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SIMULATED GEAR INJURIES ON COD AND HADDOCK, a tank experiment

by
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INTRODUCTION

During the autumn 1988 a small scale experiment was carried out to study the effect of gear induced skin damage on saithe survival rate (Engås et al. 1989). An increasing long term mortality starting about one week after treatment was found. During trawling, however, fish are exposed to different stress factors, which alone or in combination with physical damage may affect the survival rate. To study the effect of high swimming activity combined with physical damage on the survival rate, a tank experiment with cod and haddock was carried out in spring 1989.

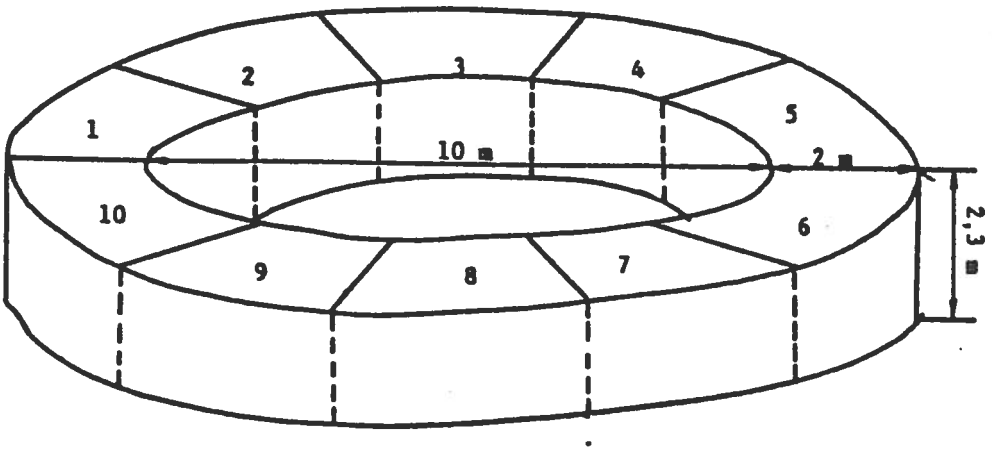


Fig. 1. The experiment tank.

MATERIALS AND METHODS

35 haddock (Melanogrammus aeglefinus) caught on longline outside Bergen and 80 cod (Gadus morhua), originally caught by traps but later on kept as farmed fish, were transported by tank on a car to the Bergen Aquarium. No visible damage or fish mortality due to the transport was observed. The fish were not measured prior to the experiment, but the cod were estimated to approx. 35 to 40 cm and the haddock to approx. 35 to 50 cm. The fish were transferred to a circular experiment tank divided into 10 chambres with dense walls (Fig. 1). Before the experiment started the fish were kept in the tank for two weeks for acclimatization. After treatment they were observed in the tank for four weeks.

To immitate the swimming activity of a fish in front of a trawl, the fish were placed in a wooden thread mill with streaming water (Fig. 2). The fish compensated the water speed by swimming against the current, maintaining a fixed position in the channel. The water speed was measured by a SD 16 current meter.

Each group of fish were kept in the thread mill at following schedule:

- 15 minutes at 1.35 m/s
- 5 minutes at 1.5 m/s
- 3 minutes at 2.0 m/s

The fish were divided into 4 treatment groups (Table 1) which after swimming in the thread mill were given the following treatment:

- **Swimming activity:** No further treatment.
- **Swimming activity/ net injuries:** Fish were transferred to a net bag (100 mm streched meshes, polyethylene) and forced to swim through the meshes. Four haddock were too large to escape through this mesh size and were instead allowed to pass through a 110 mm net.
- **Swimming activity/defined skin injuries:** Scale and mucus were removed from a predestined area of the skin surface with the reverse edge of a scalpell (Fig. 3).

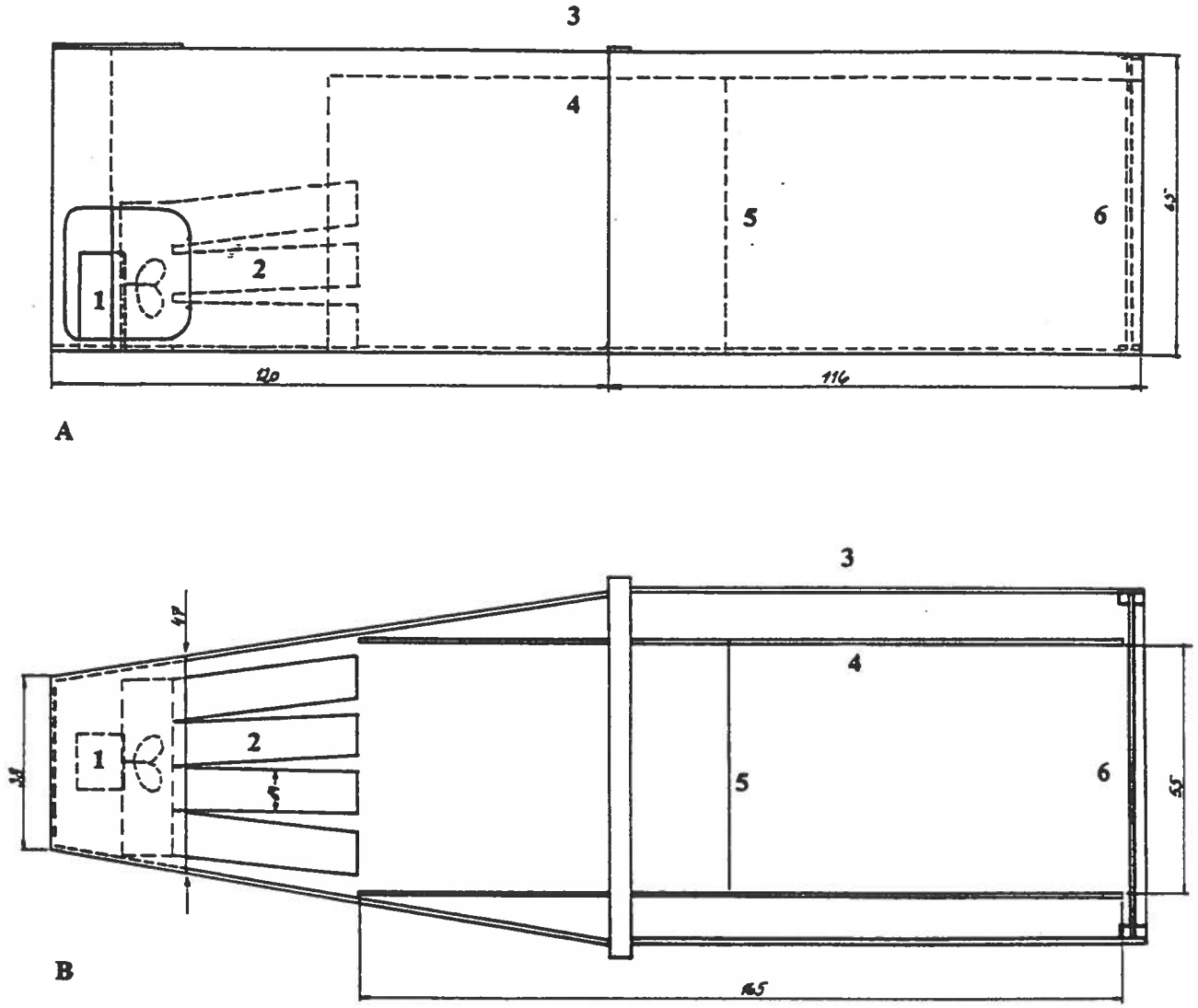
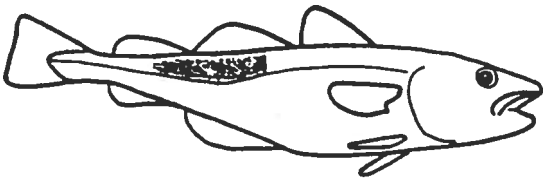


Fig. 2. The "thread mill" with streaming water where the fish were forced to swim during the experiments. A. Side view. B. Top view.
1. Current generator. 2. Injector. 3. Outer walls (wood). 4. Inner walls (wood). 5. Net grid (metal). 6. Net wall (small meshed trawl net). Measures in cm.

a)



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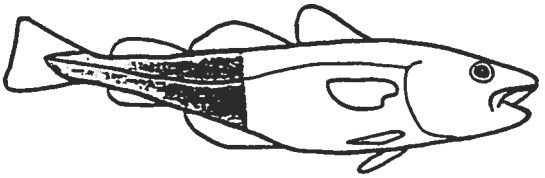

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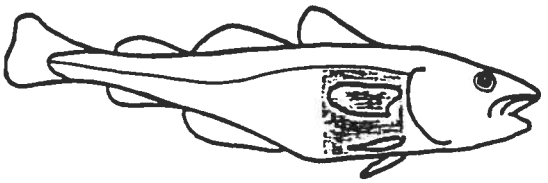
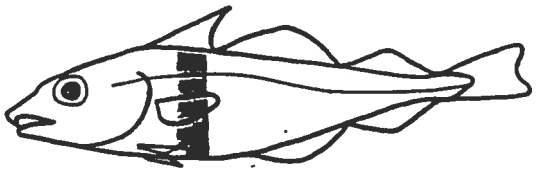


Fig. 3. Defined skin injuries on cod.
A) and c) damaged at one body side, b) damaged at both body sides.

a)



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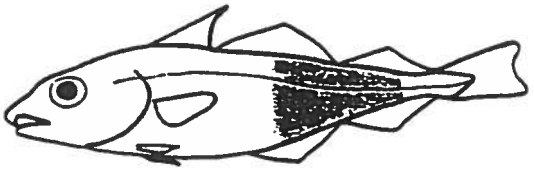

Fig. 4. Defined skin injuries on haddock.

- Swimming activity/total loss of mucus: The mucus layer of nearly the entire body surface were removed with the reverse edge of a scalpell.

RESULTS

During their stay in the thread mill most fish managed to maintain a swimming speed of 1.35 m/s (3.4 body lengths per second for a 40 cm fish) for 15 min. Single individuals were exhausted and rested against the net wall at the end of the periode. Prior to exhaustion most fish showed a typical "burst-and-glide" swimming pattern (Weihs 1974, Wardle and Videler 1980), where intervals of quick swimming movements were alternated by short resting periodes.

As the water speed increased to 1.5 m/s (3.8 body lengths per second for 40 cm fish), an increasing number of fish rested against the net wall. Some individuals got skin injuries, and probably also pressure damage after being squeezed against the wall. A significant number of fish were also damaged on the tail by clasping against the net wall, and later on (after about 5 days) developed visual infections in damaged skin.

The overall mortality during the experiment was low (Table 1). Two haddock died immediately after completed treatment from unknown reasons. Possible explanations may be pressure damage from the threadmill and/or the damage caused by handling of the fish. The first few days after treatment about one half of the haddock in the combined treatment groups seemed slow, and single individuals showed abnormal swimming behaviour. After 4-5 days almost every haddock in these groups had visible infections (effusions of blood, white coating) in damaged skin areas. Exept for two haddock dieing after one week with heavy infections, a gradual healing of the wounded skin occured during the observation periode (4 weeks).

Less damage could be seen on cod than on haddock. This may partly be due to the dark skin surface of the cod, making skin injuries

less visible for the human eye. One inividual died day 8 with infections in the injured skin regions.

The two cods and the single haddock totally deprived of mucus seemed immobile immedeately after treatment. After a couple of days, however, the cods started to eat and recovered quickly. The haddock did, however, develop extensive blood effusions along both body sides and died day 7.

DISCUSSION

Main and Sangster (1988 a and b) found high mortality among haddock escaping through the meshes of a trawl codend. It has been assumed that skin injuries, scale and mucus loss may lead to short time mortality due to distortion of the osmotic balance

Table 1. Mortality in the different treatment groups.

Treatment	Species	No.	Mortality
Swimming activity	Cod	20	
	Haddock	8	
Swimming activity/ defined skin injuries	Cod	16	1 (day 8)
	Haddock	8	1 (day 0)
Swimming activity/ net injuries	Cod	20	
	Haddock	10	2 (day 0, day 7)
Swimming activity/ total mucum loss	Cod	2	
	Haddock	1	1 (day 7)
Control	Cod	10	
	Haddock	8	

of the fish (Rosseland et al. 1982) and later on through development of secondary infections in damaged skin (Engås et al. 1989). It has also been claimed that exhaustion, caused by the persistent swimming activity of a fish trying to keep its position in front of the trawl mouth during towing, may lead to mortality (Black et al. 1961, Beamish 1966).

It is, however, difficult to prove these effects in full scale field experiments. To study different types of injuries and physical strains in more controlled conditions, we have in this tank experiment simulated gear induced damage to fish in captivity. The swimming speeds in the thread mill (1.35 to 2 m/s) are higher than the maximum sustainable cruising speed of a fish smaller than 50 cm (Wardle 1977). To maintain its position in the mill the fish were forced to use burst speed which leads to muscular exhaustion. The characteristic "burst-and-glide" swimming pattern frequently observed in the thread mill is typical for fish trying to keep intermediate swimming speeds (Wardle & Videler 1980). After completed treatment the fish were obviously exhausted, rigid and with slow movements. In our experiments no mortality was observed due to exhaustion alone.

The total observed mortality during the experiment was low. Only one cod (swimming activity/defined skin injuries group) died. The mortality was most likely due to secondary infections in damaged skin. The low mortality and the fact that the two cods deprived of mucus in addition to muscular exhaustion survived and were apparently unaffected of the treatment after about one week, indicates that cod are relatively resistant to injuries combined with exhaustion.

The mortality was somewhat higher for haddock. Four of 19 fish (21%) with a combined treatment died, two of these died immediately after treatment. The exact reason for mortality is not known. In addition to exhaustion and the intended skin damage, the tired fish who rested against the net wall at the outlet of the thread mill were squeezed along the broad side of their body

from water current and other fish. A fish may be exposed to similar strains in a trawl. Turbulent water may cause knocks against the net walls. It may also get pressure-, squeeze- and friction damage. The tank experiment may indicate that haddock are more sensitive to this kind of damage than cod.

Two haddock died day 7 with secondary infectons in injured skin. The observed mortality was much lower than was observed in a similar experiment with saithe in net pens (Soldal et al. 1989), where increasing mortality due to infections was found from day 7 and untill the observation periode was ended after 14 days.

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