Chapter 10

# Post-Harvest Handling of Freshwater Crayfish: Techniques, Challenges and Opportunities

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Additional information is available at the end of the chapter

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**Abstract**

Development of post-harvest handling practices of crayfish in Fennoscandia has largely been based on their high value and has historical rationale. Crayfish were transported from Finland to St. Petersburg and Central European markets already in the early mid-1800s using rather sophisticated methods. Crayfish require cool and moist environment for stress minimisation and may easily be transported and stored to live out of water if these principles are followed. During post-harvest process, it is important to minimise handling of crayfish from the point traps which are pulled until crayfish are processed for food. Crayfish should be protected against the elements and stored in cool containers during on board and land transport, after initial sorting of the catch. In the holding depot, crayfish are normally sorted for the second time and then placed in holding facilities waiting for the transport to markets. Holding facilities could be tanks or more developed and cost-effective systems, such as CrayShower. This storage system is based on crayfish being stored out of water in moist environment. The main principles during post-harvest handling are to keep physical disturbances to the minimum and to provide cool and moist environment for crayfish.

**Keywords:** catch, stress, survival, mortality

## 1. Introduction

### 1.1. Crayfisheries and catch in the Fennoscandian countries: history and present time

Freshwater crayfish have since ages formed a crucial part in the Fennoscandian culture both economically and culturally [1–4]. Finnish tenant farmers used crayfish to fulfil their obligations

with their landlords, as part of their annual work quota which could be substituted by providing crayfish instead of labour [5]. This greatly helped since the kids could easily contribute to the well-being of the family by trapping the required crayfish. Since then, the productive wild stock of crayfish has allowed the purchase of the first work horses, bikes, mopeds, cars and even elevation of the standard of living in the Fennoscandian countryside [5–7].

During the turn of the 1900s, crayfish exports from Finland to St. Petersburg region peaked around 16 million individual crayfish [1, 6], and this trade has been claimed to have been a corner stone for even initiation of industrial-scale enterprises in Finland. There was also a trade of crayfish to both directions between Finland and Sweden, and this trade is claimed to have introduced crayfish plague (i.e., *Aphanomyces astaci*, the disease agent) into Sweden [4, 8]. Because of the nature of the Finnish and Swedish aquatic ecosystems, there have traditionally been only a limited number of Finns and Swedes not being aware of the noble crayfish and tradition of crayfish trapping. Well, the situation has changed dramatically recently.

Crayfish plague epidemics ended the golden age of the noble crayfish fishery and trade in Fennoscandia around 1910, after the first epidemics were observed in 1893 in Lake Saimaa in Finland and some 14 years later around Stockholm in Sweden [4–6]. Regardless, the tradition of trapping crayfish and selling them to be enjoyed during autumn crayfish parties is still strong. Catches are lower and prices are higher [1, 2], but there is still a strong demand for delicious freshwater crayfish in Finland and Sweden. Thus, the development of better means to ensure maximum catch is required, and post-harvest handling methods have improved.

Crayfish trapping and post-harvest handling of the catch are closely connected to conservation of valuable native crayfish stocks [3]. For crayfish trapper, it is of utmost importance to remember that crayfish, once taken out of the water and transported away from the trapping site, should never be put back to natural water bodies again. This is to ensure that crayfish would not be accidentally introduced to new water bodies and, more importantly, the diseases accompanying crayfish would not spread. The crayfish plague has been proven a big kill joy!

### 1.2. Value of crayfish

Freshwater crayfish have traditionally had a high commercial value in Europe [5, 6], which has encouraged trapping and trade of the valuable natural resource. Crayfish have even been used as an alternative for currency, which was greatly improving the standard of living especially in the countryside and among rural population in Finland and wider in Fennoscandia, too [6, 8]. The need to develop post-harvest handling practices surfaced early with holding of crayfish along water bodies in cages and transport over short or long distances in special crates. Especially in Finland, reaching the Russian and European markets [6] required gentle post-harvest handling of crayfish. These inventive systems could be afforded and applied due to value of crayfish catch.

As an example, during the turn of the twentieth century, crayfisherman could be payed from 1 to 2 Finnish penni for a crayfish, while an industrial workers' pay was from 3 to 4 Finnish markka per day [6]. Thus, a crayfisherman having access to a productive noble crayfish stock

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could easily earn equal to industrial worker's pay during crayfish trapping season. Later, for example, during the 1980s and 1990s, the monetary value of the freshwater crayfish in Finland was roughly a minimum of 10 FIM each, and the beach price has been during the 2000s roughly from 1.50 to 2 € per 10 cm TL noble crayfish [1]. As the trade is based on very basic capitalistic principle, the price has varied somewhat depending on supply and demand in addition to various sociological issues. In Sweden, the price is based on weight, not on individual crayfish. The beach price has ranged between 290 and 530 Swedish krona per kilo (i.e., about 30 and 55 €) for noble crayfish and between 105 and 220 Swedish krona (i.e., about 11 and 23 €) for signal crayfish. Thus, crayfish have traditionally been considered as delicacy, especially when catch has been low. The scenario has somewhat changed due to the introduction of signal crayfish into the wild in Fennoscandia, and the price for the signal crayfish has been lower than for the noble crayfish. Even with the lowered price for the signal crayfish, crayfish are still considered gourmet food for festivities [9].

### 1.3. Past aspects of freshwater crayfish post-harvest handling

It was a common knowledge right from the start of crayfish trade in Finland that crayfish survive out of water under certain conditions [6]. This allowed a lively trade of crayfish, as they could be transported for long distances. Crayfish were thus highly valued, as the rural population could exploit this natural resource, supply even Central European market, and greatly improve their living standards.

Traditionally, crayfish have been transported both on board and on land for long distances in Fennoscandia, with some of the crayfish been trapped in Häme County (Finland) and Stockholm County (Sweden) transported for markets of St. Petersburg, Hamburg and even Paris as early as 1910 [10, 11]. Even a narrow railroad track was built from Lake Erken to the coast for the sole purpose of transporting crayfish catch to be shipped further by boat to other cities in Sweden and the continent [11, 12]. It was discovered that crayfish can survive lengthy periods out of water, if kept under proper conditions and processed as soon as they reached their destination. Crayfish were also placed in submerged cages during the transport, if overnighting was required. This eased their transportation stress but also allowed a rapid spreading of the diseases [6] and also crayfish, as they sometimes escaped from the cages.

Crayfish have traditionally been first stored in wooden cages around the shores of the water bodies where they have been trapped [6]. The wholesalers have then been collecting the catch from crayfish trappers and transported them either to the local markets or further to export markets in baskets made from wood splints lined with moist moss. During transport, conditions might have worsened, especially temperature could have risen, and caused stress resulting in increased mortality. Until recently, crayfish have been stored under similar conditions during transport, i.e., open cardboard or plastic boxes or crates have been used with crayfish been covered with moist cloth or layer of the tree, for example, alder and branches [10].

Crayfish have been collected by the wholesalers to be marketed and held first in cages along the shoreline of the lakes and later in holding depot's tanks [6]. Due to aggression [13, 14], this communal holding could have resulted in losses, as crayfish might have been moulting in addition to aggressive behaviour caused by crowding.

The increased mortality has traditionally been largely accepted as part of the risks included in the transport of crayfish catch with little or no development of more suitable applications for transport. One of the reasons for the lack of development has been the fact that large proportion of crayfish catch in Fennoscandia has been trapped by recreational trappers working with small-scale catches and respecting traditional aspects of crayfish trapping [1].

## 2. Factors affecting post-harvest handling procedure

Stress is an individual's response to challenge, and if the condition is prolonged, it can affect the well-being of the individual crustacean [15, 16]. Any diversion from the optimum conditions can cause stress [17], and the avoidance of stress is essential for the best practices during post-harvest handling of crayfish, as stress causes losses among the catch both as elevated mortality and as quality of the individual crayfish. In addition to the normal maintenance of the well-being of animals, crayfisherman and wholesaler have to focus on maximum cost-effectiveness during trapping and post-harvest handling processes. The elevated individual mortality among the catch as such is a loss for crayfisherman, but it also is prone to create circumstances under which the overall well-being of the whole catch might be declining due to worsening of transport and holding conditions. Moribund and dead crayfish cause water quality problems especially when crayfish are held communally and they share the same water body. Furthermore, the price of crayfish, and thus crayfishermen's income, relies on the quality of the catch, which is largely based on the capability of crayfish to survive through the marketing chain to the consumers in prime condition.

Freshwater crayfish can survive out of water for long periods, even days [10, 18], which allows several options for both transport of the catch and holding for commercial purposes. The optimisation of the post-harvest handling conditions is essential in order to minimise handling stress and mortalities [19–22]. Crayfish should be handled as briefly and gently as possible, kept moist and cool all the time [16, 18].

Crayfish should remain in wet and cool transportation and handling environment throughout the post-harvest handling chain [10, 16]. The gill structure allows gas exchange as long as the surface layer of the gills remains moist, because, contrary to fish, the gill filaments do not collapse when not supported by the ambient water, thus allowing close to normal function even out of water. Cool conditions on the other hand minimise evaporation and lower metabolic rate, thus enabling resource allocation to prevent detrimental effects of the post-harvest handling stress.

The moisture level should be as close as possible to 100% humidity during every part of the post-harvest handling chain (e.g., Refs. [10, 23]). This enables gas exchange through gills and lowers stress, as crayfish would not be experiencing water loss through surface tissues. During the post-harvest handling, the ambient temperature should remain below 20°C, preferably even closer to 10°C, to slow down the metabolism of crayfish and to pacify them, as the transport mortality is prone to decrease with the lowering temperature. In addition, the temperature fluctuation should be kept minimal, since the temperature changes, especially rapid

and significant changes within the upper optimum limit, could be causing stress and require resources from crayfish [24]. The catch has to be protected against direct sunlight, as there are multiple effects of temperature elevation, evaporation and intensive light causing stress and worsening post-harvest handling conditions.

Air exposure during transport could cause severe dehydration, even though weight loss between 3.9 and 4.5% during transportation without any specific negative effects has been reported [23, 25]. Some of the water is lost from gill chambers, but also haemolymph has been suggested to dehydrate. The slight dehydration does not seem to cause elevated mortality, especially if the transported crayfish are later submerged.

Moulting causes a drop in the catch and affects the well-being of crayfish via physiological changes during post-harvest handling processes (e.g., Refs. [14, 26]), since crayfish would be more susceptible to stress close to a moult. Normally, there are at least two periods of moulting during trapping season in Fennoscandia, when commercial catch declines and the survival of crayfish declines, too. Both of these factors affect the economics of the trapping, and special care should be taken during the moult-related changes in the condition of crayfish. While handling, crayfish can be detected as newly moulted or approaching moult by the texture and hardness of the carapace. Dead or moribund crayfish could worsen the conditions for the surviving crayfish if held communally, due to possible damage of tissues and release of microorganisms. Post-harvest handling and transport of those crayfish close to the moult should thus be avoided.

Crayfish require shelter during both transport and holding. The availability of shelter pacifies crayfish and thus reduces stress [27]. Shelter also provides refugee during communal holding, when crayfish are held in tanks in the holding depots. Shelters can be designed to allow easy collection of crayfish from the tanks, since they tend to spend most of their time in shelters to avoid aggressive interactions with co-species and exposure to ambient conditions, such as light. Shelter during transport, on the other hand, is prone to reduce stress, as crayfish will be offered escape from light, dry conditions and elevated temperature.

Predatory pressure during communal holding can result in both excess mortality and aggressive behaviour [13]. During the growth season and if there are odd moulting events in the holding tanks, the mortality can be elevated and decaying crayfish affect the water quality in the tanks negatively. This can be avoided by storing crayfish in low densities, sorting of the catch by size and providing adequate shelter in the tanks. All of these methods may be costly and thus recommended only if the tank holding of crayfish is the only option available. On the other hand, sorting of the catch for commercial purposes, for example, by size, could later decrease the need for handling prior to transit to markets and thus would be a benefit.

Harvesting practices should be planned in order to minimise stress of the market quality crayfish [16], as well as those to be returned back to water as belonging to side catch. The commercial proportion of the catch has to be transported to markets in premium condition, and this part of the catch should experience minimal stress. Crayfish from the side catch should not be excessively stressed by the process being caused by pulling of traps and sorting of catch, thus increasing their chances to survive and grow to commercial size. Practices on board and during

transport dictate the fate of the commercial catch, as stress is prone to cumulate and initiation of the stress can be a point of no return resulting in increased mortality during post-harvest handling. Thus, commercial part of the catch is the main priority and should be handled first, while crayfishermen should remember that side catch crayfish are future commercial catch.

Exposure to adverse elements, causing stress, is the main cause of losses during post-harvest handling of crayfish. There are several individual factors stressing crayfish, in addition to the main ones discussed here. Furthermore, the combination of different stressors can be detrimental. Thus, focusing on minimisation of stress of any kind and combination is crucial.

## 3. Boat transfer: from the traps to the shore

### 3.1. General handling of crayfish after traps have been pulled

The general rule is that the handling of crayfish should be kept to the minimum after the traps have been pulled. Crayfish should also experience minimum exposure to the elements while on board, as both of these cause stress to crayfish and can result in losses during boat transport and afterwards. The moment when the traps are pulled is crucial, because handling of crayfish at this point of time reflects to their future stamina and thus also survival (e.g., Ref. [16]). The process of handling and transport is prone to cause stress regardless of crayfish trappers' handling and management practices, but the level of disturbance can be controlled and stress minimised by following best practice of post-harvest handling. This point of stress initiation is thus crucial, and it cannot be overly emphasised that the fate of the catch is set at this point of time.

Crayfish should be sorted and stored according to the marketing criteria right after the traps have been pulled. Normally, the catch is sorted according to the size and general appearance. Those crayfish targeted for the further post-harvest handling and finally the commercial market should be stored according to standards aimed for the minimisation of stress immediately after sorting [28].

If the catch has to be stored any lengths of time exposed to sun, wind or dry air, crayfish have to be kept moist and as cool as the conditions on board allow [16]. Conditions on board should allow storing crayfish in the final transport conditions immediately. Crayfish can be sprayed with water, if kept in open containers, as the sprayed water improves holding conditions and could decrease temperature for the catch.

The key principle of crayfish handling after the traps have been pulled is to minimise handling time in order to avoid stress.

### 3.2. Sorting of crayfish on board

Sorting of the catch on board has become a routine among some of the commercial crayfish trappers in Fennoscandia (**Figure 1**). This allows for minimising handling-related stress for the commercial catch. In the optimum case, crayfish could then be handled next time in the holding depot during a more detailed, additional sorting.

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**Figure 1.** Sorting of crayfish catch on board according to commercial and side catch criteria. White crates with partial lids for the commercial catch and grey crate for temporary holding of the side catch.

Crayfish catch can be sorted by size, by appearance, by sex and sometimes even by species [29]. Quite often, if the catch is sorted on board, only a rough sorting to potential commercial catch and those crayfish to be released is carried out. In Sweden, specific grid systems for automatic sorting of crayfish catch by size have been utilised (**Figure 2**). The sorting is happening after a

**Figure 2.** Sorting of crayfish catch on board by size. A system of a grid with expanding distances of metal bars allows crayfish to be sorted by size as they slide on the grids. Photo by MSc Fredrik Engdalh (SLU Aqua, Sweden).

set of traps is pulled, depending on crayfish trapping practice of individual crayfishermen. An advanced commercial crayfish trapper could have from 10 to 20 traps in one set of traps, joined by a long line. This set of traps is then pulled and emptied, rebaited and set back, before crayfisherman sorts the catch. With a deckhand, sorting could happen when the traps are pulled, and thus the time the catch is exposed to the elements is minimised; such practice would also minimise the stress. The sorted catch is then stored appropriately to allow stress-free on board transport.

### 3.3. Holding conditions during boat transport

It is essential to provide cool, moist and shady conditions for the boat-transported crayfish, with special care to avoid exposure to sun [17]. As crayfish will be experiencing some form of unavoidable physical disturbance, i.e., shaking of the boat due to waves and general movement around a lake or river, other forms of stress have to be minimised.

Crayfish tend to go passive with lowering of the temperature. It is preferential to provide stable conditions during transport, and for this purpose, a simple environment within cooled foam container, i.e., esky or foam box for fish, has shown to be optimal [10, 23] and is commonly used both in Sweden and Finland (**Figure 3**). The instant cooling of crayfish under conditions, which also provide immobilisation and moisture, has shown to decrease stress [16, 28] and minimise mortalities even during prolonged transport.

**Figure 3.** Crayfish transported on board in foam boxes with cooling and moisture provided.

The foam boxes are inexpensive, provide efficient insulation and are easy to handle. Cooling units are placed on the bottom of the foam box, then a plastic or rubber grid is placed on the cooling units to prevent crayfish from frostbites and crayfish are placed inside a plastic bag to ensure proper moisture level and to prevent evaporation and sun exposure during handling on the catch (**Figure 4**). This method has been shown to minimise mortality during transport [10] with cool and passive crayfish being easy to handle later, too, if needed.

Ventilation of the transport boxes and containers is not needed [30], since there is plenty of oxygen in the air and gas exchange does not elevate the metabolic gas levels to those causing stress to crayfish. The ventilation holes could actually worsen the conditions inside the transport containers, as ventilation could increase the temperature inside the box and lower moisture level, too.

Crayfish can be transported on board in plain plastic containers, while this normally does not allow proper cooling and exposes crayfish to the elements. For short on board transport distances and weather conditions not challenging crayfish, this very basic method could be sufficient. A moist fabric on top of crayfish would then allow for shade, some cooling and moisture. These rather hardy plastic containers are sold in local supermarkets, and they can be durable, thus their popularity.

An on board CrayShower application has also been tried by the Lake Saimaa crayfishermen (**Figure 5**). The system is based on constant watering of the catch using fresh surface water from the lake. The CrayShower application requires outside energy source for pumping of the water and is dependent of the surface water temperature. The system works efficiently providing that at least the water temperature remains low, below 20°C, although during hot periods in summer, the sprayed water does not provide sufficient cooling.

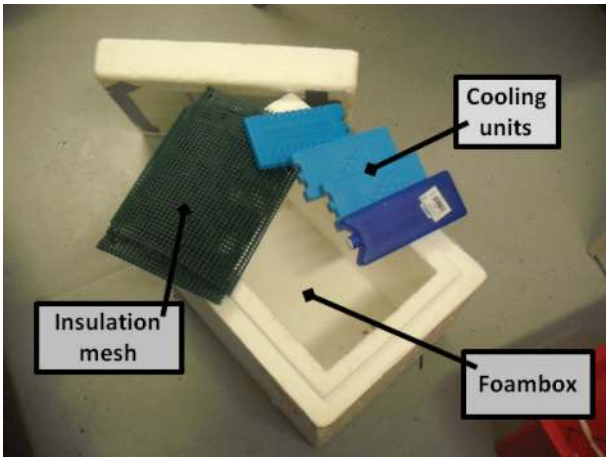


**Figure 4.** A simple and cost-efficient method for transporting crayfish on board and on land [10] with explanation on different parts inside the cooling box (an additional large plastic bag needed for protection of crayfish).

**Figure 5.** CrayShower on board transport application. This system uses lake surface water, thus not suitable during warmest summer days.

## 4. Land transfer: from the shore to the holding depot

The transport on land should also be planned to minimise stressful conditions and rough handling of the catch. Especially during warm summer months, it could easily happen that the conditions get worse, i.e., warmer, during the land transport. Again, it would be beneficial if the number of different handling phases of the transported crayfish could be kept to a minimum and thus disturbance from handling of the catch, too. Crucial for stress minimisation is that crayfish are immobilised and thus do not react easily to gentle handling.

It would be beneficial to use the same containers on board of the boat and during land transport. This would be in line with the demand for minimal handling. It would also be beneficial if specific containers with cooling and immobilisation of the catch have been used on board.

During land transport, the catch has to be protected against heat, evaporation and excess light. Normally, the catch is taken from the boat directly to the transport vehicle, which could be a trailer or a truck. The trailer should have a cover to allow for proper protection. A truck could also be equipped with cooling system [16, 31], which would further improve transport conditions. Regardless of the transport method on land, the containers where the catch is held have to be secured to prevent excess shaking.

It would be preferential to allow the catch to remain in their original containers, untouched, until the holding depot is reached and further processing of the catch is taking place [10]. Even

at this point, the catch should be handled gently to avoid activating individual crayfish, which may cause aggressive behaviour and harm to the less aggressive crayfish in the catch.

## 5. Holding of crayfish: simple is beautiful

Conditions at holding depot have to be planned to minimise handling of crayfish and thus to minimise stress at this point, too. Once again, the less crayfish have to be handled, the better. The attempt is to explore the markets to ensure that the catch can be sorted and stored under conditions, which allow minimal handling when preparing crayfish for transport to markets or next level of wholesalers.

Normally, the catch has to be sorted according to the market demand at the holding depot. The standard criteria for sorting include variables such as size, intact claws and visible trauma [29]. The first sorting on board or during trap pulling rids the most obvious substandard crayfish, but depending on the conditions and handling routine, another sorting may be required. The sorted crayfish will then be stored in separate, graded as per different orders or quality standards. Again, the sorting has to be carried out with minimal stress for crayfish, since they have already experienced stressful conditions during transport.

Crayfish have traditionally been held in tanks in the holding depot with basic freshwater crayfish aquaculture principles applied regarding conditions [14]. The communal holding of crayfish requires good conditions, as the method itself is prone to cause stress [32]. The water quality has to be optimal and water temperature low to minimise mortality during holding, due to the risk of worsening conditions resulting in elevated or mass mortalities.

Normally, the tanks are simple, and no hides are provided to allow proper water flow in all parts of the tank and to enable efficient cleaning of wastes [14, 16]. Quite often tanks are covered to allow shade for crayfish. Water level can be low, less than 20 cm, but the water exchange has to be high to ensure optimum water quality. Due to the aggressive nature of crayfish, cannibalism is commonplace even if crayfish are being fed.

During the growth season, mortalities in the holding depots can be high due to problems caused by the physiological changes related to moulting. Normally, there are periods during crayfish season, when crayfish do not survive stressful conditions of holding due to proximity of moult, either premoult or post-moult [14]. These losses could cause problems in addition to holding conditions, i.e., lowered water quality in tanks or aggressive behaviour of other crayfish may elevate mortality of the most vulnerable crayfish. Crayfish in this physiological stage should not be taken into holding facilities.

A novel method for holding of crayfish for longer periods of time, called CrayShower, was first developed on Western Australia by Marron Farmer's Association during the 1990s. The method is based on combination of minimum water usage and cool temperature. Crayfish are held out water in misty air and cool temperature conditions in plastic containers for periods from days to several weeks. The method has been recently further developed in Finland and is currently used by some commercial crayfish trappers and traders (**Figure 6**) [33].

**Figure 6.** CrayShower with stacked plastic containers for holding of crayfish and a close-up of the water sprinkler system (small picture).

Crayfish can be held under these conditions for several months without significant losses in the number or quality of crayfish. Tasting tests indicated that crayfish held for 9 months in the CrayShower were of equal quality (test and texture of flesh) compared to those been held in tanks and given food for the same period. The survival among the CrayShower-held crayfish was significantly higher and stable throughout the holding period than tank-held crayfish. Thus, the CrayShower system, being slightly more expensive to build, would be more economical to utilise than the conventional holding in tanks. The benefits of the CrayShower would be less water utilised, higher survival of crayfish and decrease in workload.

The commercial value of crayfish benefits from purging [14], which normally means gut evacuation and maybe general cleaning of the carapace from loose debris and solid particles. During communal holding in tanks, with the catch fully submerged, gut evacuation happens normally within 24 hours, depending on the water temperature in the holding tanks [34]. This excrete also affects water quality, and holding tanks require constant water exchange. In CrayShower, the gut evacuation can take up to 2 weeks [35]. Gut evacuation improves crayfish survival during further transport to markets, and it makes crayfish more desirable gourmet food when processed and served, for obvious reasons.

Some crayfish wholesalers or processers demand clean crayfish, i.e., free of solid particle matter or discoloration, which might require cleaning of crayfish or sorting the catch by cleanliness. Normally, crayfish collect dirt on the carapace and become exceedingly dirty towards the end

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of the moult cycle especially late in the trapping season or when water temperatures remain low and moulting is infrequent. During warm summers or generally warm conditions with frequent moulting, on the other hand, crayfish are normally clean and, when cooked, display a nicely even red colour with no discoloration.

Crayfish should be gently packed in specific foam boxes for the transport to the markets [23]. There should not be more than two layers of crayfish with moisture and cooling provided inside the foam box. Quite often, shallow foam boxes with less than 15 cm in height, which are routinely used in fish transport, are convenient as they can be stacked easily or can be equipped with lids (**Figure 7**). No more than two layers of crayfish inside the box ensures that crayfish can be moving around, if needed, and the pressure from crayfish would not create circumstances which would suffocate those crayfish on the bottom. Cooling can be provided in the form of ice on the bottom of the foam boxes or cooling units [10], as long as it is ensured that crayfish would not be in direct contact with frozen solid items. It should be taken care of that the water level inside the foam box is low so that crayfish are not submerged and thus capable of gas exchange during transport. There is no need for ventilation holes in the foam box, as there is always enough oxygen in the air for crayfish and the content of metabolic gases created by gas exchange does not reach levels harmful for crayfish. The ventilation actually worsens the conditions during the transport, because it may cause elevation of the temperature due to loss of insulation and it may result in loss of moisture.

**Figure 7.** An example of the foam boxes suitable for the transport of crayfish on land. The corrugated bottom structure allows for maintaining moist conditions without crayfish being submerged.

## 6. Code of practice: a case study

We will present here a synopsis of the post-harvest handling code of practice for freshwater crayfish. This is based on this short overview with detailed background information given in the above chapters. These basic principles allow for maximum number of crayfish reaching markets. These principles can easily be applied to recreational trapping practices, too. We will not go into exhausting details here in order to allow for imaginative application of the recommendations. The following basic actions should ensure minimum stress for the catch and maximum benefit for crayfish trapper:

1. Sort crayfish on board according to the commercial requirements, and store them in cool environment, away from the elements, as soon as the traps have been pulled.
2. Aim for minimal handling of crayfish both initially and throughout the post-harvest processes.
3. Allow the crayfish transport conditions with a steady moist and cool environment and total isolation from the outside elements.
4. During the boat and road transport, ensure minimum changes in the ambient conditions and a low level of physical disturbance.
5. In the holding depots:
    a. Provide either cool water tanks with shade or specific holding conditions, such as CrayShower or similar. If stored for longer periods in tanks, provide hides and ensure sufficient water exchange.
    b. Sort crayfish according to the market requirements before putting them into the storage systems to avoid repeated handling.
6. Pack crayfish in shallow foam boxes for transport to markets, with cooling and moisture provided.
7. Throughout all stages of the post-harvest handling, remove weak, moribund and dead crayfish from the stock immediately.

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