

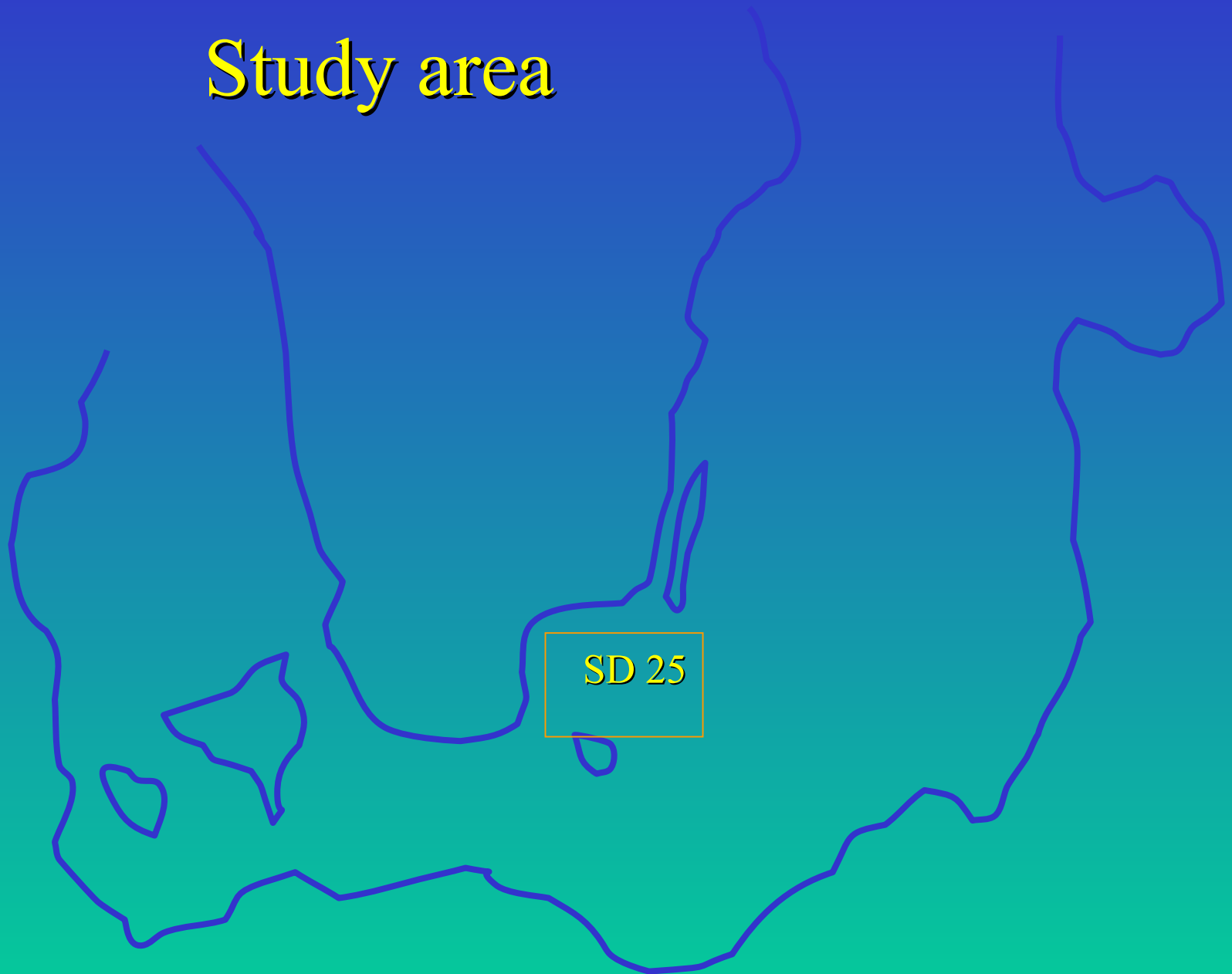
Assessment of mortality of Baltic cod that escape from trawl codend under commercial fishing conditions

Petri Suuronen, Esa Lehtonen, Mika Kurkilahti
Finnish Game and Fisheries Research Institute

Material and methods

- 30 trawl tows were conducted in 1997-98 in the Baltic to measure mortality of cod that escape through meshes of three codend types.
- All tows were carried out on a commercial trawler on commercial fishing grounds.
- Mean tow duration was ca 3 hours.
- Escapees were collected during the last 20 minutes of each haul.
- Caging duration ranged from 5 to 14 days.
- All dead escapees were daily removed from the cage by divers

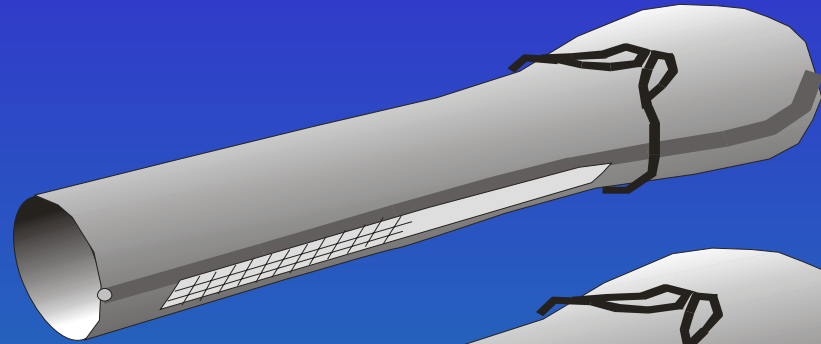
Study area



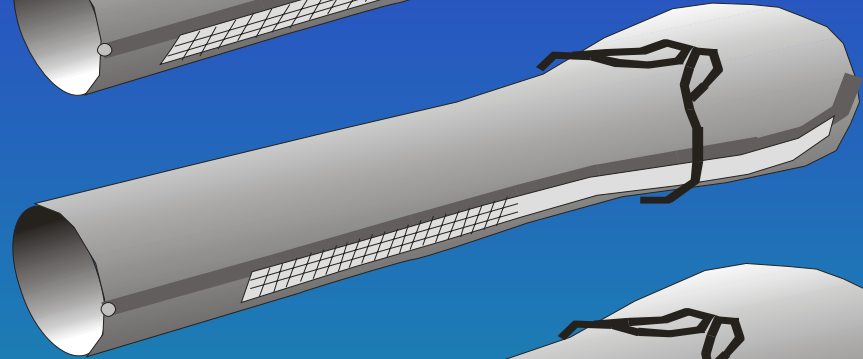
Experimental codends

- Danish type (old version) of 105 mm PET exit window codend (E105) : **14 tows**
- Standard 120 mm diamond mesh codend (D120): **12 tows**
- 105 mm square mesh Ultra-Cross top panel codend (UCTP105 **Bacoma-window**) : **4 tows**

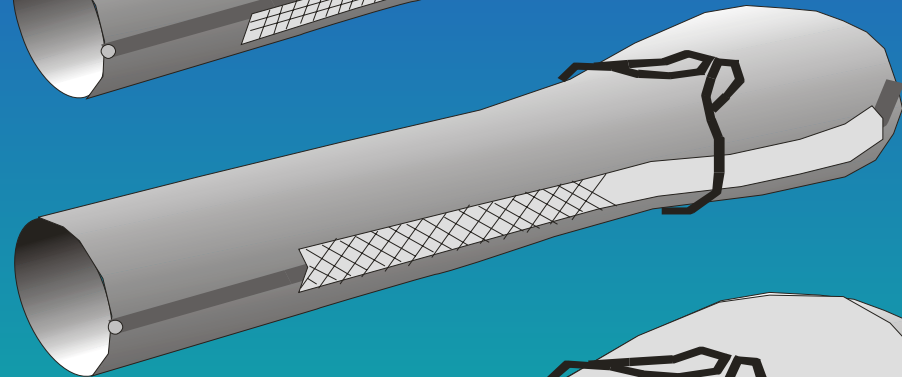
Danish (old)
2 side panels



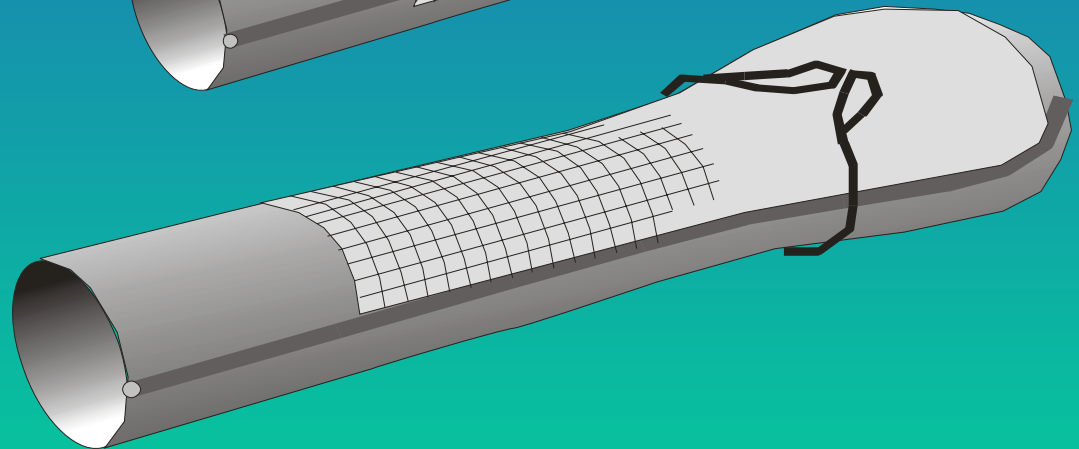
Danish (new)
2 side panels



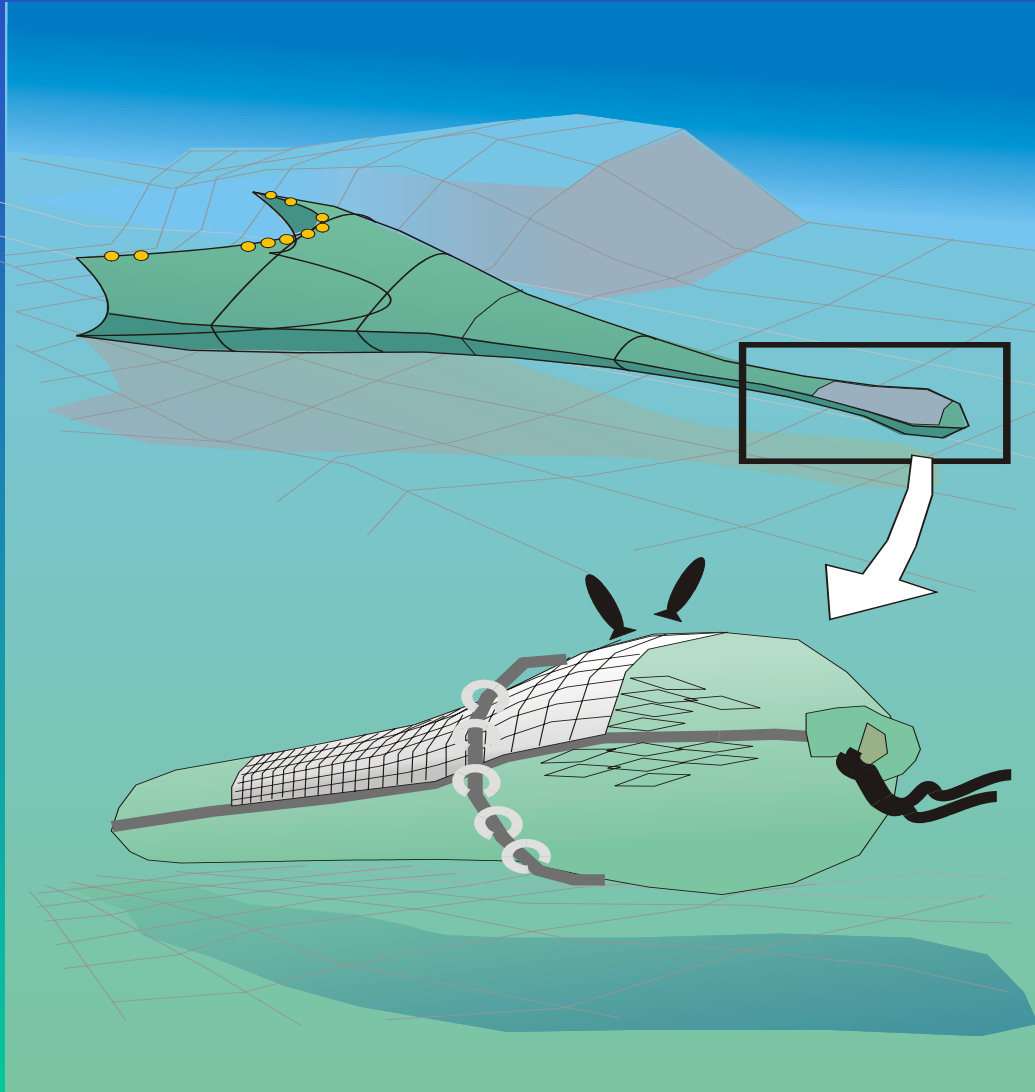
Swedish
2 side panels



BACOMA
1 top panel



Bacoma square mesh panel



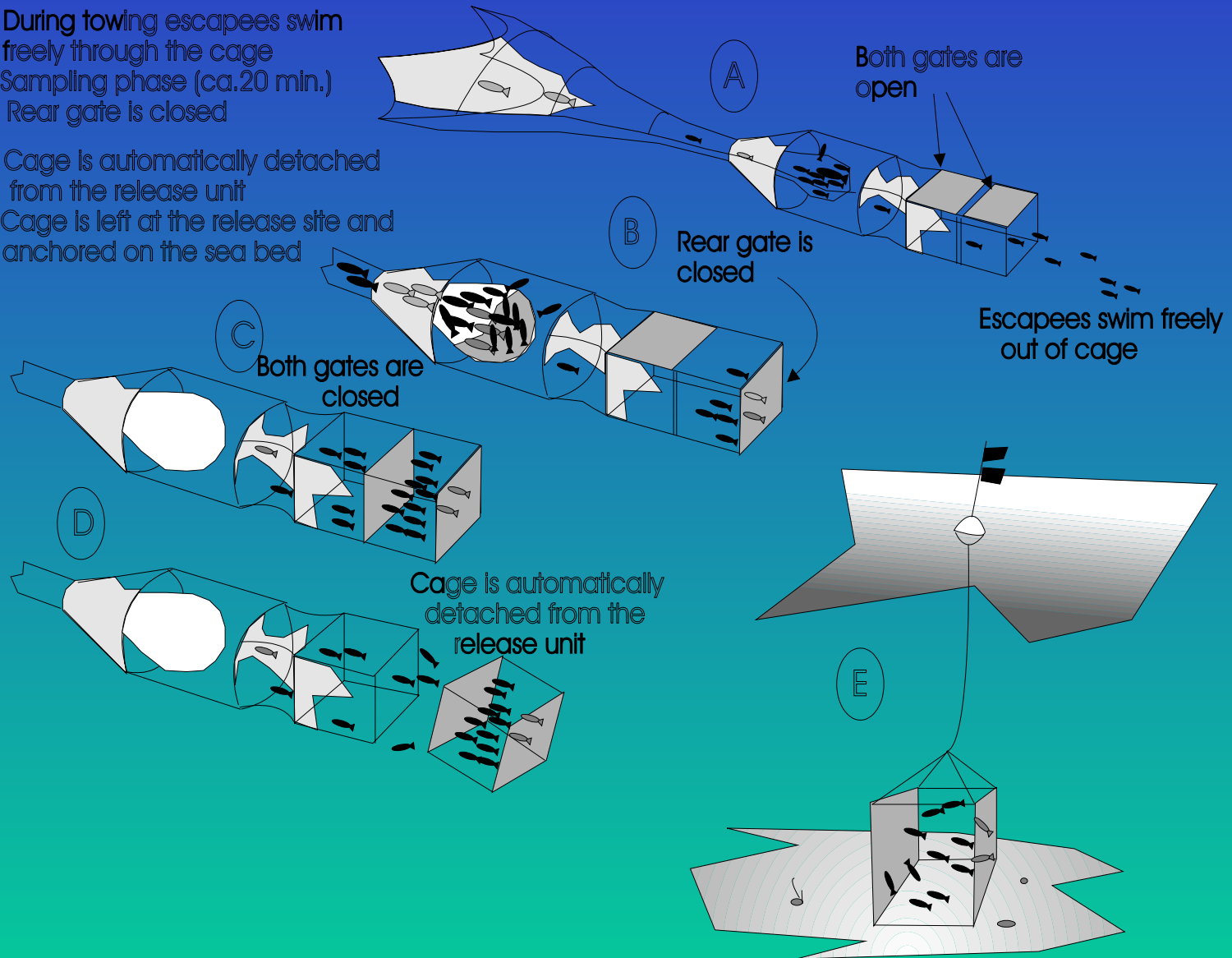
A. During towing escapees swim freely through the cage

B. Sampling phase (ca. 20 min.)

C. Rear gate is closed

D. Cage is automatically detached from the release unit

E. Cage is left at the release site and anchored on the sea bed



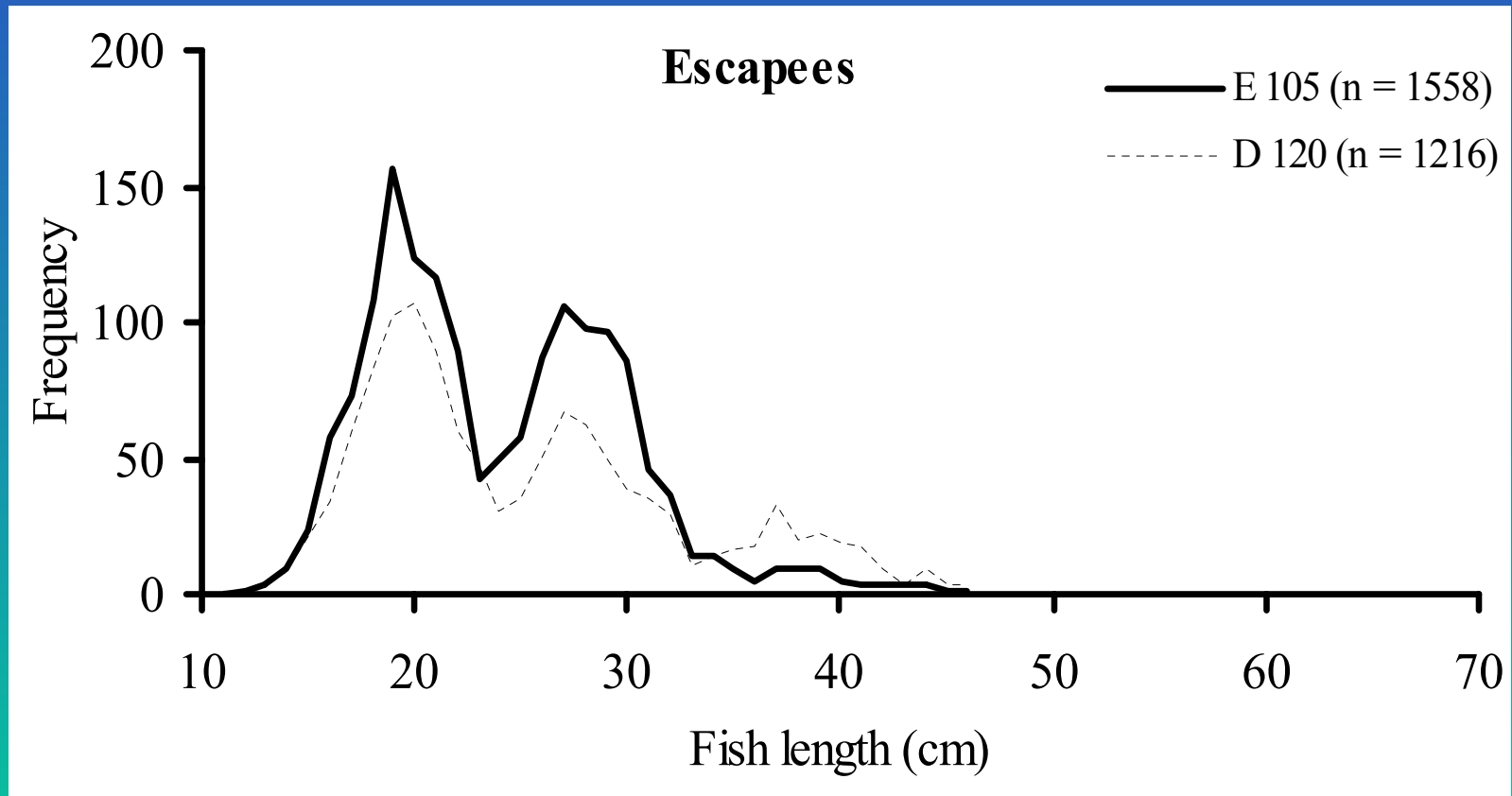
Controls

- In 1997, eel-traps, hand-lining and bottom gillnetting were used but found insufficient.
- In August 1998 control fish were successfully caught with small sea-bed anchored two-chamber pots.
- In total 47 fish were caught with 10 pots and anchored in the vicinity of the cage site at the same depths as the trawling cages (25-30 m).
- These fish were held and monitored in the same area, depth, and temperature as the trawl escapees.

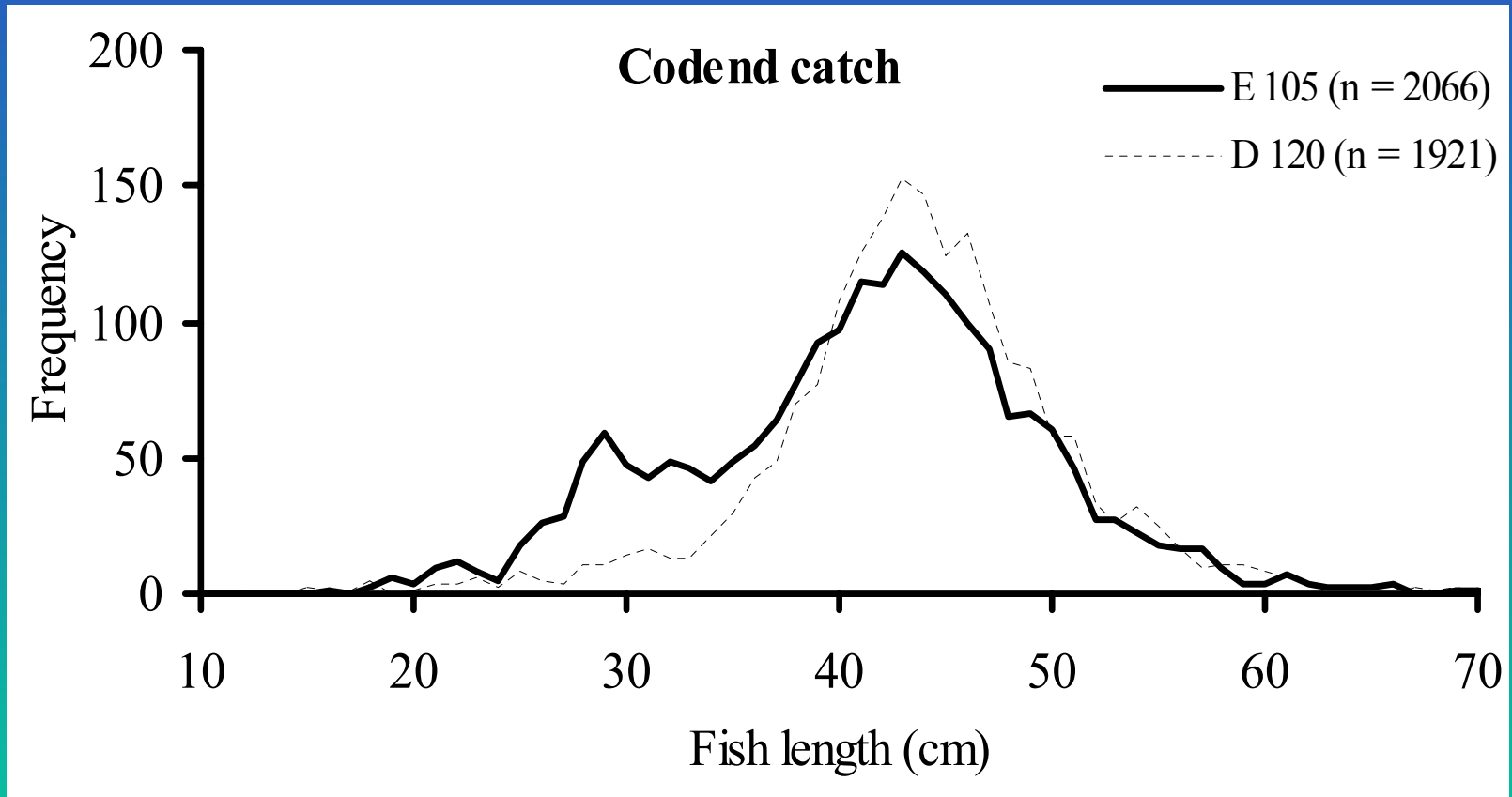
Assessment of skin injury in fish

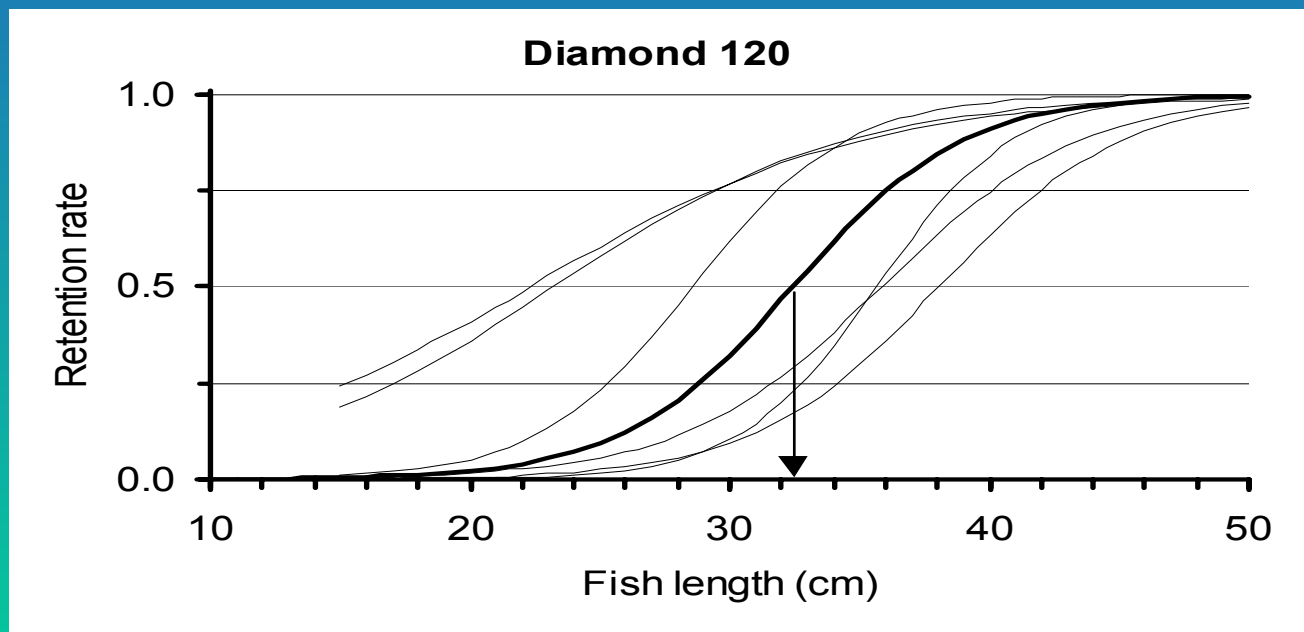
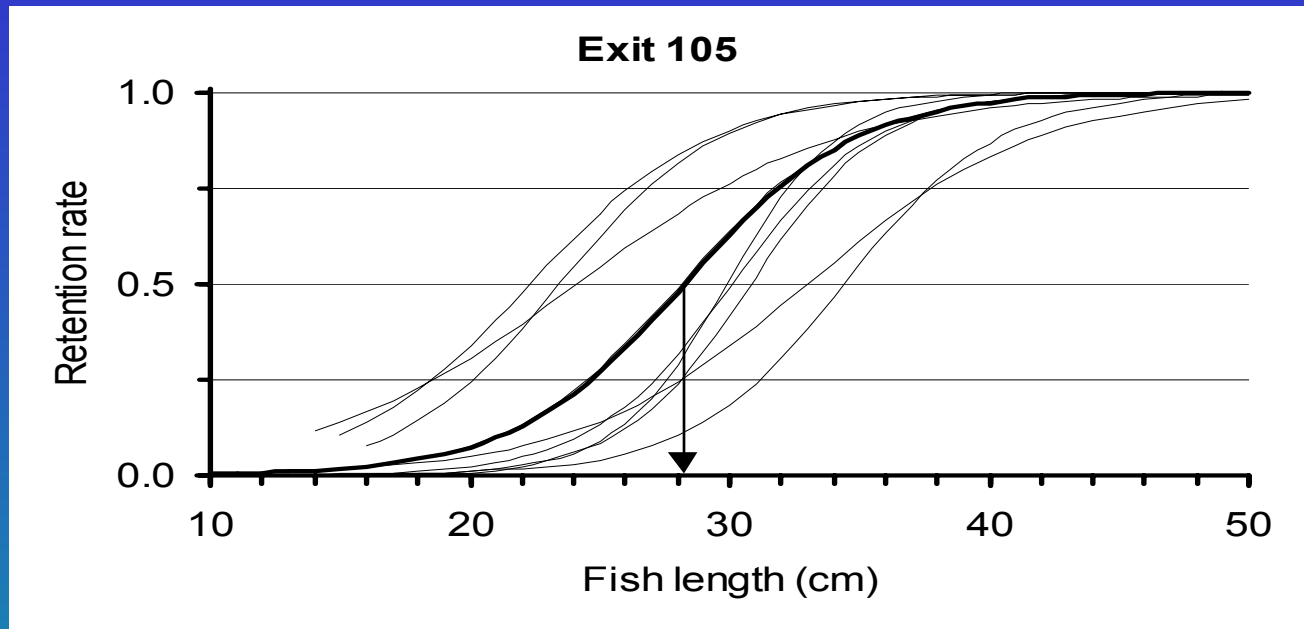
- Was conducted immediately after the fish were removed from the cage.
- Quick and careful handling: the additional injuries and damages were minimized.
- Three categories: scale loss, net marks and lesions.
- Recorded using photography and video camera.

Length frequency distributions of codend escapees (1997 data)



Length frequency distributions of codend catch (1997 data)





Main Results

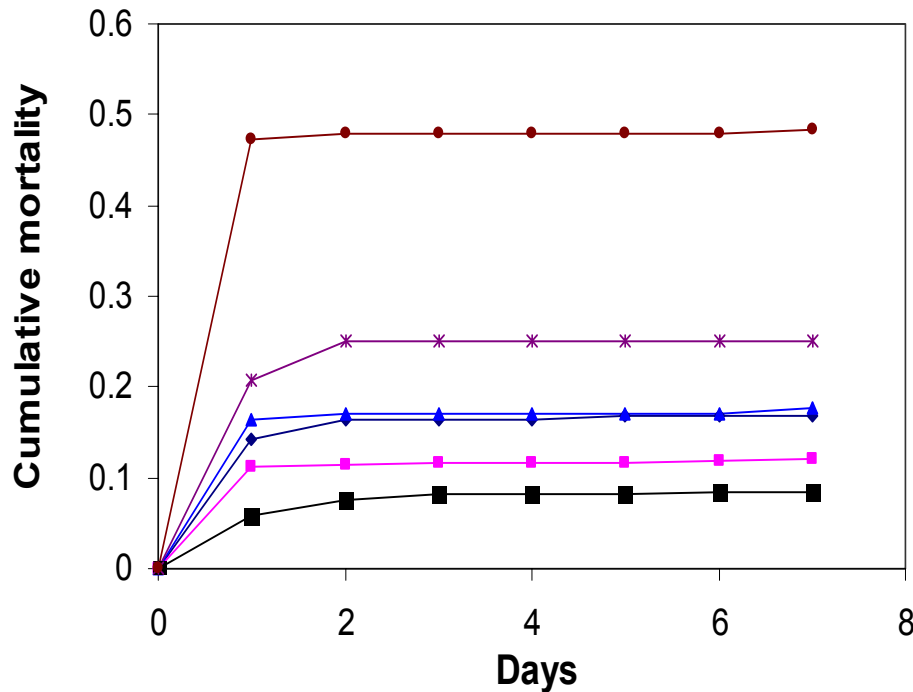
- Mortality was on average less than 3%.
- Relatively high mortalities were observed at high water temperatures ($>15^{\circ}\text{C}$).
- 92% of deaths occurred during the first day!
- An increase in water temperature by one degree Celsius increased mortality rates by a factor of 1.7
- When water temperature decreased below 12°C the predicted mortality fell below 10% even for the smallest length classes.
- Below 8°C the predicted mortality was **less than 1%**.

- Generally, the mortality decreased with increasing fish length.
- On the other hand, the bigger the fish was, the more likely it was to suffer a skin injury.
- Water temperature had a strong positive association with scale loss probability.
- Fish escaping from conventional diamond mesh codend had a somewhat higher probability of injury than those escaping from the Danish exit window codend *but no difference in mortality was observed.*

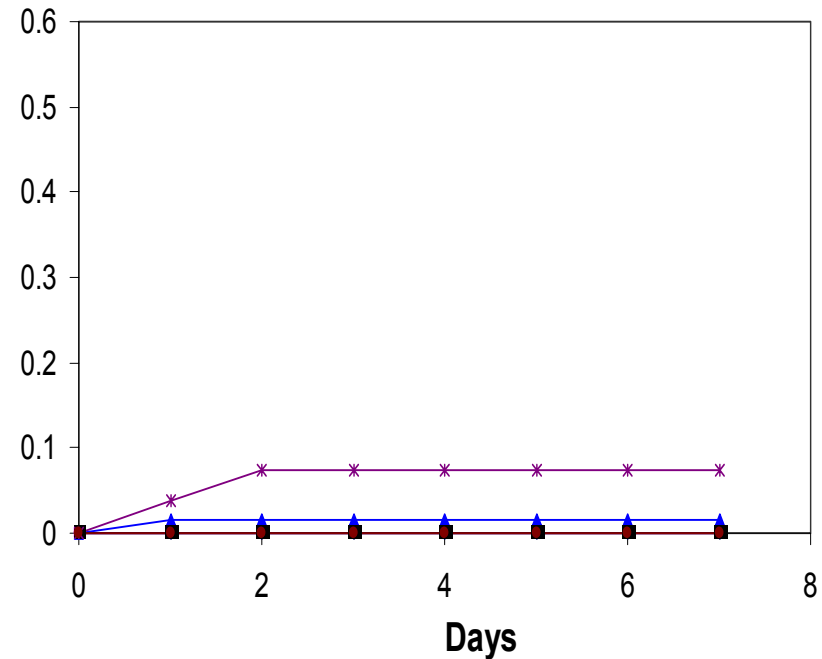
Cumulative Mortality

(Examples of tows)

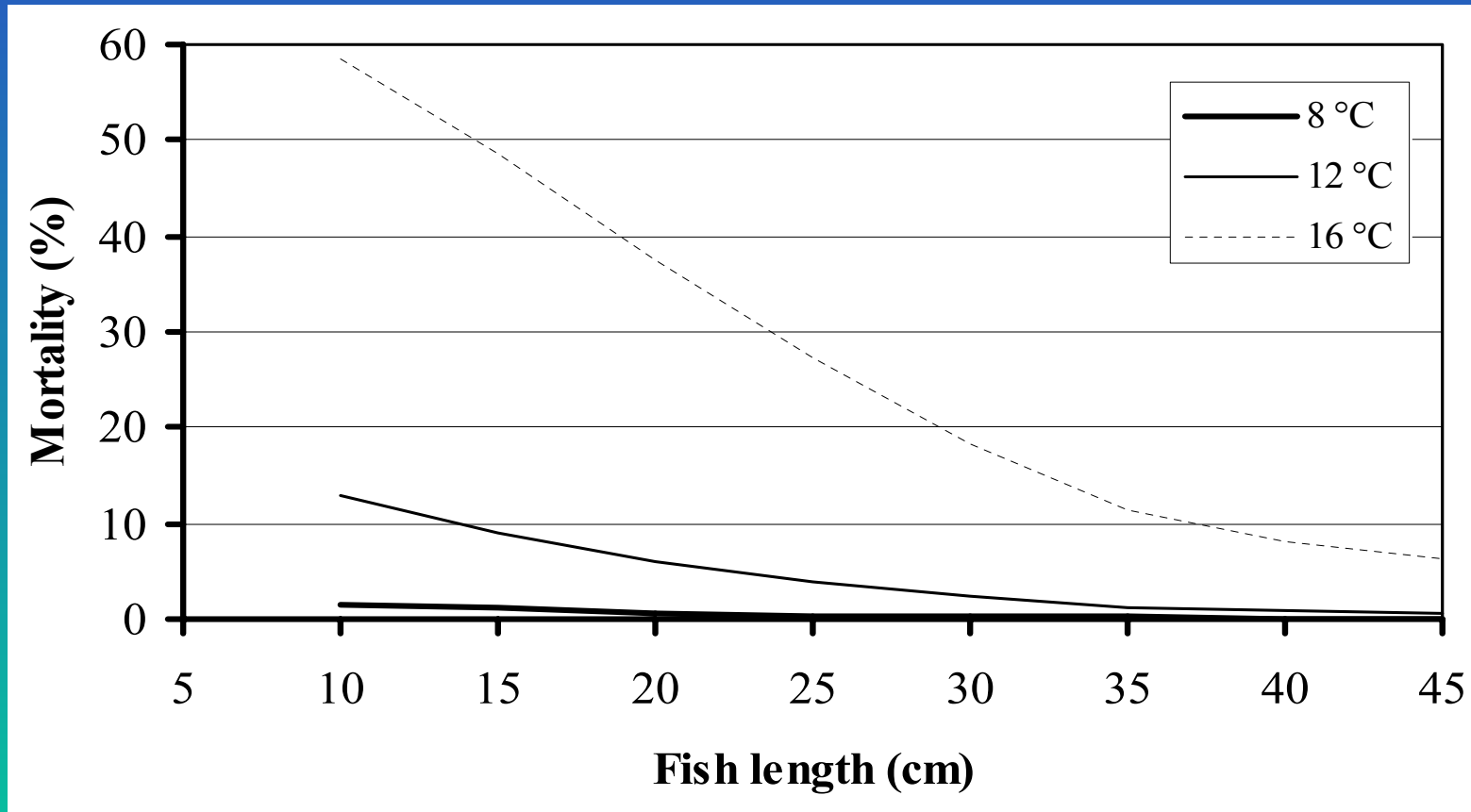
Water Temp > 15 °C



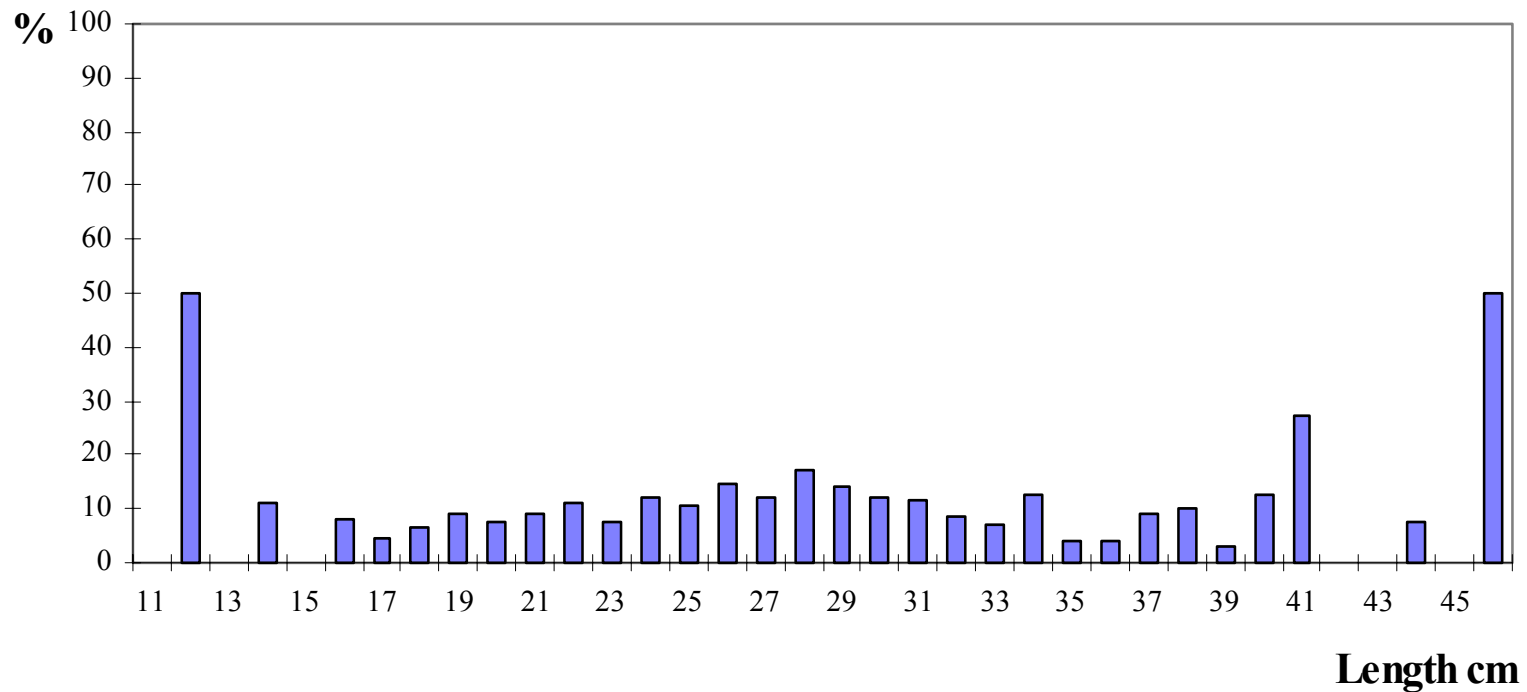
Water Temp < 8 °C



The effect of water temperature on fish mortality by size (1997 data)

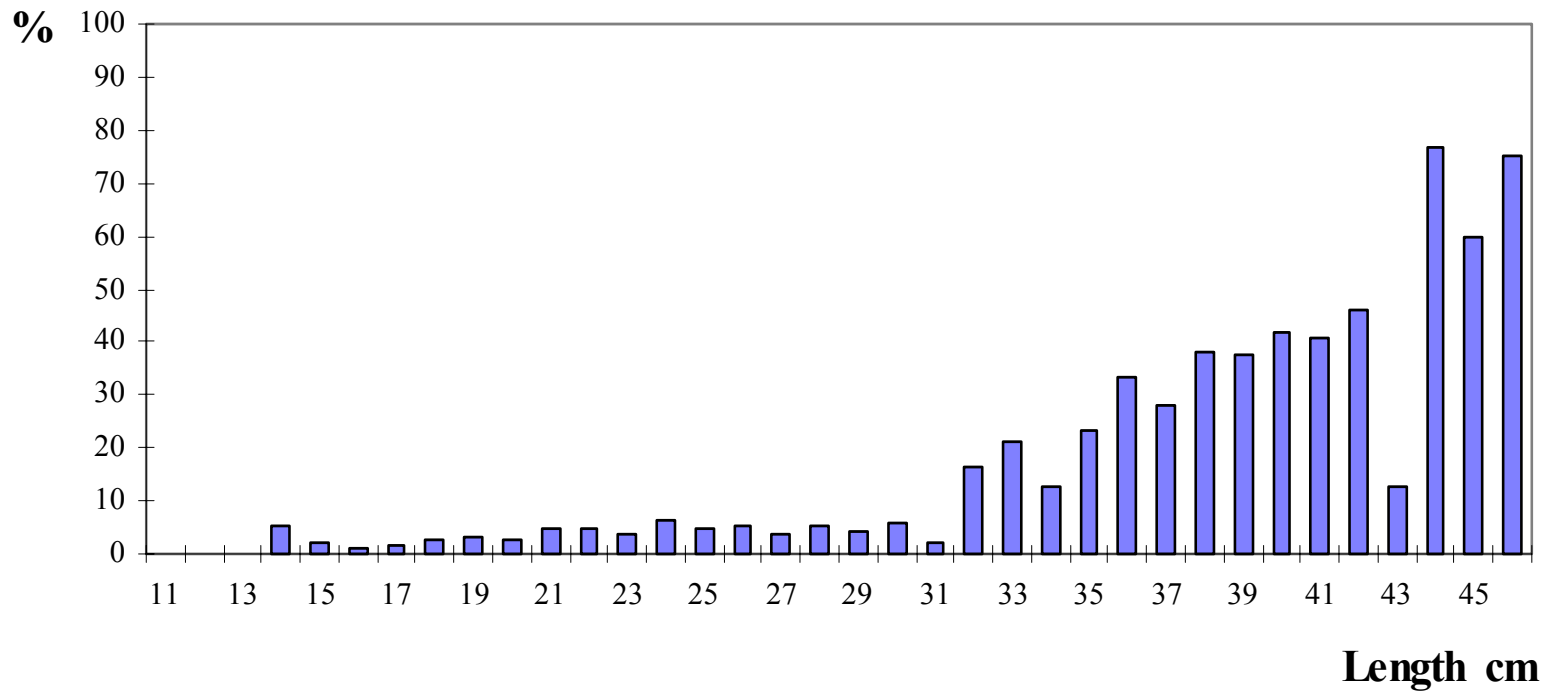


Occurrence of scale loss in codend escapees in 1997 data.



Occurrence of net marks in escapees in 1997

Net marks



Conclusions

- the results support earlier findings of high survival of cod escapees
- water temperature affected the mortality of escapees (this may be connected to the cage-method)
- in normal water temperatures (4-8 °C) low mortality can be expected
- factors other than codend type are important in determining injury and mortality of escapees
- no clear evidence of catch size effect
- survival of fish that escape near the water surface during trawl haul-back requires further work

- The 105 mm exit window codend was equipped with Danish-style 105 mm square mesh exit window panels (double 4-mm twisted PET knotted netting) on both sides of the codend.
- UCTP105 codend was made of a 105 mm standard codend that was equipped with a 105 mm square mesh Ultra-Cross top panel (black single 4.9 mm twine) attached 4 meshes in front of the codline (length of the panel was 60 meshes and width 24 meshes).

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