occasional small raw egg, whole chicks, and other prey foods for exposure to natural food options. Mink jaws and teeth are considerably more powerful than either weasels or ferrets. Fish skeletons (including the head and tail) and a variety of fish scraps left over from filleting the fish, may be obtained from a seafood deli section or local fishing trips. If possible, vary the source of food and offer local wild caught fish, frogs, and (snap trap) mice and rats (be aware of and avoid possible toxins). Note: Thiamin and Vitamin E should be supplemented in all diets where frozen/thawed fish comprise more than 33% of the total diet (AZA Small Carnivore TAG 2010. Mustelid (Mustelidae) Care Manual)

Housing:
Provide **supplemental heat** for as long as they are interested, **nest areas** (piles of fleece work well), and **cover for hiding**. As they become more mobile space needs increase rapidly(!). They would naturally be in a cave or den until eyes open and active. Bedding such as hammocks, tunnels, multi-levels, and cubes on a base layer that is absorbent and easy to spot clean (such as paper towels or small pads spread over cage pads) work well. Sturdy ferret supplies (beds, hammocks, hide-aways) are generally the right size, and large igloos can make a nice den. Provide multiple options. It is important for a successful release that the instinct to hide and stay under cover is not conditioned out, as well as being less stressful for the animal if they can feel hidden and thus safe. They like to watch everything from their hiding place. Juvenile and adult mink receptive to using a litter box; I have used high back square ferret litter boxes with sand or wood pellets for the fill.

Mustelids are scent markers. Avoid an entire cage cleaning in favor of no more than 25% at a time, including furnishings and enrichment items. Often bedding can be shaken out and returned to the cage. **Expose to a natural light cycle**. Do not house different mustelid species together as they are all in a predator/prey relationship. Juvenile mink should ideally be housed in age/ability matched pairs. Males especially may become aggressive as they get older, and injure smaller or younger cage mates.

They are high energy and very smart, so frequent changes and additions of cage enrichment is critical. New soft toys are always fun, and small dog and ferret items, teenie beanies, and dangling toys, along with tents, tunnels, containers, and other hide-aways are often suitable. Toys will be cached. Intestinal obstruction from eating toys, does not seem to be a problem like it is with ferrets but of course supervise toys and playtime. Fleece straps last longer than cords; swivel clips, shower hooks, and key rings are useful for attachment to the cage. **Target exploratory**, **ranging**, and **predation** skills.

By 8 weeks they should be offered water for **swimming**. Shallow pools they can easily get in and out of and walk around in, such as large plant trays weighted with river rock, 9x13 glass baking pans, or shallow litter box/storage bins initially, progressing to shallow tubs, low-sided kiddie-pools, aquariums, and/or stock tanks. Live minnows, ice cubes, and dive toys may encourage them to put their head under water and start swimming. They must be able to get themselves in and out easily (ramps inside and out), and will probably spend a lot of time going in then out to shake off, with brief intervals of swimming, as their fur gets water logged. Offer access to a pool as an option but do not force. Please do not "teach them to swim" by putting them in a bathtub or pool with standing water. A cautious approach to unfamiliar water is natural protection from drowning.

Mink equally value access to food, heights, and water for swimming. Access to water for swimming should always be available, and if space or caging is limited, housing should prioritize tall (with climbing structures/shelves) over wide caging (for example, a double or triple high Ferret Nation cage vs a double wide cage).

One way to introduce mink kids to the concept of swimming with currents in their water is to turn the hose on full blast into the pool. They should also have the opportunity to practice diving and deep-water swimming. A stock tank or larger swimming pool is a good option, always with a way for the mink to get in and out on their own. They swim in short intervals, rather than spending long periods in the water. They are a *semi*-aquatic animal, and their coats are not fully waterproof like the fur of otters.

Pre-release Conditioning:
They must be able to exhibit natural behaviors, including a desire to stay under cover; possess adequate senses, dentation, limbs, tail, digits, and claws for obtaining and consuming native prey and escaping predators; have attained full, or nearly full, size with some fat reserves; and have normal activity mechanics, body condition, agility, strength, and endurance for age, sex, and season prior to release. A cat wheel provides an excellent source of enrichment as well as exercise and stress release.

It is critical that the instinct to hide is not conditioned out of the young mink. While full size mink are not often predated, they may be preyed upon by larger predators such as great horned owls, fox, coyote, and bobcat. They are also prized by fur trappers, accounting for the majority of premature deaths. **Offer an extensive network of cover and hiding spaces at all times**. They may be active at all hours of the day and night, alternating rest intervals with bursts of activity, but **primarily nocturnal.**

Begin live prey training with minnows and young mice, rats, or birds. They will quickly master the technique. They are not ready for release at this point! **They must know how to both hunt and kill wild prey prior to release**, unless it is an extended and very well supported soft release. Hunting is a learned skill, and they have a narrow window of opportunity to learn before starving to death without extensive support. In the wild the young stay with their mother until fall, after spending the summer learning to hunt, and they must bulk up before winter. Exposure to wild mice and small rats, crayfish and frogs, birds, and live crickets and earthworms, in addition to a variety of fish and minnows will help prepare them for survival.

"Cage Rage" and desperate attempts to escape indicate a need for more space and/or more enrichment, not necessarily that they are ready for release.

Offer a supported release along a quiet waterway with abundant cover and prey in late August or early September. Mink are solitary, except for mating and raising the young, so try not to release in the immediate vicinity of other mink, although the adults seem tolerant of the dispersing young in late summer.

Orphan Weasel Care, Key Points

Feeding:
Weasels are strict carnivores, with an extremely high metabolism rate and little or no subcutaneous fat. **Formula must be high in protein, high in fat, low in carbohydrates, and contain taurine**. **Introduce food rapidly to new intakes** – for infants *start* with 25% formula/75%oral rehydrating solution (ORS), for juveniles start with over-diluted carnivore critical care (4 part water:1 part powder) and feed frequently (initially every 30-45 min) ad lib, rapidly increasing concentration of food/formula to 100% within 12-24 hrs, depending on the animal's response.. They require **frequent feedings** (neonates every 60-90 minutes, infants every 2 hrs.) very gradually reducing frequency as they begin eating on their own. **Be alert for hypoglycemia** (cold, lethargic). Offer as much formula as they want (often 3-5% Body Weight/feeding but may vary between 2-10%); they will not overeat. A weasel cannot gorge or self-feed too much (avoid tube feeding), while underfeeding is a significant concern and can be fatal. They will begin eating solid foods as soon as their teeth appear, long before their eyes open, but weaning does not occur for another few weeks. When the canines erupt offer small amounts of whole mouse purée or chopped whole mice supplemented with feline commercial raw (or moist high-quality kitten) in the cage at all times, changing out with each formula feeding. Continue to formula feed 10-12 times per day at evenly spaced intervals until the eyes are open, with supplemental food (chopped mouse or feline raw) always available, gradually tapering off to 3 hr. intervals as dictated by the young weasel. They will need to be offered formula at least every three hours until they *consistently* refuse the syringe. Formula (and water) can be offered in a dish once the eyes are open and they become difficult to hand feed. **Underfeeding is a much greater concern than over feeding**. They will not overeat when self-feeding, and they require constant access to food. Water bottles *may* work.

My formula; I am using **4-parts FV 32/45 (skunk) powder: 1-part KMR powder: ½ part MultiMilk powder: 8 parts water**. I have also successfully used KMR or Zoologic 42/25: Multi Milk: water, 3:1:6. I prefer KMR, Zoologic 42/25, and FV Kitten over the non-cat equivalent because it is more likely to have adequate taurine. Zoologic has slightly more protein and fat than Fox Valley equivalents. Goat milk KMR is now available, and may be more easily digested, although I have not yet had an opportunity to try it. Infants must be stimulated (I do it before feeding) until their eyes open.

The best weaning diet is 100% whole mice, wild caught when possible (various life stages of the mouse to suit the various species and ages, and puréed, chopped, or slit open as necessary; also small rats for LTW), while a high-quality frozen raw cat food (e.g. Stella & Chewy's frozen raw dinner morsels; chicken, duck or rabbit) is a practical supplemental food. Also offer insects (mealworms and crickets, misc. local worms and insects, etc.) and occasional small (e.g., quail) raw egg, small birds, fish, etc. for exposure to other natural food sources. Try to source prey items from the wild and from different providers to ensure variety.

Housing:
Provide **supplemental heat** for as long as they are interested, **nest areas** (stacks of fleece squares work well), and **cover**. As they become more mobile space needs increase rapidly(!) along with their need for tunnel systems and the ability to stay under cover when zooming around. I found an initial layer of absorbent material, with paper towels in the toilet areas, along with many tubes and tunnels made of cardboard or pvc, crinkle tunnels meant for ferrets and rabbits, hide toys, etc and several fleece stacks for sleeping areas worked well. They also like hammocks and things to climb and jump on. They like ferret housing supplies (beds, hammocks, hide-aways, tunnels) as well as the dog hide-a-stuffie toys. Hanging fleece or gunny sacks on the cage sides provides both cover and something to climb and use for spying. They love anything they can bounce on like a trampoline.

It is important for a successful release that the instinct to hide and stay under cover is not conditioned out, as well as being less stressful for the animal if they feel hidden and thus safe. They love to watch their surroundings from their hiding place, always alert for prey or predators. They are escape artists, as fluid as mercury and lightning fast. Anything that will not hold a mouse will not contain a weasel for long. **Expose to natural light cycles.** Do not house different mustelid species (including other species of weasels, or mink) together as they are all in a predator/prey relationship.

Weasels are scent markers. Avoid an entire cage cleaning in favor of no more than 25% at a time, including furnishings and enrichment items. Shake items out and return to the cage when possible.

They are high energy and very smart, so frequent changes and additions of cage enrichment is critical. New soft toys are always fun, and small dog, cat (including glitter balls and small non-realistic "mice"), and ferret items; teenie beanies; and dangling toys. Also tents, tunnels, old mittens, and other hide-aways. Toys will be cached. A sugar glider exercise wheel is excellent enrichment as an outlet for energy and also stress relief (flight).

Weasels require runways rather than height, although they do like to explore different levels. If housing is limited, prioritize length over height, and use additional enrichment to compensate for limited space. Fleece straps last longer than cords;

swivel clips, shower hooks, and key rings are useful for attachment to the cage. **Target exploratory**, **ranging**, and **predation** skills.

Pre-release Conditioning and Release:
It is critical that the instinct to hide is not conditioned out of the young weasel, as they are a prey species for most predators that eat mice (cats, hawks and owls, fox, coyote, larger mustelids). **Always offer an extensive network of tunnels and hiding spaces**. They are active day and night, along with their prey, with frequent alternating rest and activity cycles throughout a 24-hr. period.

At 8 weeks they may be able to kill live prey. Begin with small young mice; if they are ready they will quickly master the technique, if not wait a week or two and try again. They are usually extremely efficient at dispatching their prey by the second or third attempt. They are not ready for release at this point! **They must know how to hunt and kill wild mice prior to release**, unless it is a very well supported soft release. Hunting is a learned skill, and they have a very narrow window of opportunity to learn before starving to death without extensive support.

“Cage Rage” and desperate attempts to escape indicate a need for more space and/or more enrichment, not necessarily that they are ready for release.

Release in edge habitat with abundant cover and prey and near water (for drinking) towards the end of summer. In the wild the young stay with their mother until 4-5 mo. old, learning how to hunt from the time they emerge from the den and gradually dispersing in late summer. Least weasels – m. nivalis - disperse at a younger age. Juvenile least weasels (from a late season litter) released in late fall, winter, or early spring are unlikely to survive unless it is a very well supported release until spring is well underway.

Weasels often form special “buddy bonds” with one or two cage mates. Try to keep the buddy pairs together during housing changes and when released.

Criteria for Outcomes in Wildlife Rehabilitation

Neogale (formerly Neovison) vison (American Mink)

Criteria	Euthanasia	Release	Captive Placement
Legal restrictions			
Federal	N/A	It is not legal to release domestic, also identified as farm or ranch, mink[1]	- USDA permit may be needed by the institution that would be housing the animal long-term. - Appropriate USDA Health Certificate, signed by a veterinarian, for transport across state or international lines.
State (WI)	- Veterinary license or meet state rehabilitation requirements (applies to any non-releasable, non-placeable wild animal).	- State rehabilitation permit. - Mink are considered a rabies vector, SARS-CoV-2 vector, and fur-bearer species, which may have additional restrictions re: rehabilitation and release in other states.	- State captive wildlife permit for wild mink. Not required for domestic mink. - Local restrictions may apply. - Appropriate WI Department of Agriculture, Trade, and Consumer Protection (DATCP) certificate for transport outside of Wisconsin.
Drug Limitations	- Appropriate to the species and method of disposal.	- Appropriate to the species and individual[1]. - Not generally considered a food animal but One Health considerations apply.	- Appropriate to the species and individual[1].

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Criteria for Outcomes in Wildlife Rehabilitation

Neogale (formerly Neovison) vison (American Mink)

Criteria	Euthanasia	Release	Captive Placement
Assessments			
Physical/body	- Non-resolvable neurological issues. - Non-repairable bony fractures or soft tissue injuries. - Distemper or rabies (rabies suspects should be submitted for testing). - Mink enteritis virus or Aleutian Disease Virus (ADV), also known as mink plasmacytosis - Non-resolvable spinal trauma with pelvic limb paralysis, absent voluntary motor, and no appreciable pain response. - Irreversible toxicity, e.g., from environmental toxins such as PCBs, dioxin, or lead, or from poisons such as rodenticides. - Organ failure. - Limb amputation. - Blind or deaf from injury or illness[1].	- Full recovery from illness or injuries with no evidence of pain or complications. - Possess adequate senses, dentation, limbs, tail, digits, and claws for obtaining and consuming food and escaping[1]. - Juveniles have attained full, or nearly full, size with some fat reserves. - Goals of physical reconditioning met with normal activity mechanics, body condition, agility, strength, and endurance for age, sex, and season.	- Injuries are completely healed. - Injuries or illness will not progress. - Permanent disability compatible with captive purpose. - Will not require constant pain management or other intensive care management. - Able to engage in water play and other natural activities such as climbing and roaming (important for reducing or limiting stereotypic behavior[1]).

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Criteria for Outcomes in Wildlife Rehabilitation

Neogale (formerly Neovison) vison (American Mink)

Criteria	Euthanasia	Release	Captive Placement
Assessments			
Emotional/mind	- Not able to process environmental signals (presence of prey or danger), with no signs of improvement. - Stress of captivity outweighs benefits of rehabilitation.	- Able to function normally, including appropriate response to threats and potential prey.	- Injury/illness is not painful - Adapts well to captivity, with appropriate barriers from the public. - No indication of stereotypic behaviors with appropriate housing[1].
Behavioral/nature	- Inability to provide normal self-care (grooming, toileting). - Inability to self-feed. *** Note: "habituation" does NOT constitute a reason for euthanasia[1] ***	- Exhibits natural behaviors, including desire to stay under cover. - Able to recognize, hunt, capture, and consume natural prey in the natural environment. *** Note: "habituation" does NOT constitute a reason for not being releasable[1] ***	- Exhibits species-specific behavior. - Injury/illness will not prevent opportunities to thrive (rest, move, engage in water play, self-feed, groom, explore). - Does not exhibit self-destructive or stereotypic behaviors when given suitable space and enrichment[1]. - Not stressed by captivity. *** Note: "habituation" does NOT constitute a reason for captive placement[1] ***

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Criteria for Outcomes in Wildlife Rehabilitation

Neogale (formerly Neovison) vison (American Mink)

Criteria	Euthanasia	Release	Captive Placement
Standards for Care			
Resources	- Meets professional and ethical requirements. - Training as appropriate for method - Licensing as appropriate for method. - Availability of proposed means for euthanasia.	- Appropriate release site[1]. - Appropriate transportation to the release site. - Ability to supplement food during initial post-release period, especially for mink brought in as infants or juveniles (generally > 2 weeks post release for juveniles).	- Appropriate placement available (permits, resources, knowledge, training, and welfare standards) - Has access to veterinary services by a provider knowledgeable about mustelid care and challenges - Appropriate housing available, including sufficient space and enrichments[1]. -Ability to offer training to minimize stress during shifting and other procedures.
Professional standards	- Current AVMA Guidelines for Euthanasia of Animals - Current NWRA Wildlife Formulary - Current NWRA Wildlife Rehabilitators Code of Ethics (https://www.nwrawildlife.org/page/Code_of_Ethics_Rehab) - Global Federation of Animal Sanctuaries (GFAS) Standards For Caniform[2] Sanctuaries, 2018 or most recent version. https://www.sanctuaryfederation.org/	- Current NWRA/IWRC Standards for Wildlife Rehabilitation (2021 or later) - NWRA Principals of Wildlife Rehabilitation (current edition) - NWRA Wildlife Rehabilitators Code of Ethics (https://www.nwrawildlife.org/page/Code_of_Ethics_Rehab) - GFAS Standards for Caniform[2] Sanctuaries, 2018 or most recent version. https://www.sanctuaryfederation.org/ - One Health Initiative, https://onehealthinitiative.com/	- AZA Mustelid (Mustelidae) Care Manual (2010 or most recent version) - GFAS Standards for Caniform[2] Sanctuaries, 2018 or most recent version. https://www.sanctuaryfederation.org/ - NWRA Wildlife Educator's Code of Ethics (https://www.nwrawildlife.org/page/Code_of_Ethics_Ed

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Criteria for Outcomes in Wildlife Rehabilitation

Neogale (formerly Neovison) vison (American Mink)

Evaluation Criteria

Mink are semi-aquatic mammals that thrive in a variety of habitats which include access to a permanent body of water – pond, creek, stream, river, lake, or ocean. They are strict carnivores and their preferred prey is rodents, but they will consume nearly any source of protein available to them including mammals, reptiles, amphibians, and aquatic or avian species. Careful selection of a release site to match the individual being released is an important component of a successful reintroduction to the wild. Mink are tolerant, disdainful even, of humans and are unlikely to be aggressive outside of normal wildlife aggression if starving, cornered, or trapped. It is extremely difficult to promote a bond between a human and wild mink that will persist beyond adolescence (this is less true of domestic mink), although juveniles may retain a measure of dependence and reliance on humans longer into the fall than expected, especially females. They *will* outgrow this, and achieve independence, in their own time. Thus, habituation and imprinting are not considered to be a concern even for a juvenile raised as single.

Mink are independent and while often believed to be territorial, the evidence is weak and, to the contrary, fur trappers will repeatedly trap multiple mink in a small area. Adults are known to be more tolerant of unfamiliar mink passing through their territory in the late summer and fall when the young are dispersing from family groups and prey is abundant. Early autumn is considered the preferred time of year for release. Highest mortality will be seen with winter and early spring release.

Domestic mink, also referred to as farm or ranch mink, are American mink that have been intensely bred since the late 1800s in order to obtain the highest quality and quantity of pelt for the lowest cost. Breeding has focused on three primary areas of interest: coat color, reduced or absent fear aggression towards humans, and pelt size. This has resulted in an animal which often quickly grows to be 2-3 times larger than its wild counterpart, with little difference in size between the sexes; there may be loose bags of skin on the haunches (greater pelt area); and fur colors vary dramatically and include white, fawn, silver, red, blue, and also multi-colored (see https://furcommission.com/true-colors/). Fur color is an indication of selective breeding intensity, with more of the "wild" traits seen in the native dark brown and black (there is a lack of consensus over whether or not true black is a natural color for wild mink). Other changes include an altered metabolism often leading to obesity, and a more "social" nature, allowing them to live in close proximity with other mink without being excessively stressed, in addition to typical health concerns associated with inbreeding. Domestic mink should not be released into the wild, due to poor survival rates and negative impacts on native populations.

Stress and Stereotypic Behavior

Perhaps the most widely used behavioral indicator of welfare problems in captive animals is stereotypic behavior (SB). Mink display a variety of SBs similar to those displayed by other Carnivora. Thus, they show the whole-body forms typical of this taxon (e.g. pacing back and forth and whole-body bobbing), head-only forms (e.g. head bobbing, head twirling and head weaving), and finally, mink,

like some other captive mustelids, can also repeatedly scratch at enclosure walls with their front paws ('scrabbling'). Note that stereotypic behavior may help an individual to cope; for example, mink that perform high levels of stereotypic behavior may be more confident and less fearful than mink stereotyping less.

Scrabbling seems to be most often directed toward mink housed in close proximity (especially two males housed next to each other) and is reduced by increasing the distance and barriers between cages along with an enriched environment. Whole-body and head-only SBs may be alleviated with an enriched environment. Biting and attacking the bars of the cage and/or littermates, and self-mutilation, including fur biting, are other indications of stress.

Once the animal is self-feeding, housing juveniles in pairs, especially male/female pairs, until about five months of age, in addition to having access to water for swimming, structures for climbing, platforms to rest upon, interactive items such as ropes and toys, and chunky or whole prey food are all forms of enrichment shown to increase the quality of care and reduce stress and stereotypic behaviors in captive mink. Adults should be housed with similar forms of enrichment, except individually.

Young mink play very rough with their littermates, and this behavior is important to develop the skills necessary to survive in the wild. Shrieks and even screams are not uncommon, but signs of dangerously aggressive interactions including "poofing", stress poop, or physical injury, or a failure to thrive, will require that the weaker animal be separated from the more aggressive one. Adult mink and juveniles over the age of natural dispersal (about 5 mo. old) should be housed individually.

Mink should not be smelly. A mink that is "poofing" is a stressed mink, and the source of stress should be identified and addressed. A mink on an appropriate diet should also not have strong smelling feces.

Captive Housing and Release Environment

Minimum housing for mink should include access to a nest box, a pool (defined here as a body of water large and deep enough to for the mink to submerge its entire body) with easy access in *and* out of the water, such as ramps, and a platform to rest upon. More space (aquatic, vertical, and horizontal) are always better than less for reducing stress and for pre-release conditioning, but if there are resource limitations then consider the following: hiding spaces and a pool are minimum requirements, along with food and access to fresh drinking water; additional levels are more valued than horizontal space (go up, not out, if you must choose one or the other). Cage size limitations can be offset with additional and (gradually) changing enrichment such as manipulable toys; tunnels; a variety of natural prey foods and food textures; vary the size and shape of the pool; and resources for climbing and resting such as platforms, hammocks, and shelves.

Criteria for Outcomes in Wildlife Rehabilitation

Neogale (formerly Neovison) vison (American Mink)

Mink release sites require appropriate habitat and abundant prey. Wild mink are most commonly found along the edges of waterways such as lakes, rivers, and streams with abundant prey hideouts and cover, including grassy or brushy banks, overhanging banks, log jams, and along the jagged edges of wetlands with large areas of open water. In marine environments mink select shallow vegetated and tidal slopes, and sites protected from waves. Beaches with small rocks should be avoided, due to the lack of cover and low abundance of prey. Natural prey includes small mammals, slow moving and small fish, frogs, crayfish and crabs, and young muskrats. They will opportunistically also consume rabbits and hares, squirrels, birds and their eggs, reptiles, aquatic insects, earthworms, and snails. They should not be released near sites with protected ground nesting birds, to minimize human conflict.

Physical Attributes

The following is a list of physical attributes and their purpose, to help determine appropriate rehabilitation and release or captive placement opportunities versus euthanasia. The mink must demonstrate an ability to locate, capture, kill, and consume the prey available in the release area; navigate the terrain; provide self-care; and escape predators and other threats in order to be deemed releasable.

- Tails. The tail is used as a prop for balancing, and serves as both rudder and stabilizer in the water. A loss of over half the tail length will limit the animal's ability to catch fish, dive, navigate deep or challenging water ways, and also limit the animal's ability to escape using a water way. This does not render the animal non-releasable, but a release site will need to be selected with abundant non-aquatic prey and access to quiet, shallow water. With time the animal will learn to compensate for balance and other aspects of tail use, but is unlikely to ever be an agile swimmer able to make sharp turns, dives, barrel rolls, or spin in the water.

- Teeth. The canines are necessary for seizing, killing, and tearing into whole prey, and are also for protection against attack. The animal must be able to capture and consume a sufficient quantity and variety of prey available at the release site to support its naturally high metabolism. A mink without adequate teeth for release may still do fine in captivity with an appropriate diet of ground or chunked meat, and with access to rope and toys such as those made for cats and small dogs that can double as dental cleaning devices and provide an outlet for the need to chew.

- Nose, eyes, and ears. Vision, hearing, and the sense of smell are all important for mink. Mink, like other mustelids, are very sensitive to smells. I have come across no literature discussing the impacts of mink losing the sense of smell, although it is believed to be somewhat less developed than in terrestrial mustelids, perhaps due to the semi-aquatic nature. Vision is clearer through air than through water, and is used for detecting motion that would alert the mink to threat or prey, and for balance. Mink rely heavily on vision when foraging, however there is a published report of a juvenile mink in Florida that came into

rehabilitation having lost an eye to injury; the animal was radio tagged and released after being restored to health and having demonstrated an ability catch live fish. The animal was still alive and being monitored in the wild 6 months after release. Auditory acuity (hearing) serves the same purpose as vision (alert the mink to danger or the presence of prey, and for balance), and studies have shown mink can hear the ultrasonic vocalizations emitted by rodent prey. Complete loss of vision or hearing is likely to be very stressful for the animal, and have too great of an impact on the quality of life, to justify even captive placement although this may depend up on the age of animal when the loss occurred; a careful period of observation should be made prior to captive placement.

- Limbs, digits, and claws. The mink must have all limbs and paws for a reasonable quality of life; this is a non-negotiable requirement for release, and is strongly recommended for captive placement as well. The toes and claws are strong, and used (individually and together) to manipulate, position, and restrain prey; they are also used for self-defense, climbing, and (limited) digging. They have remarkable strength in individual toes and paws. The animal would need to be carefully assessed if more than one toe or claw was missing from any foot.

Medications

Guidelines for ferrets should be followed when choosing medications and vaccines. If ferret recommendations are not available, then follow guidelines for felines.

[1] Refer to the evaluation criteria for more information.
[2] The Caniformia, or Canoidea (literally "dog-like"), are a suborder within the order Carnivora. They typically possess a long snout and nonretractile claws and includes mink.

This outcome chart was created as a product of a fellowship from the Partners for Wildlife program.

Resources and References for Weasels, Mink, Marten, and Fisher

American Weasels, E. Raymond Hall, August 2015 (written over previous 25 yrs.)

AZA Small Carnivore TAG 2010. Mustelid (Mustelidae) Care Manual. Association of Zoos and Aquariums, Silver Spring, MD. p.136. Original Completion Date: 29 July 2008, revised January 2010 https://assets.speakcdn.com/assets/2332/mustelidcaremanual2010r.pdf

Biology and Conservation of Musteloids, edited by David W. Macdonald, Chris Newman, Lauren A. Harrington, 2018

"The Least Weasel, Mustela nivalis Linnaeus, Developmental Biology in Comparison with Other North American Mustela," Biological Series Volume 4, Number 7, Publications of the Museum, Michigan State University, Gary A Heidt, April 1970

The Fisher Life History, Ecology, and Behavior, Roger A. Powell, 1st Edition, 1982

The Fisher Life History, Ecology, and Behavior, Roger A. Powell, 2nd Edition, 1993

Martens and Fishers (Martes) in Human-Altered Environments, edited by D. J. Harrison, A. K. Fuller, and G Proulx, 2004

Mustelid (Mustelidae) Care Manual, Association of Zoos and Aquariums, July 2008, revised January 2010

National Audubon Society Field Guide to Mammals, 1996 rev

The Natural History of Weasels and Stoats, Carolyn King and Roger A. Powell, 2nd Edition, 2007

Walker's Mammals of the World, Ronald M. Nowak, 2-vol. set, 6th Edition, 1999

Wild Mammals of North America: Biology, Management, and Conservation (Second edition)" edited by George A. Feldhamer, Bruce C. Thompson, and Joseph A. Chapman*

Zoonotic Diseases of Wildlife, Wild West Veterinary Conference 2011, Kristian Krause, DVM, ABVP (Feline), Serrano Animal and Bird Hospital, Lake Forest, CA, USA

Carpenter's Exotic Animal Formulary 6th Edition - August 19, 2022, Editors: James Carpenter, Craig Harms*

Captive mink research: Georgia Mason and team, Campbell Centre for the Study of Animal Welfare, University of Guelph. "Georgia Mason is a behavioural biologist who studies how animals adapt to captive housing conditions (or fail to), especially conditions that meet their physiological needs but are too small or monotonous to allow natural behaviour. She is also interested in the validation of animal welfare indicators."

Interesting and well researched:

Winter World, Bernd Heinrich

Winter of the Fisher, Cameron Langford

The Lone Wolverine: Tracking Michigan's Most Elusive Animal by Elizabeth Philips Shaw, Jeffrey J. Ford

* If you need to prioritize, start with these

island or loafing area (A ZA Bear TAG 200 9). A pH of 7.5 - 8.2 and salinity of 15- 36-parts per thousand are recommended for saltwater pools prior to release (P BPA 2002); however, saltwater pools are not a mandatory requirement (AZA Bear TAG 2009).

Polar bears are incredibly powerful and can jump great height s and distances. All enclosures must be built to properly and safely contain them in accordance with the AZA recommendations (AZA Bear TAG 2009).

I I.7 Enrichment:

Environmental enrichment is a critical component of housing wild mammals and can take many forms, ranging from the simple variation in food substances and presentation to construction of complex climbing structures (Sikes et al. 2016). Enrichment utilizing materials from the animal's natural habitat will help to reduce stress, and enrichment that stimulates natural behavior s (e.g., nest building, digging, or climbing) will help to condition the animal for release. Suggestion s for species-specific enrichment items and techniques are mentioned in the preceding section (see Section 11.6).

Codes for Tables 11.1a- d Minimum Housing Size Guidelines for Mammals

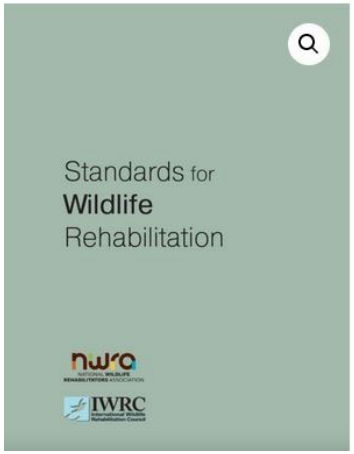
* One adult per enclosure.
\+ See species-specific text in section 11.6 For more information.
B Needs substrate suitable for burrowing/digging.
Bp Needs a bath pan (large enough to enter; need not be large enough to swim in).
Br Needs fresh browse.
C Needs branches, log s, or other suitable climbing material.
D Needs a den or hide box.
E Needs solid floor or welded wire beneath substrate to prevent digging out of enclosure.
F Feeding dishes should be place d off the ground, attached to the wall or otherwise positioned higher in the enclosure.
G Ground should be planted with forbs or other nontoxic native plants.
H Needs supplemental heating first few days out of the incubator (see Section s 11.2.1 and 11.6).
L Benefits from leaves or other greenery hung in the enclosure or distributed for hiding.
N Needs nesting substrate (e.g., towels, blankets, dried leaves, shredded paper).
P Needs artificial pouch (e.g., material pouch, security blankets).
R Benefits from rocks for climbing.
S High stress- needs privacy and quiet.
Sm Needs smooth lower walls to prevent climbing (and falling).
Su Need options for suckling (e.g., fruit) or else is likely to suckle on cagemates causing genital injury.
T Needs artificial tunnels (e.g., PVC pipe, buried boxes).
W Semiaquatic - needs pool large enough for swimming and / or defecating.
Z Great care must be taken to seal off small openings or cracks that can act as traps or escapes.

Table 11.1a Minimum Housing Size Guidelines for Young Mammals (US Customary Units}

This table is not intended to be used independently; it should be used only in conjunction with the information in Chapter 11.
All sizes here are depicted as MINIMUM and use rectangular area for ease of calculation. Larger sizes and / or alternative shapes may be more suitable.

Order ***Family*** Species	Neonate/Infant W X L x H	Max#	Codes	Pre-release Conditioning W X L x H	Max#	Codes	Release Conditioning W X L x H	Max#	Codes
Mustelidae									
~~Martens~~	~~**10** in x **20 in** x **12** in~~	~~4~~	~~H, P, S~~	~~**3** ft x **3** ft x **3** ft~~	~~4~~	~~D, N, S~~	~~**4** ft x **8** ft x **8** ft~~	4	~~B, C, D, E, S, W~~
My recommendation Martens	**10** in x **20 in** X **12** in	4	H, N, P, S	**2** ft x **6** ft x **6** ft	4^	C, D, L, N, S, T, Z	6 ft X 12 ft X 8 ft	2^	C, D, L, E, S, T, Z
~~Fishers~~	~~**10** in x **20** in x **12** in~~	~~4~~	~~H, P, S~~	~~**3** ft x **3** ft x **3** ft~~	~~4~~	~~D, N, S~~	~~6 ft x 8 ft x 8 ft~~	~~4~~	~~B, C, D, E, S, W~~
My recommendation Fishers	**12** in x **24 in** X **16 in**	4	H, N, P, S	2 ft x 6 ft x 6 ft	4^	C, D, L, N, S	6 ft X 12 ft X 8 ft	2^	C, D, E, S
~~Weasels, minks~~	~~**10** in x **20** in x **12 in**~~	~~6~~	~~H, P~~	~~**3** ft x **3** ft x **3** ft~~	~~6~~	~~D, N~~	~~**6** ft x **8** ft x **8** ft~~	6	~~B, C, D, E, F, S, Sm, T, Z~~
My recommendation ~~Weasels,~~ mink	10 in x 20 in x 12 in	4	H*, N, P, S, Z	2 ft x 6 ft x 6 ft	4^	Bp, C, D, L, N, P, S, T, Z	6 ft x 8 ft X 8 ft	4^	C, D, E, L, S, T, W, Z
My recommendation Weasels~~, mink~~	10 in x 20 in x 12 in	6	H*, N, P, S, Z	2 ft x 6 ft x 6 ft	6^	C, D, E, L, N, P, S, T, Z	6 ft x 8 ft X 6 ft	6^	C, D, E, L, S, T, Z
River otters	**12** in x **24 in** x **16 in**	3	H, P	6 ft x 12 ft x 6 ft	3	D, N, W	10 ft x 20 ft x 8 ft	3	B, D, E, T, W
Wolverines	12 in x **24 in** x **16 in**	3	H, S	**3** ft x **3** ft x **3** ft	3	D,S	20 ft x **36** ft x **8** ft	3	B, C, D, E, S
Badgers	**12** in x **24 in** x **16** in	3	H, P, S	**3** ft x **3** ft x **3** ft	3	D, N, S	**12** ft x **16** ft x **8** ft	3	B, C, D, E, S, T
Mephitidae									
Skunks	**12** in x **24 in** x **16** in	6	H, P, S	**2** ft x **4** ft x **3** ft	6	D, N, S	**10** ft x **12** ft x **8** ft	6	B, C, D, E, F, L, S, Sm, T

* Heat source until no longer used
^ Watch closely for signs of sibling aggression and be prepared to separate as necessary



Re: Vaccine Protocols for Weasels and Mink

These are recommendations from a veterinarian experienced in ferret and domestic mink veterinary care, and can be applied to wild mink and weasels with precautions. Keep in mind the metabolism of wild mink is faster than the domestic mink or ferrets, and the weasel metabolism is about 2-4 times faster than the wild mink.

Always work with your veterinarian for treatment and protocols; it may be helpful to share this document with them.

*** note: these are comments and recommendations from the wildlife veterinarian – not me! ***

Only use the ferret-specific vac, or the puppy vac "Nobivac DPV". That said, apparently the Novibac has few reactions but there is the slight possibility they could get actual distemper from them (I think this is true with the ferret specific one too, although I could be wrong). I think the benefit outweighs the risk though.

Availability of the ferret vac can be problematic. Currently a 10 pack of the ferret-specific vac can be purchased for about $180.

Do NOT pre-medicate with benedryl. This can mask the symptoms of a reaction, cause a delayed reaction, and some animals may possibly even react to the benedryl. If there's a reaction you want to be able to see it immediately and treat it. A reaction being masked is dangerous- you need to be able to see if there is ANY reaction, so that you can never administer that vac again.

Most vets are using Dex-SP at 2 mg/kg IM 30 minutes prior to vaccination in ferrets. It’s a steroid.

Stay at the vet for at least 30 min after the shot. Make sure your vet is aware of the risks and ready to reverse a reaction, should one happen.

Continue monitoring closely for 24 hours, and watch for swelling, redness, vomiting, etc.

A note about rabies vaccines in the USA. It only counts in domestic cats, dogs, and ferrets. That’s it. Not mink, not fox, not wolf, etc. The reason is there are no studies in that exact species so it doesn’t count. If they ever bite someone it is off with their heads for rabies testing, vaccinated or not. Theoretically it should work, but since no studies, doesn’t matter much. However, it may well protect the animal should they be attacked by a rabid animal after release.

Specifically for domestic mink or ferrets, but also applies to wild in rehab or education animals: Distemper is an absolute must. Especially if you do any rescue. If older a series of 2 three-four weeks apart, or if as a baby a series of 3. Then one yearly until they are 3-4. At that point they should not need boosters and you can titer the vaccine though it would be based on info for ferrets and who knows what a safe titer is in a mink? But since distemper is such a horrible and preventable disease, people should vaccinate for it. I gave up trying to reason with anti-vac people. they haven’t seen what I have. I can only give them the facts and it’s up to them. I’d rather have a vaccine reaction than a dead mink or ferret.

I always give steroids before any vaccination in ferrets or mink, I use the ferret dose of 2 mg/kg IM Dexamethasone SP in case anyone else's vet wants to do this. Wait 20-30 minutes before the vaccine and monitor closely for reactions. Never give rabies and distemper on the same day. I’ve treated 3 vaccination antiphylaxis... all in ferrets. Two rabies and one distemper vaccine. All three survived and were fine within 30 minutes. Protocol as follows:

Vaccine reaction protocol for anaphylaxis in ferrets (would use the same for mink):

Have protocol handy with dosages calculated prior to administering the vaccine, just in case.

Epinephrine: 0.1 ml of 1:1,000 solution SQ and many need second dose. If a larger ferret or mink I would do 0.2 or even 0.3 ml.
Diphenhydramine 2 mg/kg SQ, IM, or IV
Dexamethasone-SP 2 mg/kg SQ, IM, or IV

Warm SQ fluids or if able IV usually start with 1/4 shock dose (25 ml/kg) and can give more if needed. Give flow

by oxygen mask or intubation. Most ferrets turn around within 10-20 minutes and are ok with prompt care. Getting an IV line in is usually not possible, but if you can all the better.

Symptoms of anaphylaxis include: vomiting, grey/white gums, coma/extreme lethargy/unresponsive, diarrhea and usually happen within minutes of vaccination. There can be delayed vaccine reactions which can happen hours to days later that are not as severe, nor need this protocol.

One other thing. One time I had two ferrets get anaphylaxis from rabies shots at the same time. Unrelated and different ages. I did some research and some batches of the IMRAB-3 can do this. If this happens do not use the same batch. Switched batches and no problem. Just something I found out by searching the forums with someone who had a similar problem. And always report any reactions to the USDA and company

Sedation protocol –
My sedation protocol, adult domestic mink: 0.5 mg/kg midazolam, 0.3 mg/kg butorphanol and 0.05 mg/kg dexdormator (with an equal ml of antisedan to wake up). All as IM injections. (Cindy Petrauskas, DVM)