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Behaviour of saithe penned in different densities

by

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ABSTRACT

In Norway purse seine catches of live saithe are towed to the coast and kept in net pens until the fish can be processed by the fishing industry. During penning - especially during "short-time" penning - the quality of the fish is often deteriorated by tattered fins and occurence of wounds. The following study tried to find out if anything in the saithe's behaviour in the pens could explain the development of these wounds and if stocking density (6-90 kg fish/m^3) inflicted any kind of stress on the fish. Underwater television and heart beat transmitters were used to observe the behaviour. No density dependent difference in heart beat activity could be detected and the fish also seemed to endure very high stocking densities quite well. The saithe also seem to adapt the penning and handling as the pulse returns quicker to normal beat after frightening the fish the longer the saithe have been penned.

INTRODUCTION

In order to provide the fishing industry with a more continous supply of quality raw material and to avoid the heaping up of fish at the industries at times of good fishing, penning of live saithe in net pens has been started in Norway. When the fish are kept in the pens up to

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some weeks the penning is called "short-time", while by "long-time" penning is ment storage of fish in pens for several months. The dimensions of the pens and the standards for stocking densities are also somewhat different in these two methods of penning, with the highest stocking densities recommended for "short-time" pens. "Short-time" penning is done by the fishermen on suitable sites in the shortest possible distance from the fishing grounds as to enable the boats to deliver the catches until the industry can receive them. "Long-time" penning is mostly done nearby the fishing industry for preserving/ quality raw material instead of freezing the fish. However, during "Short-time" penning of saithe, considerable numbers of fish with torn fins and bruises on snout and sides have been observed. Reports from the fishermen seem to indicate that the greatest mortality occurs during this phase. Sometimes even massmortalities can occur in the pens. Although it is somewhat uncertain whether these bruises and the mortalities are consequences of the foregoing handling (seining, drying-up and towing etc.), obviously the stocking density also plays a critical role.

Manufaturers of net pens as well as the fishermen themselves operate with standards for maximum stocking density varying from 20-60 kg fish/m^3, but no systematic investigations of optimum stocking density has so far been done. In order to find methods for keeping the saithe in good condition even after a long time of penning and to investigate why and when the bruises and fish deaths start to occur, the Institute of Marine Research in cooperation with the Institute of Fishery Technology Research started experiments with "long-time" and "short-time" penning of saithe in 1978 (JENSVOLL and BRAATEN 1979).

The following study on behaviour of saithe was made in connection with an experiment with stocking density in "short-time" pens. The aim of the study was to investigate if differences in behaviour in the different stocking densities could have a part in the occurrence of wounds and also if any symptoms of stress could be detected in the high density pens.

MATERIAL AND METHODS

The experiment consist of two trials here called Trial I and Trial II, which both were carried out at Austevoll Aquaculture Station. Trial I was made in the beginning of March 1979 and Trial II in the beginning of June the same year. These test periods were chosen as they normally would reflect winter and summer temperatures. The saithe used in Trial I was caught with purse seine outside Stavanger in the end of September 1978 and transported to the Aquacultur Station in a well-boat. From October 1978 to March 1979 these fish were used in a "long-time" penning and feeding experiment (JENSVOLL and BRAATEN 1979). These fish had to be taken to the "short-time" penning experiment because due to bad fishing conditions at the time, it turned out to be impossible to get newly caught saithe. The fish had been kept in 500 m^3 net pens. Some of the pens had been given various amounts of food daily and the mean weight of the saithe therefore varied from 650-900 g. When transfering the fish to the experimental pens, the saithe had to be mixed in certain proportions.

The Trial II fish were caught by seining in June 1979, brought to the Station in a well-boat, transfered to 500 m^3 net pens and a few days later into the "short-time" pens. The mean weight of these fish was 800 g.

The experimental "short-time" pens were made of knotless netting, No. 6 (R 455 tex), with a mesh opening of 30 mm. The volume of the pens was 48 m^3 (4 x 4 x 3 m) and they were stocked with 6, 15, 30, 45, 60 and 75 kg fish/m^3. Because the saithe seemed to endure these stocking densities well, 15 kg fish/m^3 was added to all densities in Trial I, except for the lowest. The pens were hanging from a raft as shown in Fig. 1.

The winter 1979 was extraordinary long and cold and this is also reflected in the sea temperatures, which during Trial I in March were varying from 0,9 to 2,4°C in 2 m depth. The temperature was depending on whether it was high or low tide when measuring. In Trial II the temperature in 2 m depth varied from 12,1 to 12,7°C which also is somewhat lower than normal for June.

To observe the behaviour of the saithe a lowlight underwater television camera was used. Particular emphasis was laid upon observing how the fish behaved in relation to the net walls and if the fish were pushing into each other in the high stocking densities. Sequences of 5 minutes from different times of the day were recorded on videotape from each pen.

In order to study saithe's reaction to crowding more closely, two heart beat transmitters (SINTEF, NORWAY) were used in each trial. The transmitter (Fig. 2) was gently pushed down the throat of an anaesnetised fish and then the wire was taken out through the gills and the platinumelectrode was inserted as near the heart as possible through a cut in the skin (Fig. 3). Hydrophones and a general purpose receiver were used to count the heart beats. For more details about the technical equipment cf. HOLAND and MOHUS 1977. After tagging, the two fishes were put into a small net pen until several succeding measurements showed that the pulse had stabilized and was equal for both fishes. One fish was then transfered to the 6 kg/m^3 - pen and the other to the 90 kg/m^3 - pen (75 kg/m^3 - Trial II). The heart beat activity was followed approximately 1 hour intervals from 7 a.m. to 7 p.m.

Several experiments with frightening the fish by pulling up the pen walls or agitating with a hand-brailer was made and the pulse rate was then counted every 5 minutes until it had returned to normal.

RESULTS AND DISCUSSION

Behaviour

When transfered from the 500 m^3 pens to the experimental pens, the fish immediately swam towards the bottom and stayed there in an irregular school, making sudden rushes when frightened by movements on the raft. About 24 hours after being transfered the saithe were dispersed more evenly and swam peacefully anti-clockwise in a regular schoolformation. This behaviour was typical for both Trial I and II. Emphasis was laid upon observing if the fish touched the net walls, showed any signs of agonistic behaviour or pushed into each other by accident. However, no such thing could be seen, not even when the saithe were so dense stocked that it was rather difficult to observe single fish. Thus apparently

the wounds must come from hard handling before penning or the fish in the high stocking densities must suffer from some kind of stress that makes them easier susceptible to infections of small rifts and bruises.

In Trial I the formation of the school varied considerably during the day in the lowest density, with the school sometimes keeping close to the bottom and sometimes being spread in the lowest two metres. This behaviour seemed to coincide with the thickness of the cold water layer which again varied with the tide. In the highest densities the fish were so densely stocked that they could not avoid the cold water. In Trial II no such regular congregation and dispersion of the school could be seen in the pens, but on the other hand the temperature varied little in 2 m depth in the June experiment.

Heart beat activity.

Only very small differences in heart beat activity could be observed between the highest and the lowest stocking density. During Trial II (June) the saithe in the 75 kg/m^3 density had just a little slower pulse in most counts than the fish in the 6 kg/m^3 density. This would be in agreement with FRANCIS et. al. 1974, who found that chemical factors in water from overcrowede goldfish aquaria depressed the pulse rate of the fish. However, in Trial II no such regular difference could be observed, on the contrary, in many of the measurements the pulse of the saithe in the densest pen was a little faster than in the 6 kg/m^3 pen (Fig. 4). Because the transmitter batteries were discharged several times with the consequence that new saithe had to be tagged after changing of batteries, the time for surveying transmitter adapted fish became too short. This unfortunately makes the observations rather uncertain.

In Fig. 5 and 6 the results from Trial I and II are compared for the highest and the lowest density. For reasons of perspicurity only four pulse counts per day (the first in the morning, noon, about 3 p.m., and the last in the evening) are presented in the figures. Obviously the Trial I-fish, which had been penned for half a year at the Aquaculture Station, were much less disturbed by tagging and handling since their pulses became stable much faster than the Trial II-fish. Later on, in repeated tests of agitation the Trial I-fish needed even shorter time for regaining their normal pulse of 16-17 beats/min. At the end

of Trial I the time needed to regain normal pulse was only a few minutes. The Trial II-fish which were newly caught, needed several days to reach stable pulse after tagging and at the end of the trial they still needed almost an hour to regain stable pulse of 22-25 beats/ min. after being frightened.

Development of wounds and mortality

The present report is focusing on the behavioural aspects of short-time penning. Mortalities etc. are therefore only mentioned shortly, as they are dealt with more closely in JENSVOLL 1980. In Trial I the mortality was insignificant in all densities and alomost no wounds developed during the experimental period. This may be an affect of the very low sea temperature at the time, which apperently slowed down the activity of the fish as well as the life processes of bacteria, fungi etc. to a minimum. In Trial II the occurrence of wounds and the mortality was higher. Total mortality in 7 weeks was: 40, 35 45, 48, 62, 68% respectively from lowest to highest stocking density. Evidently the fish in the higher densities were more susceptable to disease and infections of minor wounds. JENSVOLL (1980) therefore concludes that 30 kg saithe/m^3 should be maximum density in short time penning during summertime. Since only minor differences were found in behaviour and heart beat activity between fish in high and low density nothing in the present study seems to contradict that result.

CONCLUSIONS

- Nothing in the behaviour of the saithe was found that could cause development of wounds and torns in short-time pens.
- No systematic diurnal rhytm could be detected in this study except for the avoidance of very cold water coming in with the tide.
- No systematic differences in the heart beat activity could be detected between the fish in the lowest and the highest density.
- The fish in the crowded pens were more susceptible to disease and infections during summer time, and therefore extra attention should be paid to fish density at that time of the year.

- The saithe obviously adapt to handling and other kinds of agitation, because the pulse showed even shorter time regaining normal beat when the fish were frightened.

- Small changes in temperature did not bring on measurable changes in pulse rate, but larger increases in temperature, however, led to faster pulse.

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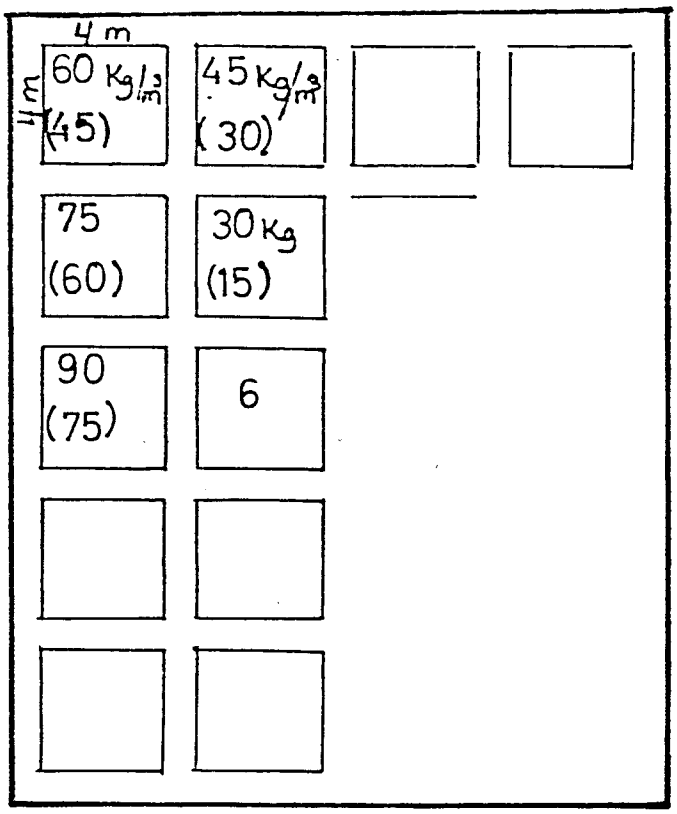
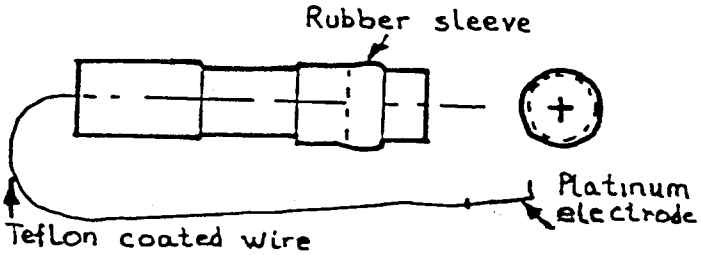


Fig. 1. Raft with experimental pens. Stocking densities in kg/m^3. Trial II in brackets.



TYPE	:	TS-760
FUNCTION	:	HEART-BEAT
FREQUENCY	:	50-150 KH2
LIFE	:	7 - 10 DAYS
RANGE	:	~ 100 M

DIMENSIONS : 46 x 10 (9) mm

WEIGHT AIR/WATER : 10/6 gms.

Fig. 2. Mechanical shape and some data of the SINTEF heart beat transmitter (From Holand and Mohus 1977).

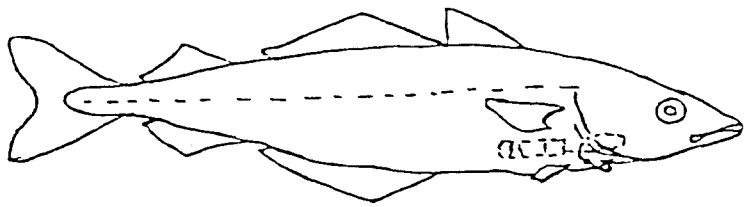


Fig. 3. Saithe with heart beat transmitter indicated.

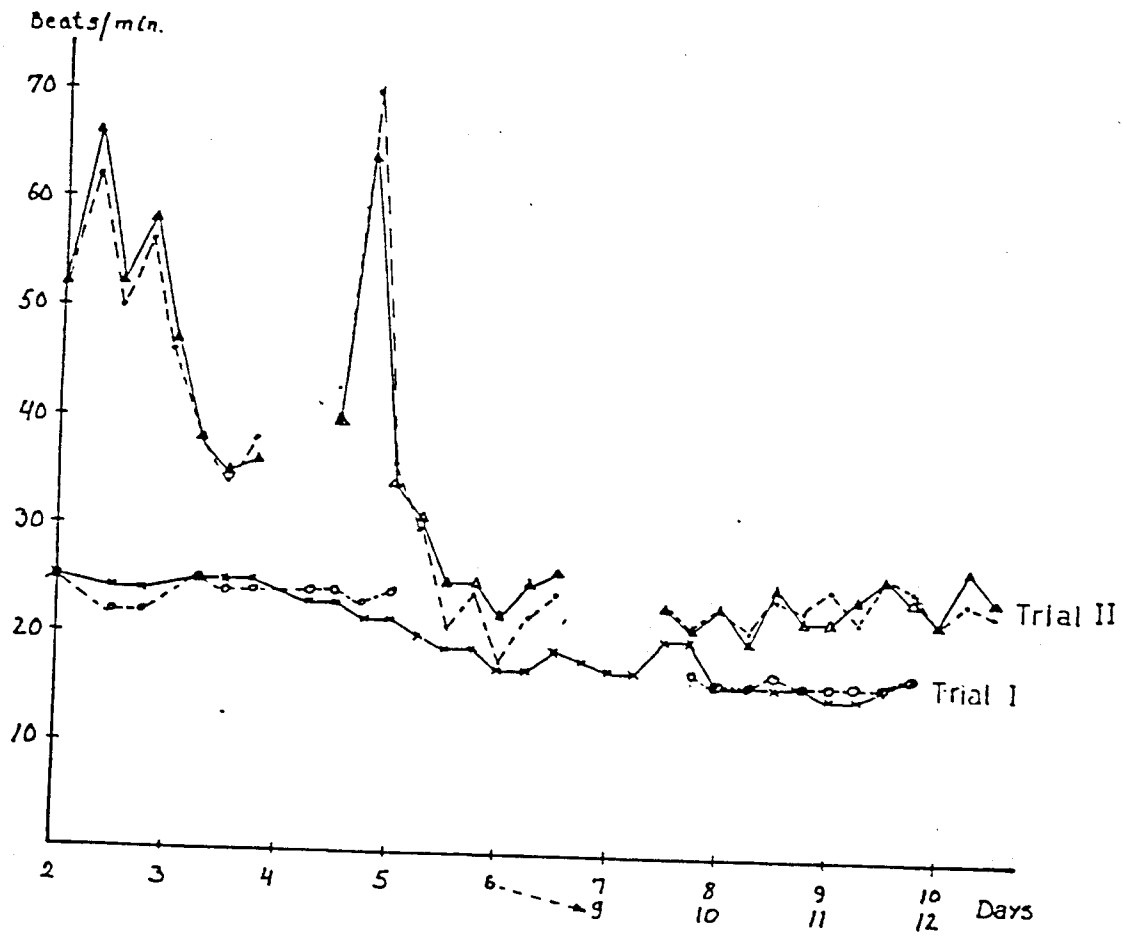


Fig. 4. Heart beat activity of tagged saithe in lowest and highest stocking density. 6 kg/m^3 = ⇄, 75 kg/m^3 = ●----●, 90 kg = o——o. No data for 7th and 8th day of experiment in Trial II. Starting point 2nd day of experiment when pulse was equal for both fish.

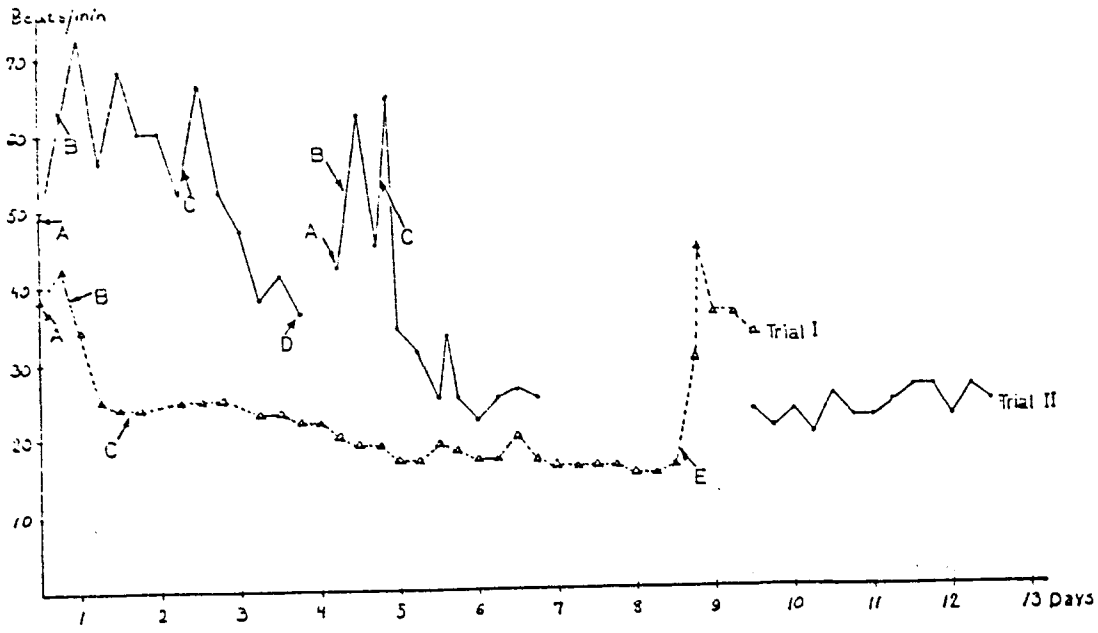


Fig. 5. Heart beat activity of tagged saithe in lowest stocking density in winter and summer (Trial I and II respectively).

A = Shortly after tagging, indoor basin (6,4°C).
B = Transfer to small observation pen (2,4°C Trial I, 12,1°C Trial II).
C = Transfer to experimental pen " " " "
D = Batteries discharged.
E = Transfer back to indoor basin.
No data for 7th and 8th day of experiment in Trial II.

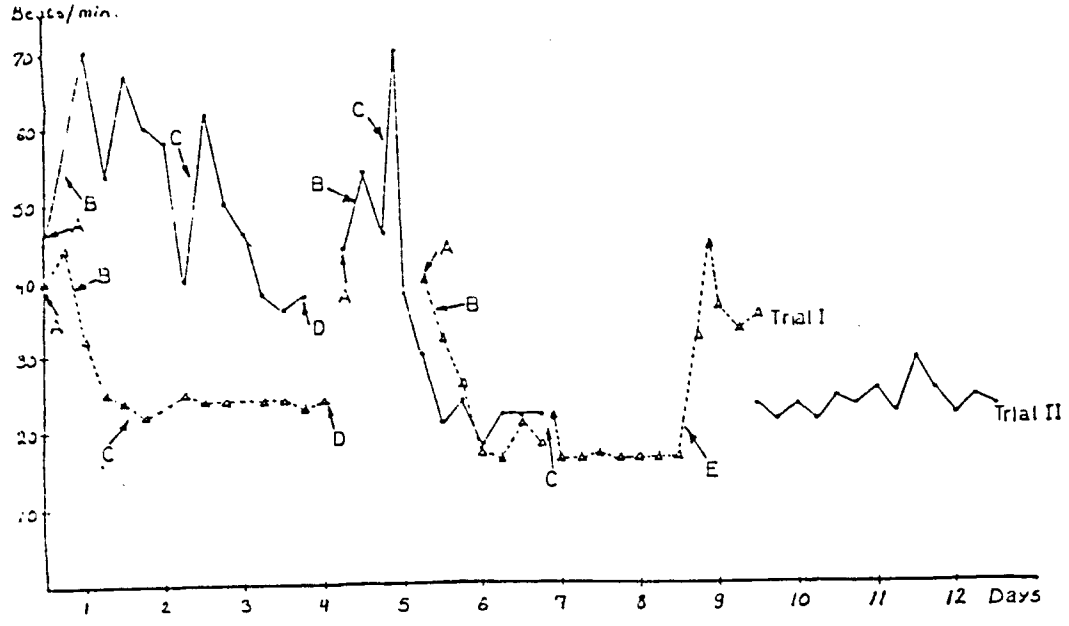


Fig. 6. Heart beat activity of tagged saithe in highest stocking density in winter and summer (Trial I and II respectively).

Legends : Fig. 5.