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MEAT MONITORING IN MARINE MAMMALS

By Jostein Eikland and Harald Ribe

Introduction

A veterinarian responsible for the practical implementation of whale meat inspection must have a good knowledge of whale biology and all phases of whaling from harpooning to carving and onboard meat handling. The veterinarian must also be familiar with the growth conditions of different bacteria in whales and whale meat.

The whale is a warm-blooded mammal with a body temperature of 35-37°C. Its blubber layer serves as insulation against cold and counteracts pressure at great depths.

Among the animals living today, the whale is certainly the one that has undergone the most extensive development and the greatest changes in its way of life. We are able to follow this development from its life on the land to its present existence in the sea.

Remnants of a rudimentary pelvis can be found in all whales, embedded in the musculature of the back part of the body. Rudiments of hind legs can be observed at the embryonic stage. However, the external limbs of the whale consist today merely of a horizontal tail fin for propulsion and flippers for steering.

Baleen whales and toothed whales

Whale species are divided in two groups: the baleen whales and the toothed whales. The differences between the groups are not quite clear, however. While the baleen whales have teeth at their developmental stage, some of the presently living toothed whales, for example the bottlenosed whale, have very insignificant teeth.

That some whale species have teeth and others have baleen is due to different feeding conditions.

Toothed whales prefer to feed on squid and fish. There are about 70 species of toothed whales, including the sperm whale, beluga, dolphin, pilot whale, bottlenose and killer whale. With the exception of the first one, *all toothed whales are small whales*, meaning that they are less than 12 m long.

The bottlenosed whale and the killer whale have been subject to hunting along the Norwegian coast. The use of the sperm whale and the bottlenose for human consumption was prohibited for quality and market reasons on 01 June 1960. On 07 March 1961, the prohibition was extended to cover all toothed whales.

The killer whale, which is a typical toothed whale and a very voracious predator, does not hesitate to take a bite even from a wounded brother. Due to its voraciousness, the possibility that *its meat may be trichinous cannot be excluded.*

The baleen whales feed on small animals, krill, and plankton. However, the difference is not quite obvious here, either. The versatility of their menu may vary. Herring, pollock, haddock, and large cod have been found in the stomach of the minke whale, which is a typical baleen whale.

Minke whale

The minke is the whale playing the most important role in Norway. As food for humans, its meat is attractive, and at present, it is the only baleen whale species hunted by Norway. Large-scale hunting for finback whales was stopped in the 1960s due to small catches.

The adult minke whale is 27-30' (ca. 9 m) long. It yields 2500-3000 kg of meat and about 1100 kg of blubber, and its liver weighs about 50 kg. The meat quantity, which varies with the age of the whale, may be as small as 500 kg.

The blubber of the minke whale is used for human food as well. At present, the export of blubber to Japan is at a standstill.

Colour, taste, fat and meat quality

Colour

Among the different species of whales, the meat of the baleen whales - the sei, finback and minke whales - is, on the whole, relatively light-coloured, while the meat of the toothed whales is dark. Otherwise, the colour can vary between the species. The lightest colour can be seen in the calves of the sei and finback whales. The meat of the minke whale can range

from light-red to brown and also take on darker tones. The meat of the bottlenosed whale is coal-black.

Taste

The taste of the different whale species is considered to vary, as in other animals, according to age and above all fat content. However, taste experts will be able to detect taste differences based on the whale's menu of certain fish species, such as capelin, whiting, and particularly, herring.

Most whales perform annually two *migrations*, one for *mating* and one for *feeding*. In the spring and summer, they migrate north or south to the Arctic and Antarctic oceans to feed. During these seasons, the vegetable plankton of these oceans grows enormously, providing food for small crustaceans - Calanus species and krill - on which the baleen whales feed. The crustaceans disappear in the fall, and the whales migrate to warmer regions to calve and mate again.

The migration of the minke whale northwards along the Norwegian coast to the Barents Sea in the six summer months is a feeding trip, as a result of which the whale accumulates more fat every year.

Fat

A comparison of whale meat with the meat of our domestic animals shows that whale meat has more unsaturated fatty acids containing double bonds, which take up oxygen easily, making the fat turn rancid sooner. Rancidity may occur in fatty whale meat already after a couple of months of frozen storage. This feature is so important that *many people consider fat content "the enemy no. 1 of whale meat sales".*

The fat content of whale meat may vary from less than 0.5% to 10-15%. The fatty tissue becomes visible when the fat percentage exceeds 2%.

Therefore, whale meat with *visible fatty tissue* is not approved for human consumption in Norway. It is trimmed off, to be used as animal feed. However, fat content varies very much also in meat without visible fatty tissue. The percentage mentioned above has to be regarded as a somewhat rough working rule, but it is still the best rule to follow in practical whale meat inspection.

The whale-meat inspector has to pay attention to the fact that fat content may vary between different groups of muscles. In a fat whale, the dorsal portions become increasingly fatty towards the ridge of the back.

A whale that loses weight has been observed to lose first the fat that carries unsaturated fatty acids. After exceedingly fatty meat is removed from a fat whale, the remaining meat that is approved for human consumption and stored frozen, will still have a shorter keeping time than meat from a thin whale.

The Japanese accept much more fatty meat for human consumption than the Norwegians. This is not attributed solely to their requirements for frozen storage, which are much stricter at a minimum of -30°C, but also to the method by which the meat is sold.

Meat quality

An excessively fat whale may be harpooned early in the hunting season, but usually, problems with fat contents do not appear until July, and then particularly when mature, pregnant female whales are killed. Females migrate northwards earlier than males.

Therefore, not only quality-conscious whale-meat packers but also veterinary inspectors strongly recommend that hunting for Norwegian consumption be stopped in good time before the mentioned problems appear, and that quotas per boat be based on a given number of tonnes instead of the number of whales. This is important, because it will result in a larger catch of younger, sexually immature whales which generally yield also a better quality of meat. As it is known that 80% of the female whales caught are pregnant and that a femaleminke whale does not reach sexual maturity until it is 7 years old, the recommended

method would also mean a more responsible resource management of the entire minke whale population. Whales with a slaughter weight ranging from about 900 to 2000 kg possess the finest quality of meat for human consumption.

When an excessively fat whale is delivered to a meat-packer, it is rarely possible during the delivery to sort out all meat that has visible fatty tissue. The rest must be sorted out for animal feed during the trimming and cutting up of the meat. However, at this timepoint the meat has already a new owner. For the meat now sorted out for animal feed, the meat-packer has thus paid a price that is paid for meat for human consumption.

Significance of hunting conditions for meat inspection

Whale-hunting differs quite essentially from the procedures related to the slaughter of domestic animals.

After a whale is shot with a harpoon equipped with a grenade head, it is immediately winched next to the boat. If it is not dead yet, it is shot dead with a large-calibre rifle. A wire-loop is then placed around its tail. The harpoon is removed, if possible, and the whale is winched onto the boat. It is immediately bled by cutting the main blood vessels in front of the flippers, and its intestines are removed before flensing.

Dismembering and handling

The blubber is removed all the way to the meat membrane and kept separately.

The meat is then carved into cuts weighing from 20-30 kg to 60-70 kg. To cool the cuts, they are placed on grids with *the white membrane down.* The largest surface of the meat shall be exposed to air. From this point on, the meat can be referred to either as *meat from offshore whaling* or as *meat from shore whaling.*

Meat from shore whaling

With the whale meat lying on the deck, the hunter specializing in shore whaling takes it to the whale-meat packer who has bought it. The meat is unloaded and placed on grids in the packer's cold storage for further cooling.

Meat from offshore whaling

Whalers hunting in more remote waters have to chill the meat in the ship's hold after it has been cooled. To prevent sun burn during cooling, the meat is covered by tarpaulins. It has to cool to the ambient temperature, but most whalers let it cool for about 24-30 hours before they take it to the hold. Depending on the circumstances, the temperature of the cuts will be 13-14°C.

Storage in the hold

Once the meat has been brought into the ship's hold, it is spread out for further cooling. Some whalers spread a thin layer of ice over the meat to accelerate the cooling. The ice layer is sufficiently thin to melt within a few hours.

The meat is then surrounded by a thick ice mantle. Today, most whalers line the sides and the bulkhead of the hold with thin construction plastic, which is changed for each new trip. The plastic functions as insulation, so that the ice lasts longer without melting. Should the ice melt at the sides, the plastic prevents the meat from getting slimy too soon and keeps away loose paint. Cleaning of the hold after unloading is easier as well. Some whalers place the plastic between the ice and the meat, which protects the meat against 'ice burn' and surficial slime formation, while others place plastic both against the walls of the hold and between the ice and the meat. Plastic between the ice and the meat is recommended, provided that it is ensured that the meat has been sufficiently cooled for icing.

When the meat is unloaded at the meat-packing facility, its temperature is about 0-1°C.

The packer stores the meat safely by re-icing it in his cold storage, with the exception of meat that goes immediately for trimming. If several cargoes are unloaded at the same packing facility, each one is separated from the others with plastic sheeting or an ice mantle.

Keeping quality

Correctly treated meat is very resistant against internal decay. Experience has shown that internal decay of whale meat will be avoided at the packing facility, if the whale is dismembered within a reasonable time after death. The external surfaces of the meat, which lie against ice or plastic are naturally exposed to the processes of decay.

Bacterial flora

The bacteria found in whale meat can be divided in internal and external bacteria.

The internal bacteria are present in the whale musculature already at the time of the first control test (which can be done half an hour after death). In this respect, the whale is like other animals. However, the whale has a considerably higher bacterial count - up to 50 times higher - which is assumed to be attributable to the frequently severe death struggle. The bacteria found in whale meat are almost always the same as those found in whale faeces, namely clostridia (*Clostridium perfringens,* type A, and *Clostridium bifermentans*) and faecal streptococci. Therefore, the *bacterial invasion* is assumed to take place by migration of bacteria from the gut to the bloodstream during the death throes and to continue until the whale is bled and eviscerated. The bacterial growth may be significant particularly if the whale is exposed during this time to passive movements such as hauling.

The inner bacteria originally present in the gut grow best at body temperature. They multiply rapidly even when the temperature drops to 25°C, and some of them can still multiply at 10°C.

Clostridium perfringens, type A, is gas- and toxin-producing and grows only anaerobically. Its growth stops when meat is chilled to a temperature between 25° and 15°C. The toxins are not destroyed by cooking, and gas-spoiled whale meat may cause food poisoning,which can have fatal consequences for children and weakened individuals.

The properties of whale meat provide more favourable conditions for clostridia than for streptococci, and thus, the total bacterial counts are dominated by clostridia.

Clostridia invade first the carbohydrates in the meat. This affects the pH and is quite possibly the reason why pH measurements are rather useless in whale-meat inspection. By the time pH measurements would indicate beginning decay, the inspector has already registered the spoilage by his own senses.

Because the cooling of a large cut of whale meat takes longer, it rots more easily, due to the action of gas.

The "external" bacteria infesting the cuts in connection with dismembering also derive mainly from faeces, as faecal bacteria contaminate the working area.

The other bacteria types found include some coliform bacteria as well as *Pseudomonas* and *Achromobacter*. Some of these grow at temperatures near the freezing point.

As pointed out above, whaling differs from the procedures found in a slaughterhouse. Whaling is hunting.

The length of the death struggle is very significant for the quality of the meat. If the whale does not die when harpooned, it may make huge efforts to get loose, and by doing this, get severely exhausted. Its glycogen reserves become depleted, with the result that the pH does not drop significantly. This means that bacteria, particularly Clostridium spp, have goodgrowth possibilities in whale-meat from the beginning. The new grenade-headed harpoons are supposed to improve this situation considerably.

pH, buffer action, and lactic acid content in musculature

pH, buffer action and lactic acid studies indicated that whale meat is subject to the same conditions as mammalian muscles in general. The estimated "basic" pH value (the pH the muscles would have without lactic acid) was 7.56 ± 0.14 in 20 sperm, blue and finbacked whales, while in the rabbit musculature the values were 7.3 and 7.7. The real pH of whale musculature varied from 7.4 to 5.3, and enough glycogen was present to result in a final pH of 5.7 ± 0.2 for blue and finbacked whales. In view of the way a captured whale dies, after a long hunt and a violent death struggle, it must be assumed to have relatively large glycogen reserves in its muscles.

Other factors influencing meat quality

In addition to the already mentioned factors influencing meat quality, there are other factors which may explain why whale-boats sometimes return with decayed meat.

Sometimes, the whale may not be bled, or its bleeding is delayed. Similarly, a long time may pass before the whate is eviscerated. It can not be excluded that the resulting unfavourable conditions become even worse if the whale's stomach is full of undigested feed.

Article 4 Section 11 of the Whale-Meat Regulations states that the processing of a whale has to begin as soon as possible and latest within one hour after its death and that it has to be performed as quickly as possible. Harpoon-damaged meat shall be cut out immediately, as it decays rapidly.

Every now and then, harpoon-damaged meat is trimmed off carelessly.

Sometimes the harpoon may hit the whale in the belly, with consequent contamination problems. Meat spoiled like this develops a characteristic unpleasant odor, which the whalers call "belly smell" or "gut smell". The meat may also turn pale green.

It is very important to cool the meat sufficiently before it is chilled. However, under favourable hunting conditions this may be difficult. Similarly, whalers may miscalculate the quantity of ice, either by taking too little ice with them or by making the ice mantle around the meat too thin. The situation may become precarious especially if the weather turns warm.

The time period between the capture of a whale and its delivery to the meat-packer is naturally important as well.

Many years of experience have shown that regardless of how correctly the whaler handles the meat and how good the onboard hygienic conditions are, "slime" will develop on the meat surfaces that lie against the ice, the sides of the hold, and the bulkhead, when the meat is *older than 3 weeks*. When it is older than 4 weeks, decay often appears on the meat surfaces resting against the central posts of the hold or against other parts where the ice has melted completely. Whale meat with a slimy surface presents hygienic problems in connection with trimming and results in quality impairment of the finished product, reducing the profits.

Pathological changes

For whale-meat inspection, disease-caused changes in whalemeat seem to have very little significance. Abscesses (boils) may occur in the blubber and the muscles, but malignant growths with metastases have never been reported. Mastitis and individual cases of liver changes have been recorded. Both endo- and ectoparasites, for example liver flukes, may occur.

Some years ago, a whale that had been captured in Vestfjord and delivered to Skrova, weighed only half of what it should have weighed considering its length. Its liver wasseverely infested by liver flukes, which had caused bile duct inflammations and extensive degenerative changes. This was assumed to explain the weight loss. The whale liver fluke (*Lecithodemus goliath*) is found relatively frequently in adult minke whales.

Trichines have been found once in a beluga, which is a typical Arctic toothed whale species, but they have not been found in other toothed whales and never in baleen whales.

Some whale meat has to be discarded because of old harpoon wounds, but the primary cause of discarding is decay, both external and internal.

In view of the large amounts of meat landed and the great number of cargoes received, very little meat is discarded in the small-whale industry. The majority of the whalers have become very clever at meat handling in the course of the years.

As far as shore whaling is concerned, years may go by before any meat is discarded during delivery, and when it does take place, it can be attributed practically always to gas-caused deterioration or other internal decay.

Iced lots of meat from remote waters are naturally more prone to problems. However, especially early in the season, when the weather is cool during the hunt and the return, entire cargoes can be delivered without rejections. In most cases the amounts of waste and rejects are minimal, indicating the required standards.

Implementation of meat inspection

Reception of iced cargoes

When iced cargoes are received, it is useful to inspect the hold, preferably at the time the hatches are opened, to sense any abnormal smells or to have a look at the meat and the icingconditions. Therefore, it can be requested that the hatches not be opened before the veterinarian arrives.

The inspector requests the ship's certificate, issued by the Inspection Office of the Fisheries Directorate, or for other information required for the inspection. If a lot of ice has melted in the hold, the temperature of the meat must be measured.

First-line inspection

With the cuts on the inspection table, they are checked for *odour, colour, texture, and visible fat* as well as *pathological processes, etc.*

A deep incision is made into the centre of a cut, where the meat cools down slowest, and a small piece of meat is extracted.

Meat spoiled by gas formation

If gas-caused deterioration is present, *the knife will make the meat crackle.* If a cut is hit with the knife, a hollow sound is heard. Gas bubbles can be seen in the meat, or *gas seeps out* when the meat is squeezed, and the meat may float on water. However, this is a somewhat rough test.

The entire unloading staff should participate in the odour control, particularly those who work in the cold storage. Note that an abnormal odour may not be detected until the meat is in the cold storage.

The inspector should be most concerned about gas-caused decay, because it may result in a smell and taste that do not stop people from eating the meat, and this may lead to food poisoning.

However, most spoiled meat in a damaged cargo gets rejected as a rule because it is *ill-smelling and without gas.* This is interpreted to mean that the meat has been cooled sufficiently quickly to inhibit the growth of Clostridia, while the further chilling has taken place so slowly that other, more proteolytic bacteria have had the chance to multiply.

Character of whale-meat inspection

Whale-meat inspection is characterized by that the veterinarian must perform the inspection by taking random samples from the time the meat arrives as mixed cuts to the time it is packed.

Experience has shown that at irregular intervals, cargoes of meat arrive that contain major quantities of spoiled meat. This takes place so infrequently, however, that in practice it does not justify a much stricter random sampling during delivery, as even a single control incision into a cut will reduce the percentage of steaks that can be cut from it and thus lower the economic profits. Therefore, the possibility can not be excluded that in practice, a cargo containing some decayed meat gets accepted without that the decay is detected by the normal random sampling method during the delivery. It has to be remembered in this connection that the inspection is not conducted on whole animals. The whales have been already carved into smaller pieces at this point, and meat from a whale killed in an unfortunate manner may lie mixed in with the rest. Also, only a part of the meat from such a whale may be noticeably damaged.

Should *a damaged cargo* arrive, with the damage attributable for example to gas-caused decay, internal decay not dependent on gas, "gut smell", or other abnormal smell, *inspection* of the cargo *is very difficult.*

When this kind of damage is indicated, every single cut of meat must be inspected by incision. However, it is never possible to sort out all decayed meat during the delivery.

Experiences from the unloading of such cargoes have shown that some cuts which on the inspection table look organoleptically satisfactory, may smell quite rotten a few days later, even if they have been stored well iced in the packer's cold storage.

These cuts were naturally severely infected by bacteria in advance, but the decay processes seem to be accelerated by the very handling of the meat during the delivery. In cases like this, it is not known if the mentioned processes are of a bacterial or some other nature.

Loads delivered with such damages are trimmed at the packing facility under a more rigorous inspection, and the entire cutting and packing staff participates in the inspection. The veterinarian is present during the entire trimming period and carries out a post-inspection of the waste discarded during the trimming. The rejected meat is weighed and discarded in the presence of the veterinarian. Some meat may have to be dyed to make it edible. A certificate is drawn up for the meat discarded during delivery and trimming, containing a satisfactory description and the underlying reasons and law provisions for the rejection; copies of the certificate are forwarded to the packer and the whaler (see Art. 8, Ss. 22, 29 and 30, of the Regulations).

Before final approval, random samples of the ready-cut product may be taken for bacteriological examination, if considered necessary.

Bacteriological examination in connection with the delivery of mixed cuts is *only occasionally useful*. Samples taken from iced cargoes are hardly sufficiently representative of the cargo, and besides, it is generally not possible to wait for the results for 2-3 days.

Thus, it is mainly human judgment and human senses that have to be relied on during the delivery and trimming of small-whale meat, and experience has shown that this works quite well.

Rules of the Norwegian Raw-Fish Dealers Union

The Raw-Fish Dealers Union looks after all firsthand sales of whale meat north of Kristiansund. The Union's Circular no. 20/1994 states as follows:

"The Sales Management has set the following minimum prices for the meat of minke whale taken starting from the beginning of the annual hunting season (all price zones):

Meat for consumption, NOK 37.00 per kg.

Meat cut from whale carcasses after regular justifiable flensing, is not included in the mixed price. If such meat is landed for use as animal feed, it can be priced at NOK 1.00 per kg. The supplier can include no more than 2% of such meat in the total weight of meat delivered, etc."

Meat for human consumption at a minimum price of NOK 37.00 corresponds roughly to what the Regulations call *mixed steak meat*, or what could be also called *mixed cuts of meat.*

Meat cut out without regular justifiable flensing includes meat between and on the outside the ribs, the thinnest belly muscles and any small pieces, trims and shreds, which correspond roughly to what the Regulations call *mixed residual meat.*

Such residual meat is landed especially by hunters engaged in shore-whaling, who land with newly hunted meat lying on grids on the deck. Most whalers hunting in remote waters do not usually bring in this kind of meat, even though some of them may land varied quantities of it. If, besides, this meat is slimy, it has no or little value. In iced cargoes, this meat lies frequently mixed in with the cuts. As soon as the hold space allows, it has to be sorted out, so that it can be unloaded and weighed for use as animal feed. (May require dyeing.)

The prices set by the Raw-Fish Dealers Union for mixed meat intended for cutting for human consumption are based on the prerequisite that the meat is of a regular good quality. This quality requirement correponds to the requirements of veterinary inspection.

If a meat lot does not meet the required standards, the reason may not consist only of external or internal decay, abnormal odour, pathological processes, or unsusually slimy or discoloured meat, but also of the presence of so much fat that the meat is directly destined for animal feed.

All of the above circumstances may result in trimming off or sorting out during the delivery, to make the meat meet the regular good quality standard.

It is also worth mentioning that in connection with the delivery of iced cargoes, both *whalers and packers* have had over the years *a certain relaxed attitude*, which was necessary to make everything run smoothly.

Circular no. 24/1993 of the Raw-Fish Dealers Union states, under Item 4 concerning complaints, as follows:

"Should the purchasor find that the goods are not in keeping with the contract made, *a complaint has to be filed immediately* upon the discovery. The responsible veterinarian is called in without delay, before the delivery continues, and the decision of the veterinarian must be accepted by both parties. Complaints presented by the purchasor after the catch has been received at the purchasing site, do not apply to the whaler or the Raw-Fish Dealers Union, even if the veterinarian refuses all or part of the goods received. The purchasor is at all times obliged to complain of errors during the delivery and while the whaler is present. Thus, the right to complain becomes inapplicable, if the purchasor does have an examination conducted during the delivery to reveal possible quality defects before the end of the delivery.

However, a departure must be made from these rules, if a veterinary inspector within a week from the delivery finds in the meat defects demonstrably attributable to poor handling by the whaler."

The whalers are obligated to deliver their catches to licenced whale-meat packers.

Ready-cut unfrozen whale meat may be taken for inspection to regular public meat-inspection stations, but otherwise, whale-meat inspection is attached to the licenced packers and can be performed at their premises only.

Retail cut inspection

A packing facility lays emphasis on a successful production setup with good work hygiene, on random-sample controls performed by the veterinarian at cutting tables, and on contacts between cutting and packing employees, who are regarded as participants in the inspection.

The final cutting of the meat is the phase during which the last remains of possible damaged meat and meat with visible fat tissue can be most reliably sorted out.

Stamping

According to the whale-meat regulations, meat-control stamps cannot be applied until the meat is ready packaged.

Tenderizing

To be good and tasty, whale meat has to be tenderized and aged just like other meats. In practice, fresh unfrozen whale meat is calculated to age sufficiently in the course of the 3-4 days it takes the ready-cut steaks to reach the consumer, but most people prefer meat that has been iced for at least 14 days.

Appeals

The decisions of the responsible veterinarian can be appealed on the basis of Section 29 of the Regulations concerning public meat inspection. The appeal authority is the municipal healthand social welfare committee or some other competent authority appointed by the municipal administration. The decisions are final. Before the appeal authority makes its decision, statements have to be obtained from the county veterinarian and/or other competent veterinarian.

Inspection of seal meat

The present body of regulations, the Meat Control Act, *does not cover inspection of seal meat*. Therefore, any inspection of seal meat has to be based on the Food Act and the regulations issued pursuant to the Act. The most important provisions are found in The

General Directives for the Production and Marketing Etc. of Foods, particularly Ss. 3, 4, 5, 6 and 13, and the Hygiene Regulations.

According to the National Food Authority, a new law on meat and meat products is in the making. There is reason to assume that this law will include all vertebrates except fish. A body of regulations is absolutely needed for seals and other animal species not presently included. The aim must be to cover the food aspect of the entire hunting and production system.

Traditional food

The northern seal-hunting communities have a long-standing tradition of eating seal meat. People outside the communities were also in the habit of securing themselves some "flippers" when the hunters returned. For many, this became a permanent spring tradition. Seal meat has gradually become an exotic dish on restaurant menus as well.

Biology

Harp seal

The harp seal is found in the North Atlantic from Baffin Bay to the Kara Sea. Its new-born young (whitecoat) has *a white woolly coat, which is lost in a couple of weeks and replaced by grey fur with black-spotted guard hair (greyling)*. The subadult harp seal has brown spots on its entire body.

Adult males have a black head and a conspicuous, broad black band along each side. The bands meet over the back (saddle). The females have a more irregular colouring and lack the black head. Harp seals have a long fox-like head.

The species often swims on its back and preferably in herds. It weighs 100-150 kg, and its body length is 1.5-2 m. The female is a little smaller than the male. The animal feeds on fish (such as capelin, herring, cod) and crustaceans.

Newborn harp seals are 90-95 cm long and weigh 7-10 kg. The whitecoats are particularly helpless and vulnerable during the first days of their life. Their mortality is frequently high, especially if they happen to fall into water, for example because of bad weather or ice movements. They may be exposed also to predation by polar bears, or to lack of food, etc.

The suckling period is short, only 8-12 days. Seal milk has a fat content of 40-50% and a protein content of about 10%. At the end of the suckling period, the young may weigh up to 35 kg, with a subcutaneous blubber layer of about 5 cm.

The harp seal reaches sexual maturity at an age of 4-5 years. Mating takes place immediately after the end of a suckling period. Pregnancy lasts about 7 months. A female can have one young annually. It gives birth to its young on the ice on large whelping grounds; on the East Ice (the White and Barents seas) in February-March, and on the West Ice (areas around Jan Mayen Island) in March-April. The life-span of the harp seal is reported to be about 30 years.

Hooded seal

The species occurs from New Foundland/Baffin Bay to Jan Mayen Island. It is found in small numbers at Spitsbergen and in the Barents Sea.

The young seal (*blueback*) has a bluish-gray back and a creamy yellow belly. The subadult hooded seal has a rather grayish-black back and a gray belly. The adult seals are gray with larger and smaller black spots. The male has an inflatable skin fold on its head, which it can inflate to twice the size of a football, so that it covers its entire nose and face. The male is also able to inflate its nasal septum and blow it out like a red balloon through one nostril .

Unlike other Norwegian seal species, the hooded seal is frequently seen resting high above the water surface on small icebergs. An adult male reaches a length of 2.5-3 m and weighs over 400 kg. The female is smaller at 150-350 kg.

Newborn hooded seals are about 1 m long, weigh 15-20 kg, and are equipped from birth with an about 2 cm thick blubber layer. The young are born with a woolly coat for swimming. The suckling period is 3-4 days. The young seals are reported to be able to grow at the rate of 7-8 kg per day, while the female may lose as much as 70 kg during the same period. At an age of only 2-3 weeks, the young are good swimmers.

The male hooded seal reaches sexual maturity at an age of 4-6 years and the female at 3-4 years. Mating takes place 10 days after pupping, the pregnancy is 11.5 months long, and usually there is one pup. The pupping takes place in four established areas each year in March-April; three of the areas are west of Greenland and one around Jan Mayen Island (the West Ice).

The hooded seal feeds mainly on deep-sea fish, squid and shrimp. It may reach an age of 35 years. It lives on drifting ice and undertakes extensive migrations both singly and in small herds.

Diseases of seals

Bacteria

A large number of the diseases found in seals are connected with bacterial infections. These can be *primary infections,* and they may lead, among other things, to pneumonias, gastroenteritises, and septicemias, or they may be *secondary infections,* for example of skin.

It was not unusual earlier that sealers developed a swollen finger and corresponding swollen lymph nodes (blubber finger). It was known already at that time that this was bacterial. The causing agent is assumed to have been *Erysepelothrix rhusiopathiae.*

Eye diseases are not uncommon, neither are dental diseases with abscess formation, particularly among walruses.

Among young seals, primary causes of death include pneumonia, traumas and peritonitis. Pneumonias in wild seals are frequently connected with lungworm infections.

Salmonellosis and leptospirosis are not uncommon among some seal species on the US westcoast (1). In the wild, seals have also been known to suffer from botulism.

NMT [?] conducted in 1991 in Tromso a study of pathogens in the seal gut. It is almost impossible to avoid cross-contamination of meat during onboard processing. Tests were done for *Salmonella spp., Yersinia enterocolitica and Listeria monocytogenes.* A total of 174 samples collected from four different sealing boats were examined. *No positive finds* were made.

Viruses

Several types of viruses have been isolated from seals. Mortality has been caused especially by infections by herpes, influenza A, and morbilli-viruses. The seal epizootic occurring in harbor seals in European waters in 1988 and killing almost 18 000 animals, was a morbilli-virus infection. (1)

Fungi

Fungi are isolated mostly from seals kept in zoos. Candida albicans dominates among the fungi.

Parasites

A number of parasites have been isolated from seals. *Trichines* play an important role in meat control, and they have been encountered in *walrus, bearded seal* and *ringed seal.* (1)

Both the harp seal and the hooded seal were tested for trichines in the 1950s and in 1992, but the results were negative.

Insects

Among insects, especially lice - the seal lice - may cause problems for the seals.

Handling of meat

The meat that is intended for human consumption comes preferably from young animals. It usually consists of dorsal muscle, flipper and flank meat. Sealers avoid carcasses in a bad condition and animals with wound injuries/inflammations and/or other defects.

The time from killing/bleeding to skinning/carving varies from minutes to 3-4 hours. The carcasses may during this time period be piled up, which provides a good opportunity for external contamination with urine and faeces.

The steak-meat is cut out after the animal has been skinned. An effort is made to avoid puncturing the body cavities. To avoid/minimize contact with the deck, the meat pieces are laid out on the inside of the pelt before they are placed in baskets or bins.

The meat is cooled in seawater, preferably for 24 hours. It is then trimmed, wrapped in plastic, deep-frozen, and placed in the freezer room. Salting in barrels - particularly of flippers - has been common as well.

Seal meat is dark and bloody and has a characteristic odour.

As the main purpose of seal-hunting is not to obtain meat, the conditions onboard are not organized with the carcas work in mind. The space for processing/storing meat onboard is very limited. The skinning/steak-meat carving is done on cocos mats on the deck, which

becomes soiled with blood, urine and faeces, which may then contaminate the equipment, hands/gloves and tools.

No facility is in place for washing off the contaminants, for example by using seawater for rinsing the equipment, etc.

Inspection

As mentioned in the introduction, no legislated control exists for seal meat meant for the market. Seal meat is found on restaurant menus with increasing frequency. Mostly it is served salted, smoked, or as steaks or stewed meat.

The traditional method of preparing seal meat requires long cooking time, but the preparation methods change and so does the "guarantee" offered by heat-processing.

Butcher's shops are beginning to show interest in seal meat as well. It should be pointed out in this connection, that it has happened that seal meat has been sold as whale meat. Perceiving the difference between these two meat species is difficult. Now that the retail price for whale meat has increased to about NOK 200.00 per kg, the consumer has to be alert to the possibility of cheating.

Export

Seal meat and blubber were previously exported to Japan. A certificate issued by the Meat Inspectorate contained a confirmation guaranteeing that it was seal meat, the name of the sealing vessel, as well as information on the type of packing and possibly labelling and storage conditions.

Such a certificate is obviously of little value, but for the importing country/importer, the name, title and stamp were perhaps of the foremost importance.

Other uses

Meat left behind on the ice may prove to be nutritionally more valuable than previously assumed. The pharmaceutical industry is studying whale and seal oil, which are viewed by it as emerging health products. Research circles at Tromso have detected that seal oil has a very positive cardiovascular effect (Osterud, B.; pers. comm.).

However, at the moment we can only dimly perceive the outlines of the future uses of these oils.

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PHOTO CAPTIONS

A: Whale meat with visible but moderate marbling. According to the present whale-meat regulations, this is animal feed. There is nothing wrong with the meat itself, and it would be very well suited for example for grilling, steaks, etc. The Japanese would consider it a delicacy.

C: The meat surface is greenish yellow and discoloured due to oxidation, which has penetrated to a depth of about 1-1.5 cm. The age of the meat is less than one year. It is very much marbled and unfit even for East-Asian palates.