Sea Tiger Report

Report on comparative tests of “Sea Tiger” sea kayak and other sea kayaks on behalf of the British Canoe Union

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Twelfth June 1990

Introduction

The writer's involvement in this project came about in a rather happenstance manner. Having attended the BCU Sea Touring Committee meeting at Craster on 17/vi/89 to represent the Scottish canoeing Association, Touring Committee, and talk to two items on the agenda and minutes of the previous meeting, i.e. a "Sea Tiger" document and the revision of the British Standards Institute Specification MA91 dealing with safety in canoes.

As it turned out no discussion took place as the BCU Touring Committee had set up a working party to look at these items, had appointed two members and requested that the STC appoint "the other two". I was asked to be one and John Ramwell the other.

The working party was to be chaired by Ray Rowe and the fourth member was Alan Rees. Enquiry soon revealed that discussion of BS MA 91 was not part of the working party remit. There were five terms of reference for the working party the first being "To consider the complaints referred to the BCU by Frank Goodman on behalf of the BCMA safety panel:

(1) That to design a kayak for the sea with free flowing surfaces is an inherently dangerous practice.

(2) That to advocate the removal of hatches as a basic system for emptying water from the hull whilst at sea is inherently dangerous advice."

The working party "met" by telephone conference (excepting Alan Rees) and one paragraph of its report reads "Working party has no practical experience of the Sea Tiger's handling characteristics with water on board but does have first hand experience of emergency flooded compartment in a conventional kayak fitted with bulkheads. It was therefore felt that a simple trial should be carried out on a Sea Tiger in a shell-flooded state in order to discover any performance phenomenon which might make it significantly more dangerous than a conventionally built sea kayak. A conventionally built kayak would need to be available for comparison."

Shortly after the above meeting Ray Rowe left the BCU's employ and John Ramwell resigned from the working party, for good reasons. This rather left things in limbo and in a fit of utter madness I offered to do the simple trial for the BCU!

Aims

The basic aim of these tests was as stated in the working party report. It was decided to use different states of loading of the Sea Tiger and progressively flood the hull while photographing the resultant trim and recording the paddler's comments. As in the interval, Peter Lamont's report on progressive flooding of a Sea Tiger in an unloaded condition became available it was decided not to repeat his efforts but to concentrate on a "Day Trip" loading and a "Touring Load".

Method and equipment

Nick Padwick provided two Sea Tigers for the trials. Other craft had to be procured; it was a case of what was available. People were reluctant, understandably, to loan their shiny new Skerrays, Mariners, Huntsmans, Icefloes etc., so a club Nordkapp and Anas Acuta were obtained together with a couple of Hebrides and a KW7 with a pod, from Geoff Good. Bathroom scales weighed the loads; a "calibrated" plastic bucket provided the "on-board" water and waterproof paper used to record the results. For each test the paddler first paddled round the course with the kayak at the test load to get the feel of the un-flooded kayak. Then measured amounts of water were poured into one hatch as detailed in the test reports, the kayak paddled round the course and his or her comments on the handling recorded. A photograph was taken at each stage of flooding. At conditions of flooding where it was obvious that the cockpit or pod would have flooded eventually it was deliberately filled to save time on the test.

Summary of results

Tests with day trip loading

As expected all the bulkheaded boats went out of trim to a greater or lesser degree when water was put in either bow or stern. This of course results in a craft which is difficult to control in windy conditions i.e. weathercocking effect is greatly magnified. The buoyant effect of even one clothes bag (without the air squeezed out) was amply demonstrated. Stability was also affected although the "feel" differed between different kayak designs. No matter which compartment was flooded the stability was at its worst in a partially filled state, improving somewhat as the compartment reached capacity. A situation well known to the drivers of road tankers!
Both craft with pods stayed in trim for much longer than bulkheaded boats. In longer waves pitching did cause the Sea Tiger to take up an end-down trim, this was with much larger amounts of water on board and the permanent buoyancy which is standard on this boat prevented the large angle of dip experienced with the others.

Tests with touring loads

These were only carried out on the Sea Tiger and when the equipment was packed in a realistic manner a great improvment was observed. No matter how much water was put in, the kayak stayed fairly well in trim although with a large sea running with head and tail-on waves some degree of out of trim must be expected at interim flooding levels. The stowed equipment also acted as baffles to slow down the water movement thus improving stability. While no touring load tests were carried out on bulkheaded kayaks similar improvements in performance can reasonably be expected although with flooding of an end compartment trim will still be affected and flooding of the cockpit area should not give as much of an improvement due to its much lower proportion of volume available for gear stowage.

Rescues

Emptying on most occasions was carried out ashore. The Sea Tiger was recovered with an unnatural cruising load and a day trip load by the "Hatches Off" method. An Anas Acuta with cockpit and aft hold flooded was recovered by a combination of straight lift and HI, not all that easy! There is room here for some of the "old" sling lifts used in Scotland in the days of canvas boats.

Results

All 81 photograph records of the test kayaks referred to in the text are summarised in Table 1.

Sea Tiger test one
5/ix/89

For full report see Appendix 1.

Purpose

Evaluation of 'Hatches Off' recovery method (developed by Nick Padwick).

Location

Largs marina, N Ayrshire, Firth of Clyde.

Conditions

Sea state, short breaking sea. Wind NW F4-5 onshore. Tide 2 to 3½ hours after low water, with no tidal stream.

Load

Duncan Winning 88.9 kg; fore, sandbag 19.0 kg; aft, 4 BDH and 1 sandbag 25.4 kg (total 133.3 kg).

Comments

Loading unrepresentative, too concentrated, allowing more water aboard than would be possible with more bulky packing and it could move about affecting stability.

Litres of water: "+C" indicates cockpit also filled.

0 litres Fig. 1, kayak fairly heavy. Handled quite satisfactorily. Paddling hard into a head sea brought water up deck into pod (no spraydeck).

40 litres Fig. 2, kayak stayed level. Entrapped water caused a slight roll but not bad.

60 litres Figs. 3 and 4, "Cargoe" moving about with the wave action accentuating the roll but controllable.

80 litres Fig. 5, same as stage 3 (60 litres) only stronger roll.

100 litres Fig 6, same comment as stage 4 (80 litres).

120 litres +C Fig 7, definitely tippy after the pod had flooded balance had to be given some thought, especially when turning. When running down a wave the water movement to the bow carried the bow under and it stayed there with the stern in the air (Fig. 8). Balance had to be worked at and although the kayak could be paddled it was not really going anywhere. The kayak was recovered, not easily as it was heavy, by two canoeists using the "Hatches off" recovery method advocated by Nick Padwick.

Sea Tiger test two
28/v/90

Location
Royal West of Scotland Amateur Boat Club, Esplanade, Greenock.

Conditions
Sea state, small waves not breaking. Wind F1-3 offshore at right angles to second leg of course. Tide SW stream approx 1½ knots parallel to second leg of course. Wash haphazard from other craft crossing course from time to time.

Course
From slipway out round two moored boats and back to slipway, giving a triangular circuit with legs of approx 100 metres each.

Load
Helen Sutherland 61.2 kg; fore clothes bag 4.1 kg; aft 2 BDH, flask, 2 flares, 3.6 kg (total = 68.9 kg).

Comments
No spraydeck. Centreboard (skeg) raised. Buoyancy of bags carried: (positive buoyancy minus load) front = 10.2 kg, rear = 5.7 kg.
Litres of water: "+C" indicates cockpit also filled.

0 litres Fig. 9, paddles easily, is manoeuvrable (centre board is raised at all stages). Feels bulky compared to the boats that Helen is used to and is uncomfortable in that no foot rest position was arranged for the test.

60 litres Fig. 10, less stable but quite manageable.

80 litres Fig. 11, as stage 2 but heavier to paddle.

100 litres Fig. 12, still paddles OK. Not rolling as much but rolls further and with more force.

120 litres Fig. 13, when paddled water is level with stern. A lot less stable. Paddler must concentrate.

140 litres Fig. 14, when paddled 18" of stern deck is under water. Felt very tippy. Took approximately 1 gallon of water in pod.

160 litres Fig. 15, same as stage 6 only more so.

180 litres +C Fig 16, at this point the pod was very close to flooding so it was helped to do so. With the pod flooded the boat was fairly stable but not really going anywhere. So Helen exited the cockpit. She was able to stop paddling and place her hands on the cockpit rim, push herself out rearwards and keep her hair dry. No photo is available of the flooded position but 30" (76 cm) of bottom were showing at bow and the boat was under from the cockpit aft i.e. not with as high an inclination as in Peter Lamont's paper, Fig. 11.
In the test reported here the paddler was lighter and there was 5.4 to 21.8 kg of buoyancy aft. With no paddler on board, the Sea Tiger

levelled out and was easily recovered by one paddler using the "Hatches Off" method advocated by Nick Padwick. On landing and unloading the bow buoyancy block was found to have come loose.

180 litres +C, as no photographs were taken at stage 9 on the 28/v/90, the opportunity was taken on the Sea Tiger Test 3 on 9/vi/90 to put in the same day trip load and 180 litres of water to get a photograph. On this occasion the Sea Tiger levelled out as shown in Fig.17. The bow was lifted as shown in Fig.18 giving a similar attitude to that found on the 28th.

However, the kayak slowly returned to the level. It was not possible to ascertain the location of the buoyant gear in either case as the items were not fixed in position but the location of the 5.7 kg of buoyancy could certainly affect the trim.

Sea Tiger test three
9/vi/90

Location
Largs Marina. N Ayrshire, Firth of Clyde.
Conditions
Sea state calm. Wind F1. Tide one hour either side of high water with no tidal stream.
Course
Triangular from Marina slipway approx 100 metre legs.
Load
Shona Cowrie 64.4 kg; fore, clothes bag, sleeping bag 7.6 kg; centre, food consisting of 14 tins in a bag 11.8 kg; aft, tent, primus, billy & paraffin, flask and bottle plus First Aid and repair 21.3 kg (total = 105.1 kg).
Litres of water: "+C" indicates cockpit also filled.

0 litres Fig. 19, easy to paddle, comfortable, dislike skeg rattle.
40 litres Fig.20, stable.
60 litres Fig. 21, slightly less stable.
80 litres Fig. 22, no change in stability, tins rattling.
100 litres Fig. 23, no change in stability.
120 litres Fig. 24, heavy to paddle, slightly less stable again. Spray sheet on.
140 litres, as for 120 litres.
160 litres Fig. 26, water level inside equals water level outside. Slightly less stable again.
180 litres, water level inside slightly higher than outside.
200 litres Fig. 27, difficult to fill to top of aft hatch. Surprisingly stable. Hatches left off.
200 litres +C Fig. 28, pod flooded. In pic. water is flowing out of aft hatch.
200 litres +C Fig. 29, water can flow in and out of hull space at will.
200 litres +C Fig. 30, Shona paddling the flooded ST hard. The kayak was obviously very heavy and hard to get going but once making way paddled OK. Kayak hard to turn but not affected by wind very much.

Anas Acuta
30/v/90

Location
Royal West of Scotland Amateur Boat Club, Greenock Esplanade.

Conditions
Sea state calm. Wind S F1-4. Tide at high water and for 1½ hours with tidal stream 1 knot, parallel to second leg of course.

Load
Lindsay Dowds 63.5 kg; fore 4.1 kg; aft 3.6 kg. The same load as for ST test 2.

Comments
Valley Canoe Products states the Anas Acuta takes 60 litres fore and 80 litres aft. The test took >65 litres fore and >60 litres aft, allowing for the load. Cockpit volume was not checked. Litres of water: ">65" indicates more than 65 litres. "+C" indicates cockpit also filled.

Anas Acuta fore hold flooding

0 litres Fig. 31, no apparent effect from cross wind. Note: Photo with paddler (Helen Sutherland) from "Sea Tiger test 2 used here to show trim only.

20 litres Fig. 32, constant course correction on all 3 legs of circuit. Not unstable.

40 litres Fig. 33, as stage 2. but more correction needed.

50 litres Fig. 34, fore hold full. Almost un-steerable.

50 litres +C Fig. 35, cockpit flooded (clothes bag in fore compartment). Became more steerable but very tippy.

>65 litres +C Fig. 36, cockpit flooded. Clothes bag removed from fore hold, 15 litres of water added with difficulty. The cockpit was then flooded again. Bow on the bottom. It is reasonable to assume that in deep water the kayak would have adopted a vertical position.

>65 litres Fig. 37, cockpit empty. Hatch cover removed (clothes bag removed). By rocking the boat and pushing it down a small extra amount of water was introduced. Not measurable. The boat was fairly stable but was uncontrollable i.e. not steerable. Boat drained.

Anas Acuta cockpit flooding

20 litres Fig. 38, kayak felt normal. Clothes bag re-stowed in the fore hold.

40 litres Fig. 39, as for 20 litres.

60 litres Fig. 40, beginning to feel less stable.

80 litres Fig. 41, boat becoming heavy to paddle.

95 litres Fig. 42, cockpit full, boat heavy to paddle, difficult to control direction but more stable than before.

Anas Acuta aft hold flooding

50 litres Fig. 43, course corrected on two legs of circuit, OK dead into wind. Felt heavy but stable.

>50 litres Fig. 44, aft hold took very little more water not measurable with equipment. Behaved as at 50 litres. Very difficult to turn.

>50 litres +C Fig. 45, cockpit flooded. Stern on bottom. Potential Cleopatra's Needle.

Nordkapp test
30/v/90

Location
Royal West of Scotland Amateur Boat Club, Esplanade Greenock.

Conditions
Sea state calm. Wind variable S F1-4. Tide 1½ to 3 hours after HW with tidal stream 1 knot parallel to 2nd leg of course.

Load
Lindsay Dowds 61.2 kg; day trip fore 4.1 kg; aft 3.6 kg (total = 68.9 kg).

Comments: VCP Brochure states 70 litres fore and 100 litres aft but this kayak took only 60 litres fore and 70 litres aft. Allow for load and plus amounts. Cockpit volume not checked.

Litres of water: ">55" indicates more than 55 litres.

"+C" indicates cockpit also filled.

Nordkapp fore hold flooding

0 litres Fig. 47, handled OK.

20 litres Fig. 48, had to correct course on all 3 legs of circuit. Stability OK.

40 litres Fig. 49, full to top of hatch, clothes bag present. Steering difficult but stable.

55 litres Fig. 50, clothes bag removed. Boat stable, direction uncontrollable.

>55 litres Fig. 51, hatch off. Boat rocked releasing air, a little extra water in. Behaved as for 55 litres.

>55 litres +C Fig. 52, cockpit flooded. Bow on bottom. In deep water assumed kayak would go vertical. Boat drained, bag replaced in fore hold.

Nordkapp aft hold flooding

20 litres Fig. 53, manoeuvrability OK. Stability iffy. No obvious course corrections.

40 litres Fig. 54, unstable, hard to turn but keeping on course (Wind dropped).

57 litres Fig. 55, hold full. Hard to turn but more stable.

>57 litres Fig. 56, hatch off, water entered. Behaved as for 57 litres.

>57 litres +C Fig. 57, cockpit flooded. Stern on bottom. In deep water it is assumed that kayak would go vertical. Boat drained.

Nordkapp cockpit flooding

40 litres Fig. 58, stability iffy.

60 litres Fig. 59, very unstable, otherwise OK.

80 litres Fig. 60, not much different from 60 litres. Very difficult to turn.

100 litres, not much change. No photograph.

130 litres, cockpit full. No photograph. More stable, very heavy, hard to manoeuvre.

Hebrides test
4/vi/90

Location
Largs Marina. N Ayrshire. Firth of Clyde.
Conditions: Sea state calm. Wind F1. Tide 3 hours after LW.

Load
Austin Kelly 68.9 kg. No gear load in kayak.

Comments
The test was conducted to observe the difference in flooding between two similar kayaks. Both with bulkheads but one with permanent buoyancy at each end as well. This second kayak does not have deck hatches but larger hatches in the bulkheads. In the pics the normal bulkhead/deck hatch/no additional buoyancy kayak is designated "Hebrides (1)" and the bulkheaded/no deck hatch/additional buoyancy kayak is designated "Hebrides (2)". Litres of water: ">75" indicates more than 75 litres.

0 litres Fig. 61, Hebrides 1. No water or load in kayak.
75 litres Fig. 62, Hebrides 1. Fore hold full, tippy but controllable.
>75 litres Fig. 63, Hebrides 1. Boat rocked, air released, small extra amount of water in. No change in handling.
90 litres Fig. 64, Hebrides 1. Aft hold full. Less stable, far less controllable, very hard to turn.
?? litres Fig. 65, Hebrides 2. Fore hold full, kayak more level and more stable than Hebrides 1.
?? litres Fig. 66, Hebrides 2. Stern hold full, steadier and more controllable than Hebrides 1.
?? litres Fig. 67, Hebrides 1. Hatches off, flooded, sunk.
?? litres Fig. 68, Hebrides 2. Hatches off, flooded, floating.
?? litres Fig. 69, Hebrides 2. Cockpit only flooded, heavy but paddleable.

KW7 test
9/vi/90

Location
Largs Marina. N Ayrshire, Firth of Clyde.

Conditions
Sea state small waves. Wind F2. Tide 1 hour before HW to 1½ hours after with no tidal stream.
Course: Triangular from marina slipway, approx 100 metres each leg.

Load
Stuart Irons 66.2 kg; aft only 7.7 kg. Fore hatch could not easily be opened.

Comments
Hole in pod connecting to hull space with tube for foot pump pipe. Seal between pod and tube poor. Water leak into pod not measured. Leak at aft end toggle hole. Polystyrene pillar buoyancy aft, unable to move fore hatch to see into hold.
Litres of water: "+C" indicates cockpit also filled.

0 litres Fig. 70, very manoeuvrable and easy to paddle.
20 litres Fig. 71, slightly heavier to paddle.
40 litres Fig. 72, beginning to feel tippy.
60 litres Fig. 73, same as stage 3 only more so.
80 litres Fig. 74, ditto.
100 litres Fig. 75, paddler feels very unstable.
120 litres Fig. 76, as stage 6 (100 litres) but more so becoming much harder to turn but keeping course in conditions.
140 litres Fig. 77, becoming stern heavy.
160 litres Fig. 78, paddler getting very nervous.
180 litres Fig. 79, getting more stable again.
200 litres Fig. 80, kayak has slow roll which paddler can predict.
200 litres +C Fig. 81, kayak afloat, bow submerged. This paddler would have capsized soon. Could not go anywhere in this condition.

Conclusions

While the writer has conducted these tests he feels that it is up to the BCU working party to draw its own conclusions from the results. In this respect it is understood that Geoff Good, BCU Director of Coaching, is considering re-constituting the working party to allow it to finish its job. However, the writer will give his opinions.

Information from other sources

As there was a lack of direct experience of the Sea Tiger it was decided to obtain some feed back from users, who had experience of both the Sea Tiger and conventional sea kayaks. Nick Padwick provided some names and most responded. However, the two examples in the Appendices were sourced by the writer without Nick Padwick's knowledge so should be free from any possibility of collusion, not that I think there would be any anyway.

A separate series of small tests were conducted by Mr George Kerr during his school outdoor activities sessions. George is an experienced sea touring canoeist, yachtsman, canoe builder, BCU Senior Instructor Sea, E2, BCU Senior Instructor Inland and uses a Nordkapp for his own canoeing and has done for some years. His report is also appended.

Opinion

The following are the writer's own opinions, without prejudice to the conclusions of the BCU working party or anyone else.

While conducting these tests from a strictly neutral position (I use my own home built and designed sea canoe, so have no axe to grind with regard to the disputed designs) I have been mildly surprised by some of the results. Considering these and the input from others I do not consider that the Sea Tiger contains inherently dangerous design practices indeed it seems to be a good boat which suits some people very well but like any other sea canoe it will not suit everybody. One aspect I do like is the provision of permanent buoyancy as standard. My own kayak has it too, although with an un-bulkheaded hull it should be anyway. One aspect highlighted by the tests was the marked improvement in performance when flooded brought about by the presence of a properly packed load in the boat, i.e. restriction of both the volume available to take in water and its ability to move freely. In this respect I think that greater publicity should be given to the recommendation of one speaker at last year's Sea Canoeing/Coaching Conference that the free space left in the stowage compartment(s) should be taken up with air bags. This would minimise the effects of water penetration to these compartments and increase the performance of the craft very greatly in such circumstances.

I feel that these tests satisfy the requirements set out in the working party report for a "simple trial" and should permit that part of the working party's remit on the actual Sea Tiger to be concluded.

Should the BCU decide that further trials are required, I suggest that co-operation of the canoe trade would be required to supply a selection of kayaks to have holes drilled at suitable locations and all paddled together, as a cruising group, round a triangular course, in both directions until one by one they fell by the wayside (see: Carter 1991 p5 “The slow leak”). The whole to be recorded on video and repeated for three loads, empty, day cruising and touring and three flooded conditions, bow hold, cockpit and aft hold.
I doubt if the trade would wish to come up with the boats (based on comments at meeting) and the exercise would be expensive, not justified and those that did not like the results would find some reason to ignore it. (Again based on comments at meetings about the dispute) Finally I suggest that the report is made available, by the BCU, at reproduction cost to anyone who wants it.

Acknowledgements

I would like to thank both Garnock Canoe Club and the Royal West of Scotland Amateur Boat Club for their assistance in conducting these "simple trials" and in particular the following individuals some of whom actually got quite wet in the process.
Garnock Canoe Club: George Kerr, Bill Dunlop, Jennifer Irons, Ewan Hunter, Shaun Cowrie, Austin Kelly and Stuart Irons.
Royal West of Scotland Amateur Boat Club: Les O'Neill, Helen Sutherland and Lindsay Dowds.

Appendix one
Test of "Sea Tiger" Rescue
"*Hatches Off* " recovery method

Object
To assess the viability of the "Sea Tiger" "Hatches Off" recovery method with a loaded kayak.

Location
Largs, Ayrshire, Sunday, November 5, 1989.

Weather
Wind NW F4-5 on shore with short breaking sea. Tide flooding north, neaps.

Method
Loading
A "Sea Tiger" kayak was loaded as follows:

Front hatch

1 Sand Bag	19 kg

Aft hatch

3 Large B.D.H. Bottles	17.70 kg
1 Medium B.D.H. Bottle	3.20 kg
1 Sand Bag	4.50 kg
Total for aft hatch	25.40 kg
Total for kayak	44.45 kg

This loading was not as fair on the kayak as it should have been, in that the weights were concentrated and this meant that;

a) the cargoe was prone to shifting where a normal cruising load would have been bulkier for the given weight and would have filled the space better and prevented movement;

b) the concentrated load allowed more water into the kayak than would have been possible with a normal bulkier load. The B.D.H. * bottles were filled with water (fresh).

For the test the Sea Tiger was paddled by an experienced paddler who had previously been in a Sea Tiger for about one hour two years before. He weighed in at 197 lb (85.45kg) in canoeing gear ready to step into the boat. All items were weighed on a set of bathroom scales.

* B.D.H. bottles are 3 litre plastic, screw-top containers for 2.5 litre, ribbed glass 'Winchester' bottles in which, at one time, were supplied various reagents from British Drug Houses Ltd.

The kayak was launched, as loaded, and paddled into, across and with the seas to get a feel for its handling. Then measured amounts of sea water were introduced into the hull via the forward hatch and the course re-paddled with each new loading until the kayak became unpaddleable.

The loads (kg) were as follows:

			Total + paddler
1	Loaded as defined – 'gear' load, Fig. 1	44.45	129.9
2	Plus 40 litres sea water, Fig. 2	41.00	170.0
3	Plus 60 litres sea water , Figs. 3 and 4	61.50	191.4
4	Plus 80 litres sea water, Fig. 5	82.00	211.9
5	Plus 100 litres sea water, Fig. 6	102.50	232.4
6	Plus 120 litres sea water , Figs. 7 and 8	132.00	261.9

Results

The kayak initially handled as expected being fairly heavy. Paddling hard into the head sea brought water up the foredeck and into the cockpit (for the tests a spraydeck was not used). It did not, however, seem excessively wet.

With increasing amounts of water in the hull, the kayak became harder to paddle (i.e. heavier) and had a tendency to list slightly to one side due to "shifting cargoe", also the rolling increased but the period of roll was slow enough to make balance quite easy up to 100 litres added (Fig. 6), through support strokes, while paddling. Trim appeared to stay level.

Initially, at 120 litres added (Fig. 7) handling was much the same but needing a bit more thought to balance, then the pod flooded and balance had to be worked at and progress was slow. Within a short time, when paddling down wind and sea, the water surge in the hull (not violent) took the bow under the surface and the stern became airborne as in Fig. 8. The paddler was still in the cockpit at this stage and balancing the boat, although not easily. However, as the kayak was now unpaddleable the paddler exited the cockpit (with his head remaining dry!).
The kayak now floated upright and level. The two rescuing canoeists had never seen a Sea Tiger before the day and following verbal instructions, removed the hatches, turned the kayak upside down and positioned themselves, in a raft, to do an X rescue. As anticipated, the kayak was very heavy and the hardest bit was getting the initial lift of the stern prior to breaking the water seal at the aft hatch. After that the water drained out of the front hatch and the kayak was pulled over the raft, slowly, until level then turned right side up, returned to its element and the paddler re-instated.

Observations

While the rescue was successful it was not exactly easy, strength was needed for the initial lift and one of the rescuing kayaks did receive some damage. The kayak immediately before rescue (i.e. with the hatches removed) was for all practical purposes full and supported only by the permanent buoyancy fitted in the ends, additional water having entered after the removal of the hatches.

Although the following did not happen it would be quite possible to;

a) lose small, loose items out of the forward hatch;

b) have the flow of water out of the forward hatch blocked by gear. This could be freed by the canoeist in the water, if he or she is fit enough. Perhaps this should be mentioned in the "Sea Tiger" owner's manual.

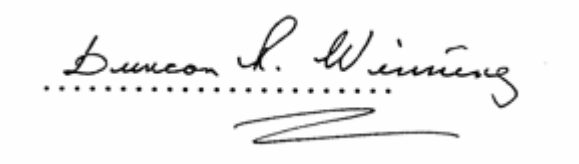
However, this test was really quite harsh. It is reasonable to assume that a group of sea-proficient canoeists would have attended to a leaking boat long before the situation reached the unpaddleable state which was contrived in this test.

The test should not be considered as typical of the tests, which the B.C.U. working party on the Sea Tiger recommended. Rather, it was a quick shot at getting something on the rescue method in time for the meeting of interested parties at Nottingham on the November 9, 1989. It was not practical to attempt more in the time considering the test kayaks had only become available to the testers on the week of the test and they all have their livings to earn.

Another point highlighted by the test was the importance of packing a kayak well, so the cargoe does not shift and that it is made as bulky as space permits (excess air in gear bags) to limit the space available to be occupied by an ingress of water. Another point for the maker's instructions of all kayaks?

Conclusions

The recovery method as described in the "Sea Tiger" publication titled "The SeaTiger" "X" or "H" Rescue for use in the event of a major leak caused by damage" is a viable recovery method for "Sea Tiger" sea kayaks.



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November 7, 1989

Appendix two
Nordkapp and Sea Tiger: A comparison

I should start with my background. My first sea kayak was a second hand Anas Acuta which I sold only because it lacked the luggage capacity for a long trip. I bought a Nordkapp which I used without reservation for three years. I then went on a day trip with someone twenty years older then me who out-paddled me in a quartering sea in his thirty year old, home designed and built, rudder controlled boat. I managed to convince myself that his advantage was not due to his greater ability but to his rudder. I immediately had one fitted to my Nordkapp and became an instant convert. Nevertheless, I haven't had the courage to retest my ability against the man who converted me!

Two unrelated events led me to try a Sea Tiger. First I saw the kayak at the 1988 Scottish Canoe Exhibition and listened to Nick Padwick arguing his design's features. Secondly in summer 1988, the flange that connects the footrest to the hull broke off my Nordkapp as I paddled across the Sound of Gigha; fortunately the final leg of a week's expedition. During the same trip, the rubber sleeve that covers the rudder cable where it passes through the deck had perished resulting in a very wet cockpit. I was reminded of the old Skye man who taught me to climb and who refused to go to the hills with any adjustable equipment on the grounds that anything adjustable must have a built-in weakness. I reflected that the Sea Tiger has the minimum adjustable and moving parts; no footrest, no rudder, no pump, an integral backrest.

On return home I bought a Sea Tiger which I have paddled as well as the Nordkapp for one year. The following is a comparison of the two.

Speed

I expected the Nordkapp to win easily. It is longer by 2 feet 5 inches (74 cm). I suppose that the only genuine test is for the two boats to be paddled against each other by paddlers of identical ability. As a compromise I paddled them over identical courses, once at a comfortable all day pace and once flat out. On both occasions the Nordkapp won by similar margins, around half a minute on a thirty minute course. I would not claim to draw any conclusion from this other than any difference in speed is unlikely to be significant. I am sure that the respective designers would claim that this was not a fair test and that their boat would perform better in rough conditions.

When paddling with friends we have swapped the two boats during journeys to make comparisons. I believe that the Nordkapp is faster in calm water and a head sea; the Sea Tiger is faster in a quartering or following sea.

Handling

Just as the rudder transformed sea paddling for me when I first tried one, I am now a convert to skegs. The Sea Tiger's skeg is easily set and the boat then holds its course unerringly. When retracted the kayak becomes more

manoeuvrable than any other sea boat I've tried. I have just one serious and one minor reservation. The serious one is that I cannot adjust the skeg without breaking the rhythm of the paddling action (although I have met someone who claims to be able to do this) and, consequently, I have to stop paddling for a second or so to make the adjustment. This must be a disadvantage in a big sea compared with the rudder's foot control which is completely independent of the paddling action.
The minor reservation is the care with which the Sea Tiger has to be packed to ensure it is well trimmed. If it is not, it is difficult to judge the necessary position for the skeg.
The Sea Tiger is considerably more stable than the Nordkapp. The latter feels like a thoroughbred which the former does not. This, of course, is completely subjective. In testing conditions the stability of the Sea Tiger gives it a clear edge.
The Nordkapp is an expedition boat and is designed to handle well when packed. When empty it is very bouncy. The Sea Tiger handles similarly whether packed or empty.

Capacity

I was surprised at the clear margin by which the Sea Tiger wins here. Not only does the boat hold a lot more than the Nordkapp, it will hold items of more awkward shapes and it is a lot easier to load. This is due to a combination of the boat's greater depth, the space between the hull and the pod and the angle of the rear hatch.

Comfort

No question here either. The backrest on my Nordkapp is adjusted perfectly and I've positioned Karrimat foam round the seat with loving care so that it fits me like the proverbial glove. Although the Sea Tiger seat feels unusual when first sitting on it, I felt at home as soon as I was on the water. Unpadded, I could spend hours in it comfortably. The Sea Tiger also gets high marks for not requiring a footrest with the result that there is plenty of room for my feet.
The Nordkapp is a drier boat, not through any noticeable difference in water displacement but because a twin seal spraydeck keeps the cockpit dry in almost any conditions. I have not been able to find a spraydeck that prevents water entering the Sea Tiger in anything but the calmest conditions. As the area of the bottom of the pod is comparatively small, several inches of water can accumulate in a short time. Good overtrousers or a wet suit are essential.

Handling out of the water

I expected the Sea Tiger to have a clear edge. The shorter length and the metal rails alongside the cockpit do make it easier to manoeuvre than the Nordkapp and the shape of the pod results in water emptying naturally from the cockpit as soon as the boat is turned on its side. However, the impossibility of getting one's fingers round the inside of the cockpit combing (owing to the design of the pod) make it more difficult to manoeuvre in some situations. For the solo paddler, the Sea Tiger has a substantial advantage as it can be carried laden far more easily.

Safety

I won't go over the arguments concerning the pod and deck rails that have been aired before in this magazine. I confess that I had been unable to visualise the pod from what I had read. There is no doubt that this is the area where the Sea Tiger has the greatest advantage. For an average paddler like me, the possibility of self and assisted recovery is transformed. Rolling it with the pod full of water without the spraydeck is almost as easy as rolling it with the spraydeck on. Re-entry in a deep sea and subsequent rolling is comparatively straightforward.

Workmanship

Until recently I'd have taken good workmanship for granted. My Nordkapp was perfect on arrival and it was entirely watertight until time and repeated chipping of the gelcoat on rocks took their toll. However, when Valley fitted the rudder the quality was not the same. The seal between the rudder and the hull leaked, the flanges that hold the cables in position dropped off within days, and, as explained earlier, the footrest flange broke after two years. On the Sea Tiger, the skeg required major surgery with an electric sander before it would move freely and the boat had to be returned to find the cause of leaking hatches. I'm assured that the fault lay in the manufacture of Valley hatches.

Conclusion

Which would I choose? If I was going out in modest seas, did not have to carry a massive load and wanted an aesthetically pleasing kayak I'd take the Nordkapp. It looks the part and has a balance and indefinable character that the Sea Tiger lacks. If there was a chance of testing conditions or I wanted to carry a massive load, the pleasure of paddling the Nordkapp would be outweighed by the sheer practicality and safety features of the Sea Tiger.

Appendix three
Telephone conversation with David Hayter (Sea Tiger user) 21/8/89

By Duncan Winning

As David was a user of the Sea Tiger I enquired about problems with the deck-hull joint. In 1987 David's Sea Tiger suffered a 3" (7.5 cm) split at the seam after being strapped down on a roof rack in a fully loaded condition and driven for some hours, the last section on rough island roads with some severe jolts. Immediately thereafter David and a companion crossed the Minch. Conditions became N F5 to 6, i.e. on the beam, with wind over tide. David's boat took water in at the seam. On reaching the Outer Hebrides David emptied out 10 to 15 gallons he reckons (45 to 68 litres). He could not have got much more in because of the amount of gear in the boat. He said that although he realised he had water on board, his boat still handled acceptably in the conditions and was faster than his companion, a Nordkapp with a rudder! Due to conditions!

During David's solo St. Kilda trip he and Sea Tiger slid some 25 feet (8 metres) down the rock of Haskeir, and got swept up under an overhang, damaging some of his deck mounted equipment. He was able to perform a self recovery and get his loaded kayak righted and hauled back up the rock. He doubted the feasibility of achieving this without a safety cockpit.

He also spoke of landing in bad conditions by swimming in with boat in tow and stated that the deck arrangement on the Sea Tiger made the attachment of lines before leaving the cockpit more easily accomplished than a more conventional deck arrangement.

He complained at the attitude of the canoeing establishment in that he found information on sea kayaking omitted reference to the Sea Tiger which he has found to be the safest boat for him.

Appendix four
Report on Sea Tiger 8/xi/89

By George Kerr

The canoe was found to be very buoyant and very stable by several beginners who have only been canoeing for three months. They much preferred it to the county Nordkapps which they usually paddle. It responded well to turns and manoeuvrability tests but was almost impossible to turn by a beginner with the skeg in the lowered position. Its directional stability in a quartering sea was excellent with the skeg down. This also helps considerably with its stability in beam seas.

The canoe was filled with water in the hatches to simulate swamping from a crack or hole below the waterline. It was still paddleable with approx. 150 litres of water aboard and a 76.2 kg paddler. At 200 litres of water it was barely paddleable but was still fairly high in the water thanks to the foam buoyancy, presumably 13.3 kg at each end. The test was carried out in F3 conditions in short steep waves and there was no problem encountered in water rushing from bow to stern provided one was aware of the sloshing action in dipping the bow and stern alternately. With 150 litres of water aboard it was quite fun actually. The most disappointing aspect of the whole canoe was the fact that you were always sitting in a pool of water which very quickly made you cold and wet in the lower extremities.

Table 1 Index of 81 photographs with kayak type and degree flooded.
Key: MVC = minimum volume cockpit; primary buoyancy = closed compartment; secondary buoyancy = solid foam end blocks

Photograph	Kayak	Internal arrangement	Buoyancy	Compartment(s) flooded	Volume (litres)	Original report reference	Date
Fig. 1	Sea Tiger	MVC/confluent hull	primary + secondary	none	0	0.1	5.xi.89
Fig. 2	Sea Tiger	MVC/confluent hull	primary + secondary	hull	40	0.2	5.xi.89
Fig. 3	Sea Tiger	MVC/confluent hull	primary + secondary	hull	60	0.3	5.xi.89
Fig. 4	Sea Tiger	MVC/confluent hull	primary + secondary	hull	60	0.4	5.xi.89
Fig. 5	Sea Tiger	MVC/confluent hull	primary + secondary	hull	80	0.5	5.xi.89
Fig. 6	Sea Tiger	MVC/confluent hull	primary + secondary	hull	100	0.6	5.xi.89
Fig. 7	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	120	0.7	5.xi.89
Fig. 8	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	120	0.8	5.xi.89
Fig. 9	Sea Tiger	MVC/confluent hull	primary + secondary	none	0	1.1	28.v.90
Fig. 10	Sea Tiger	MVC/confluent hull	primary + secondary	hull	60	1.2	28.v.90
Fig. 11	Sea Tiger	MVC/confluent hull	primary + secondary	hull	80	1.3	28.v.90
Fig. 12	Sea Tiger	MVC/confluent hull	primary + secondary	hull	100	1.4	28.v.90
Fig. 13	Sea Tiger	MVC/confluent hull	primary + secondary	hull	120	1.5	28.v.90
Fig. 14	Sea Tiger	MVC/confluent hull	primary + secondary	hull	140	1.6	28.v.90
Fig. 15	Sea Tiger	MVC/confluent hull	primary + secondary	hull	160	1.7	28.v.90
Fig. 16	Sea Tiger	MVC/confluent hull	primary + secondary	hull	180	1.8	28.v.90
Fig. 17	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	180	3.22	28.v.90
Fig. 18	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	180	3.23	28.v.90
Fig. 19	Sea Tiger	MVC/confluent hull	primary + secondary	none	0	3.10	9.vi.90
Fig. 20	Sea Tiger	MVC/confluent hull	primary + secondary	hull	40	3.11	9.vi.90
Fig. 21	Sea Tiger	MVC/confluent hull	primary + secondary	hull	60	3.12	9.vi.90
Fig. 22	Sea Tiger	MVC/confluent hull	primary + secondary	hull	80	3.13	9.vi.90
Fig. 23	Sea Tiger	MVC/confluent hull	primary + secondary	hull	100	3.14	9.vi.90

Photograph	Kayak	Internal arrangement	Buoyancy	Compartment(s) flooded	Volume (litres)	Original report reference	Date
Fig. 24	Sea Tiger	MVC/confluent hull	primary + secondary	hull	120	3.15	9.vi.90
Fig. 25	Sea Tiger	MVC/confluent hull	primary + secondary	hull	140	3.16	9.vi.90
Fig. 26	Sea Tiger	MVC/confluent hull	primary + secondary	hull	160	3.17	9.vi.90
Fig. 27	Sea Tiger	MVC/confluent hull	primary + secondary	hull	200	3.18	9.vi.90
Fig. 28	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	200	3.19	9.vi.90
Fig. 29	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	200	3.20	9.vi.90
Fig. 30	Sea Tiger	MVC/confluent hull	primary + secondary	hull + cockpit	200	3.21	9.vi.90
Fig. 31	Anas Acuta	two bulkheads	primary only	none	0	1.90	30.v.90
Fig. 32	Anas Acuta	two bulkheads	primary only	bow	20	1.12	30.v.90
Fig. 33	Anas Acuta	two bulkheads	primary only	bow	40	1.13	30.v.90
Fig. 34	Anas Acuta	two bulkheads	primary only	bow	50	1.14	30.v.90
Fig. 35	Anas Acuta	two bulkheads	primary only	bow + cockpit	50	1.15	30.v.90
Fig. 36	Anas Acuta	two bulkheads	primary only	bow + cockpit	65	1.16	30.v.90
Fig. 37	Anas Acuta	two bulkheads	primary only	bow	>65	1.17	30.v.90
Fig. 38	Anas Acuta	two bulkheads	primary only	cockpit	20	1.18	30.v.90
Fig. 39	Anas Acuta	two bulkheads	primary only	cockpit	40	1.19	30.v.90
Fig. 40	Anas Acuta	two bulkheads	primary only	cockpit	60	1.20	30.v.90
Fig. 41	Anas Acuta	two bulkheads	primary only	cockpit	80	1.21	30.v.90
Fig. 42	Anas Acuta	two bulkheads	primary only	cockpit	95	1.22	30.v.90
Fig. 43	Anas Acuta	two bulkheads	primary only	stern	50	1.23	30.v.90
Fig. 44	Anas Acuta	two bulkheads	primary only	stern	>50	1.24	30.v.90
Fig. 45	Anas Acuta	two bulkheads	primary only	stern	>50	1.25	30.v.90
Fig. 46	Anas Acuta	two bulkheads	primary only	stern + cockpit	>50	2.10	30.v.90
Fig. 47	Nordkapp	two bulkheads	primary only	none	0	2.30	30.v.90
Fig. 48	Nordkapp	two bulkheads	primary only	bow	20	2.40	30.v.90

Photograph	Kayak	Internal arrangement	Buoyancy	Compartment(s) flooded	Volume (litres)	Original report reference	Date
Fig. 49	Nordkapp	two bulkheads	primary only	bow	40	2.50	30.v.90
Fig. 50	Nordkapp	two bulkheads	primary only	bow	55	2.60	30.v.90
Fig. 51	Nordkapp	two bulkheads	primary only	bow	>55	2.70	30.v.90
Fig. 52	Nordkapp	two bulkheads	primary only	bow + cockpit	>55	2.80	30.v.90
Fig. 53	Nordkapp	two bulkheads	primary only	stern	20	2.90	30.v.90
Fig. 54	Nordkapp	two bulkheads	primary only	stern	40	2.10	30.v.90
Fig. 55	Nordkapp	two bulkheads	primary only	stern	57	2.11	30.v.90
Fig. 56	Nordkapp	two bulkheads	primary only	stern	>57	2.12	30.v.90
Fig. 57	Nordkapp	two bulkheads	primary only	stern + cockpit	>57	2.13	30.v.90
Fig. 58	Nordkapp	two bulkheads	primary only	cockpit	40	2.14	30.v.90
Fig. 59	Nordkapp	two bulkheads	primary only	cockpit	60	2.16	30.v.90
Fig. 60	Nordkapp	two bulkheads	primary only	cockpit	80	2.17	30.v.90
Fig. 61	Hebrides 1	two bulkheads	primary only	none	0	2.18	4.vi.90
Fig. 62	Hebrides 1	two bulkheads	primary only	bow	75	2.19	4.vi.90
Fig. 63	Hebrides 1	two bulkheads	primary only	bow	>75	2.20	4.vi.90
Fig. 64	Hebrides 1	two bulkheads	primary only	stern	90	2.23	4.vi.90
Fig. 65	Hebrides 2	two bulkheads	primary + secondary	bow	full	3.10	4.vi.90
Fig. 66	Hebrides 2	two bulkheads	primary + secondary	stern	full	3.20	4.vi.90
Fig. 67	Hebrides 1	two bulkheads	primary only	bow + stern + cockpit	sunk	3.60	4.vi.90
Fig. 68	Hebrides 2	two bulkheads	primary + secondary	bow + stern + cockpit	full	3.70	4.vi.90
Fig. 69	Hebrides 2	two bulkheads	primary + secondary	cockpit	full	3.90	4.vi.90
Fig. 70	KW7	MVC/confluent hull	primary + secondary	hull	0	4.00	9.vi.90
Fig. 71	KW7	MVC/confluent hull	primary + secondary	hull	20	4.10	9.vi.90
Fig. 72	KW7	MVC/confluent hull	primary + secondary	hull	40	4.20	9.vi.90
Fig. 73	KW7	MVC/confluent hull	primary + secondary	hull	60	4.30	9.vi.90

Photograph	Kayak	Internal arrangement	Buoyancy	Compartment(s) flooded	Volume (litres)	Original report reference	Date
Fig. 74	KW7	MVC/confluent hull	primary + secondary	hull	80	4.40	9.vi.90
Fig. 75	KW7	MVC/confluent hull	primary + secondary	hull	100	4.50	9.vi.90
Fig. 76	KW7	MVC/confluent hull	primary + secondary	hull	120	4.60	9.vi.90
Fig. 77	KW7	MVC/confluent hull	primary + secondary	hull	140	4.80	9.vi.90
Fig. 78	KW7	MVC/confluent hull	primary + secondary	hull	160	4.90	9.vi.90
Fig. 79	KW7	MVC/confluent hull	primary + secondary	hull	180	4.10	9.vi.90
Fig. 80	KW7	MVC/confluent hull	primary + secondary	hull	200	4.13	9.vi.90
Fig. 81	KW7	MVC/confluent hull	primary + secondary	hull + cockpit	200	4.14	9.vi.90

Fig. 1 Winning 1990

Fig. 2 Winning 1990

Fig. 3 Winning 1990

Fig. 4 Winning 1990

Fig. 5 Winning 1990

Fig. 6 Winning 1990

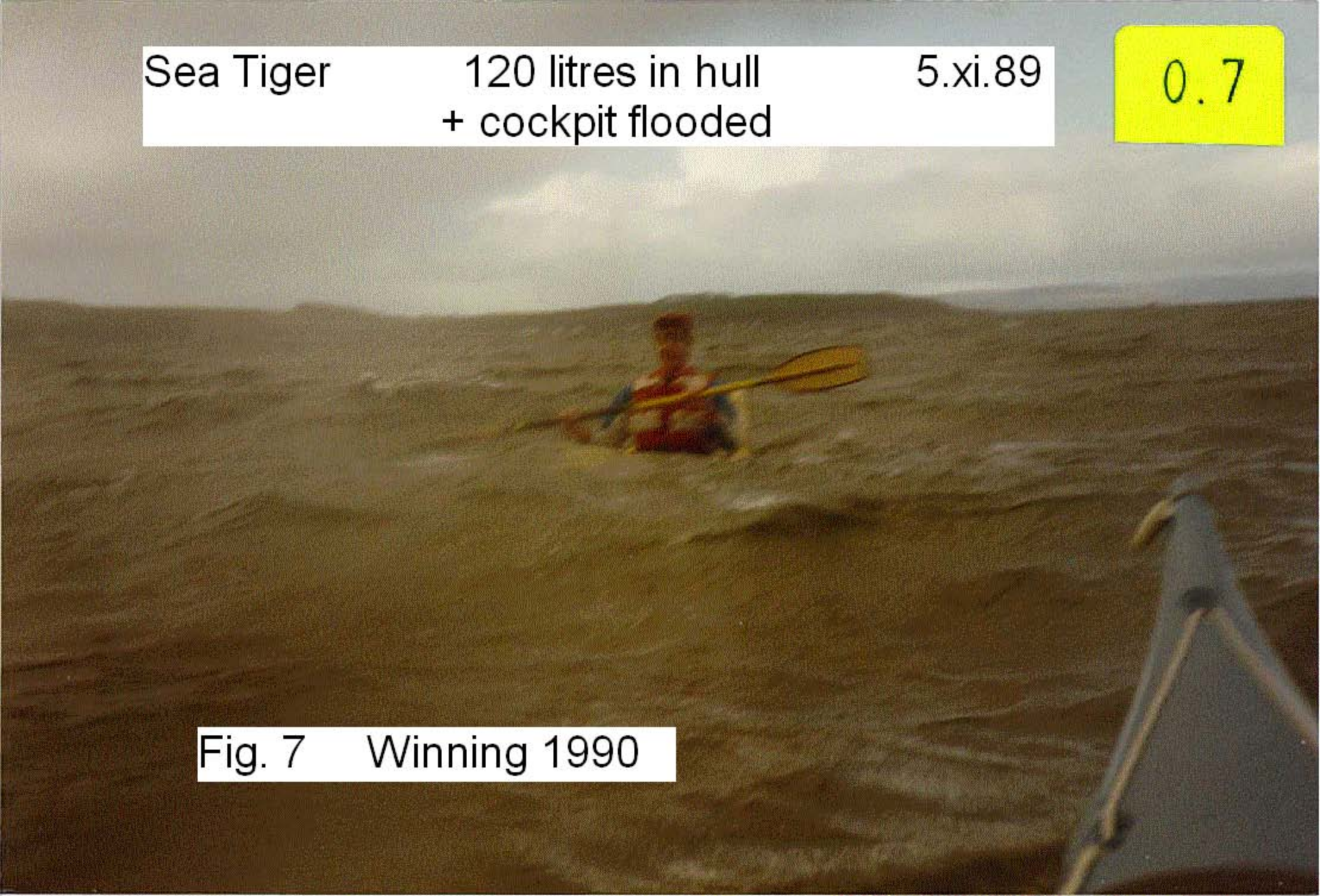


Fig. 7 Winning 1990

Fig. 8 Winning 1990

Fig. 9 Winning 1990

Sea Tiger 60 litres in hull 28.v.90 1.2

Fig. 10 Winning 1990

Sea Tiger 80 litres in hull cockpit dry 28.v.90 1.3

Fig. 11 Winning 1990

Sea Tiger 100 litres in hull cockpit dry 28.v.90

Fig. 12 Winning 1990

Sea Tiger 120 litres in hull 28.v.90
cockpit dry

Fig. 13 Winning 1990

Fig. 14 Winning 1990

Sea Tiger 160 litres in hull cockpit dry 28.v.90

Fig. 15 Winning 1990

Sea Tiger 180 litres in hull cockpit dry 28.v.90 1.8

Sea Tiger 180 litres in hull 28.v.90
+ cockpit flooded

Fig. 17 Winning 1990

Sea Tiger 180 litres in hull 28.v.90
+ cockpit flooded

Fig. 18 Winning 1990

Sea Tiger 0 litres in hull 9.vi.90 3.10

Fig. 19 Winning 1990

Sea Tiger 40 litres in hull 9.vi.90 3.11

Fig. 20 Winning 1990

Fig. 21 Winning 1990

Sea Tiger 80 litres in hull 9.vi.90 3.13

Fig. 22 Winning 1990

Fig. 23 Winning 1990

Fig. 24 Winning 1990

Sea Tiger	140 litres in hull cockpit dry	9.vi.90	3.16

Fig. 25 Winning 1990

Sea Tiger	160 litres in hull cockpit dry	9.vi.90

3.17

Fig. 26 Winning 1990

Fig. 27 Winning 1990

Sea Tiger 200 litres in hull 9.vi.90 3.19
+ pod cockpit flooded, water flowing out of aft hatch

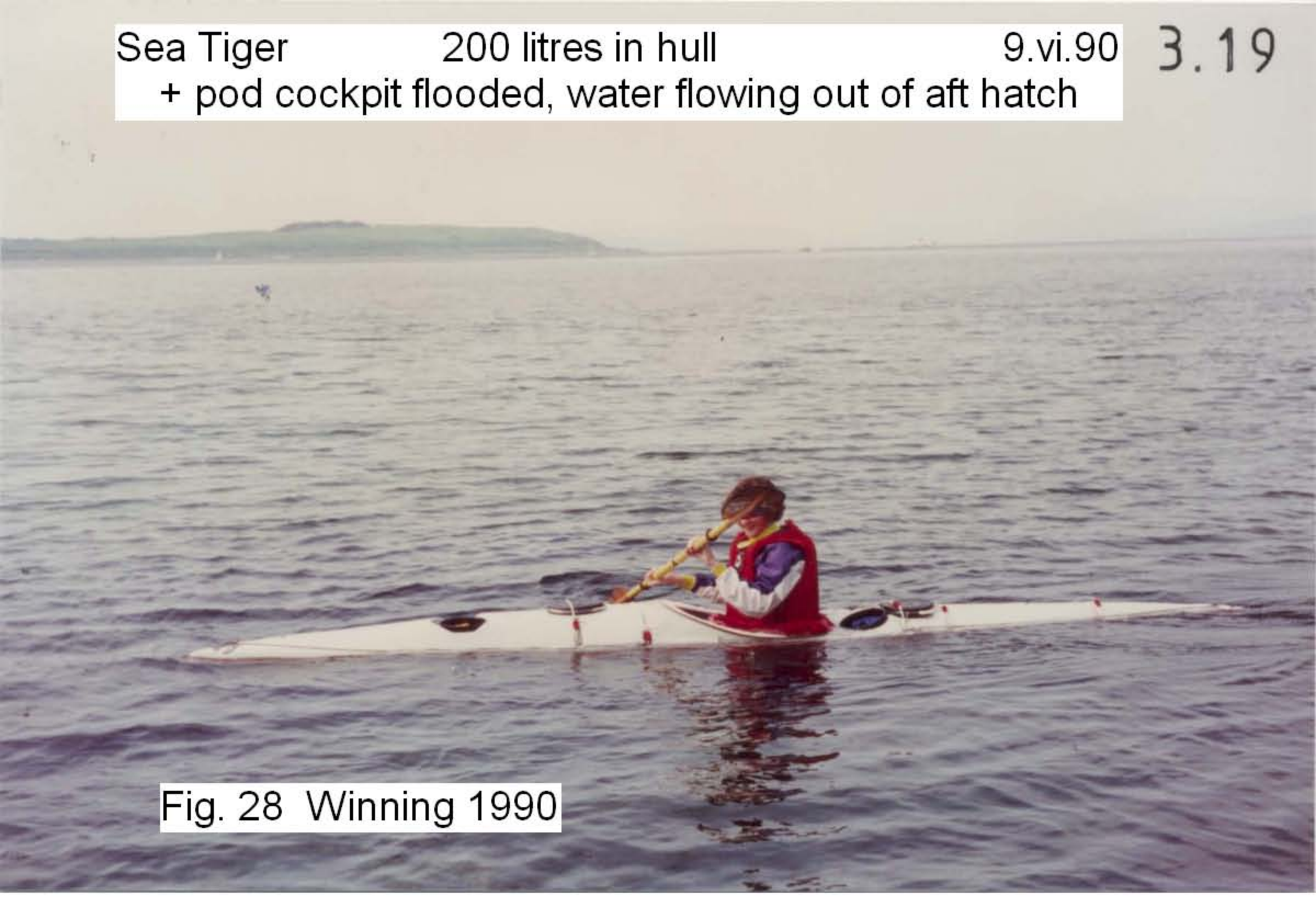


Fig. 28 Winning 1990

Fig. 29 Winning 1990

Sea Tiger about 200 litres in hull 9.vi.90
+ pod cockpit flooded, water flowing in and out of hatches
kayak supported by buoyancy blocks fore and aft,
being paddled hard

3:21

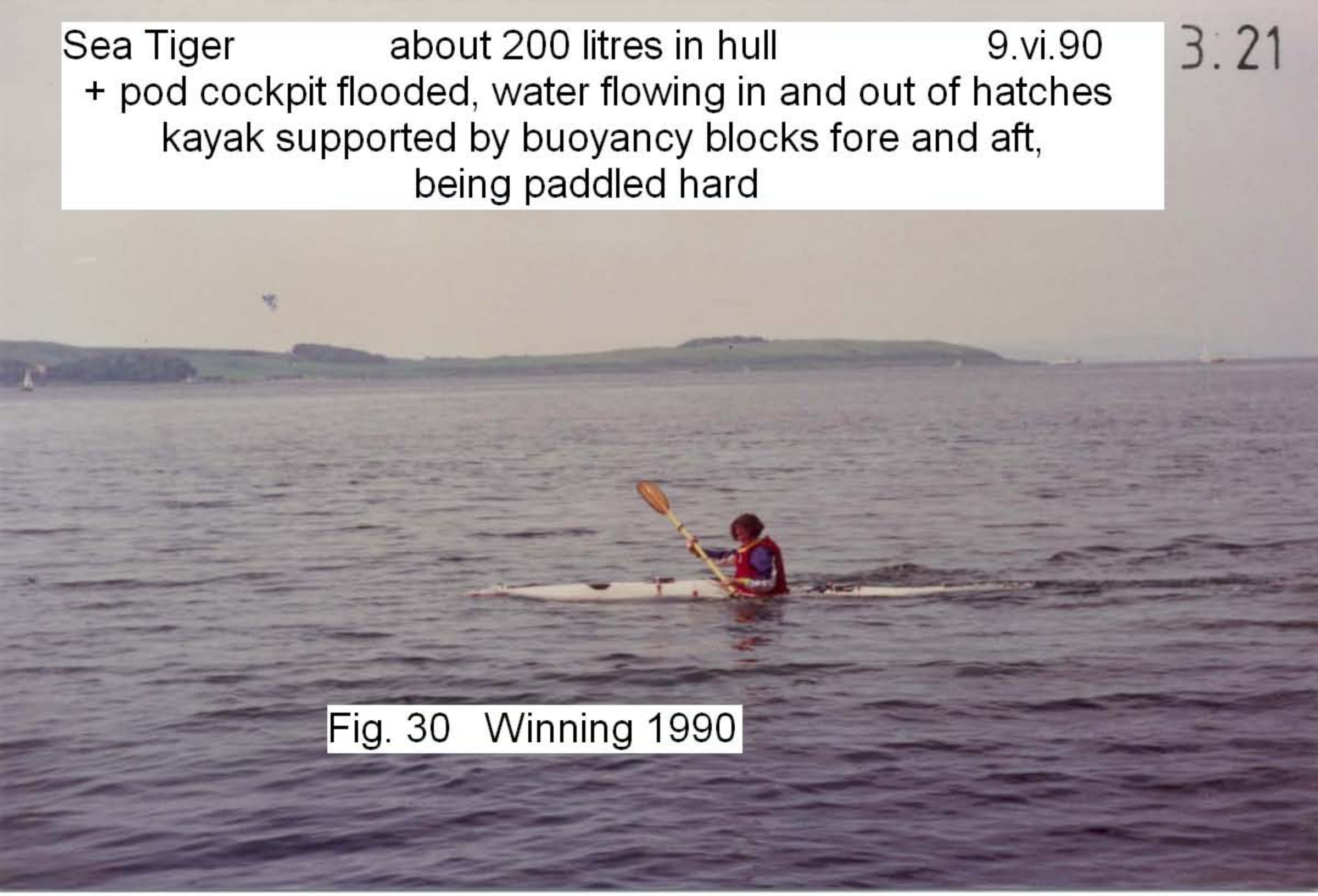


Fig. 30 Winning 1990

Fig. 31 Winning 1990

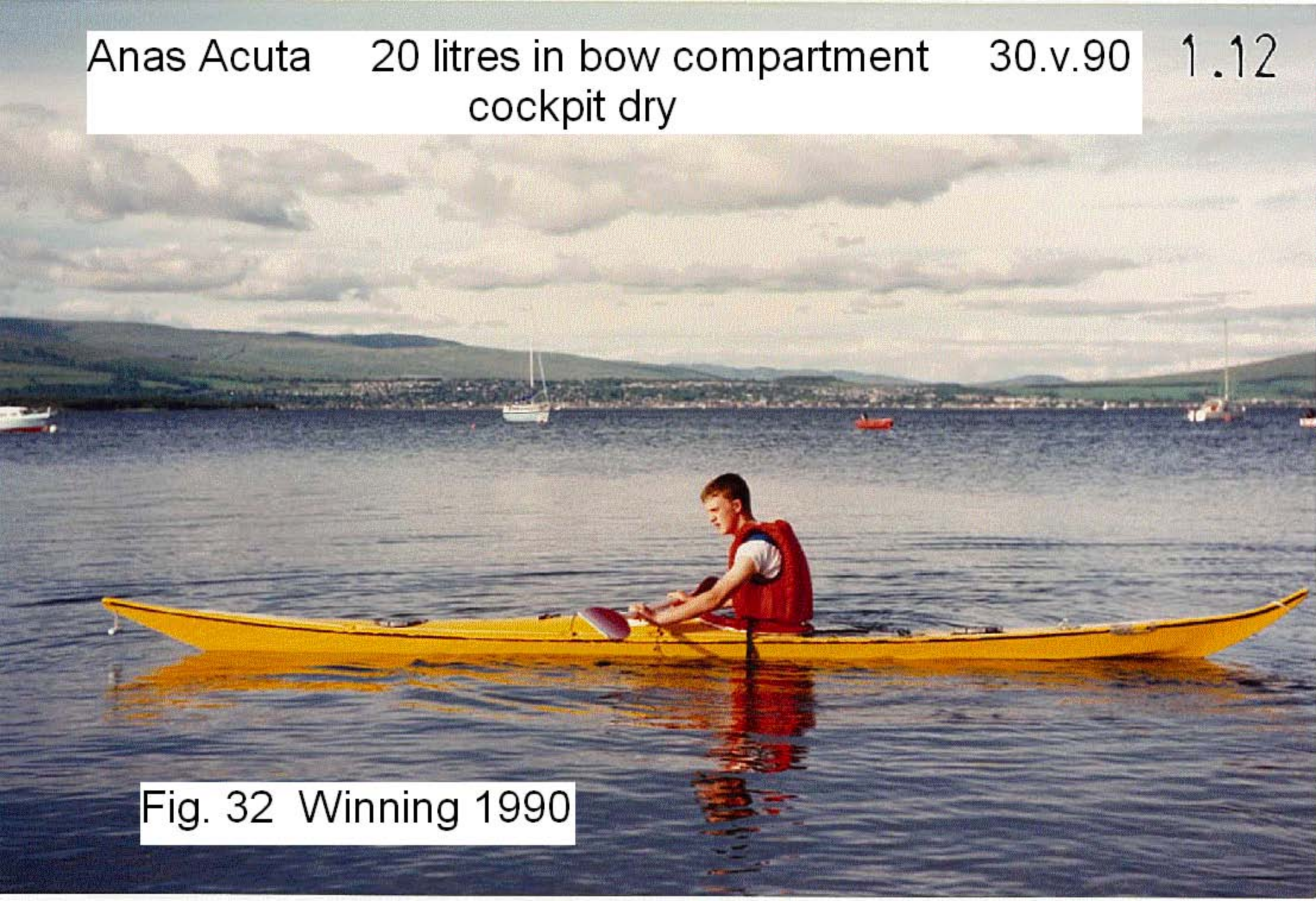
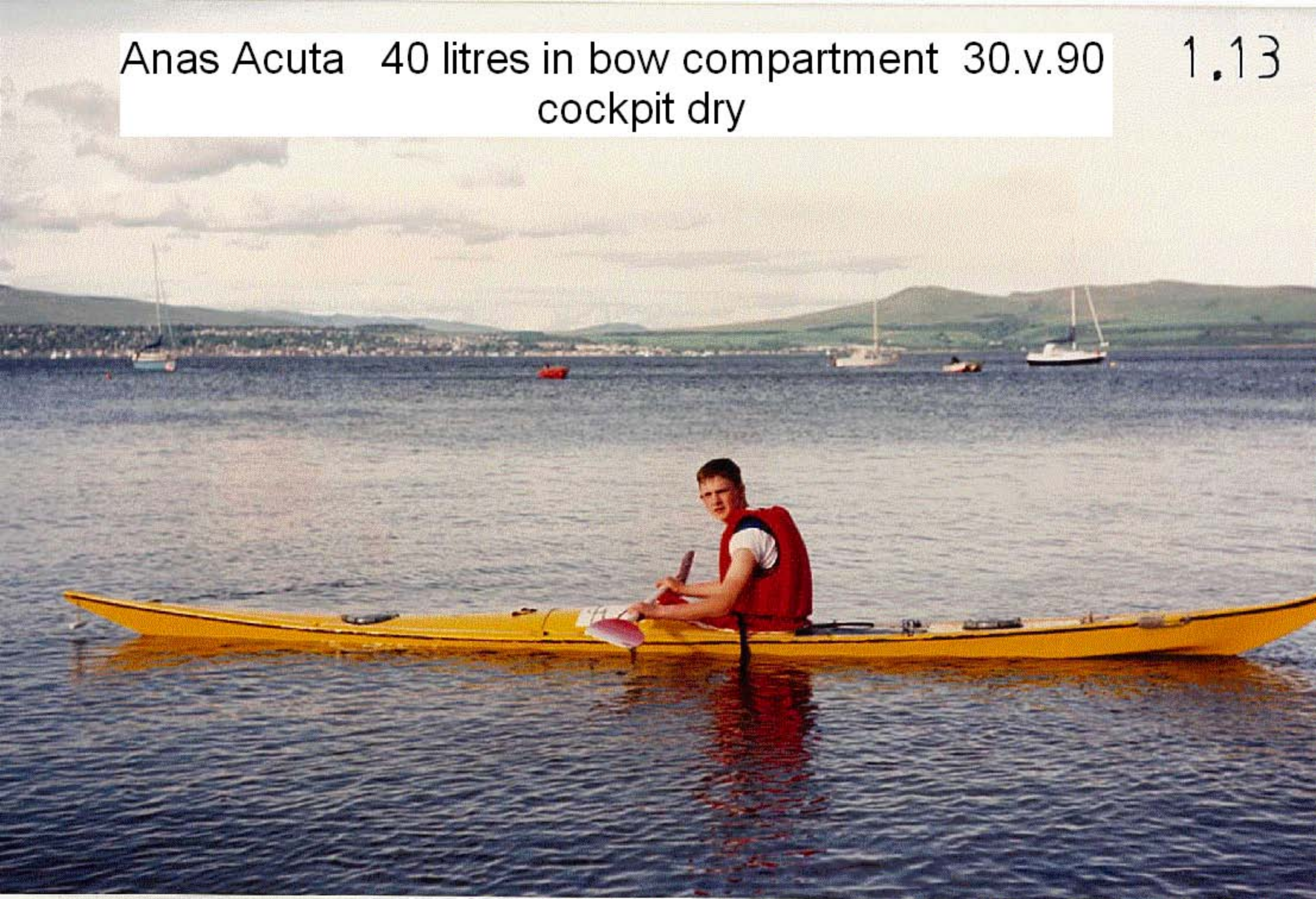


Fig. 32 Winning 1990


Anas Acuta 40 litres in bow compartment 30.v.90
cockpit dry
1.13

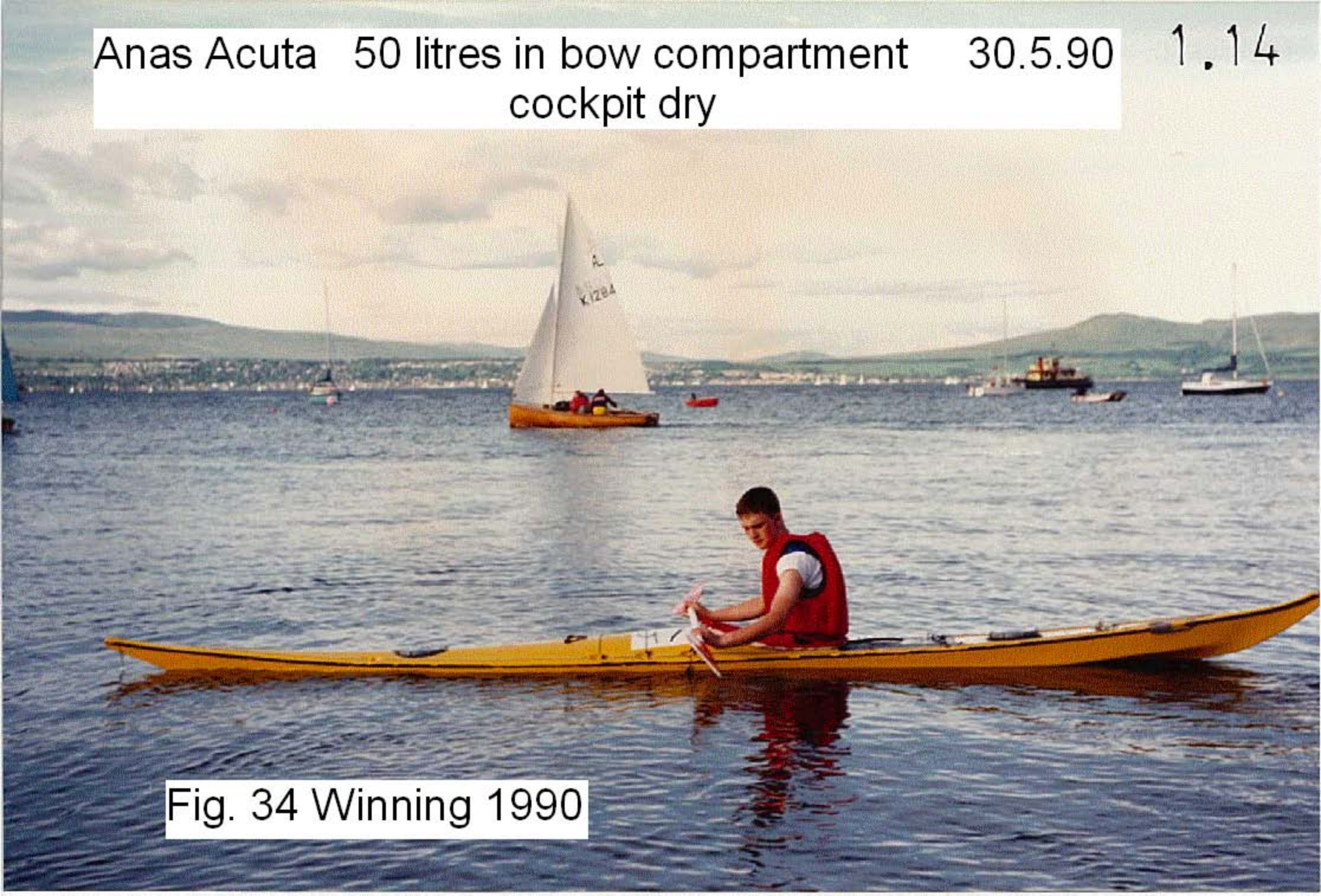


Fig. 34 Winning 1990

Anas Acuta 50 litres in bow compartment 30.v.90
cockpit flooded

1.15

Fig. 35 Winning 1990

Anas Acuta 50 litres in bow compartment 30.v.90 1.15
cockpit flooded (air trapped under foredeck)

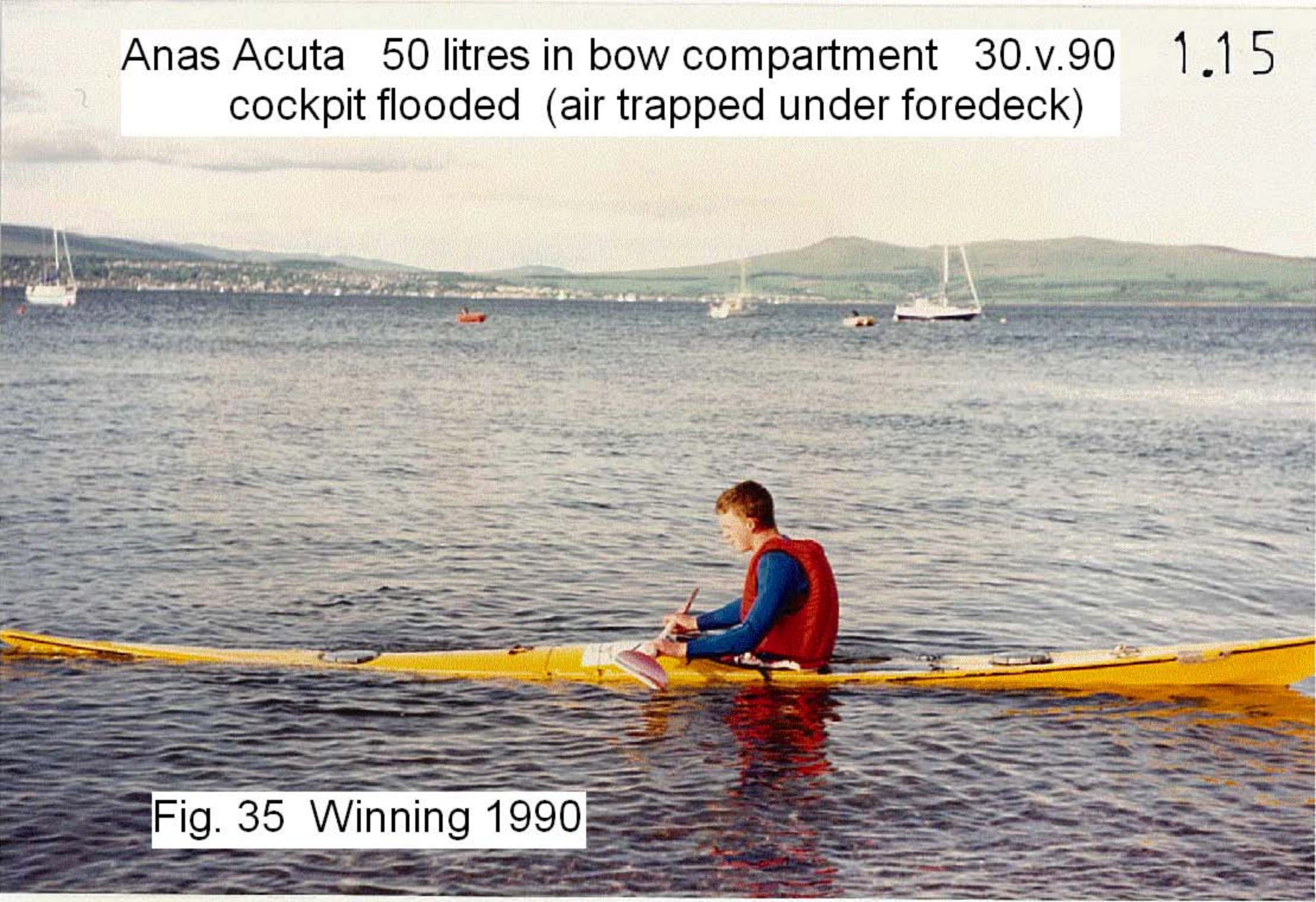


Fig. 35 Winning 1990


Anas Acuta 65 litres in bow compartment 30.v.90 1.16
cockpit flooded, bow resting on sea bed

Fig. 37 Winning 1990

Fig. 38 Winning 1990

Fig. 39 Winning 1990

Fig. 40 Winning 1990

Fig. 41 Winning 1990

Anas Acuta 95 litres in cockpit 30.v.90 1.22

Fig. 42 Winning 1990

Fig. 43 Winning 1990

Anas Acuta >50 litres in stern compartment 30.v.90 1.24
cockpit dry

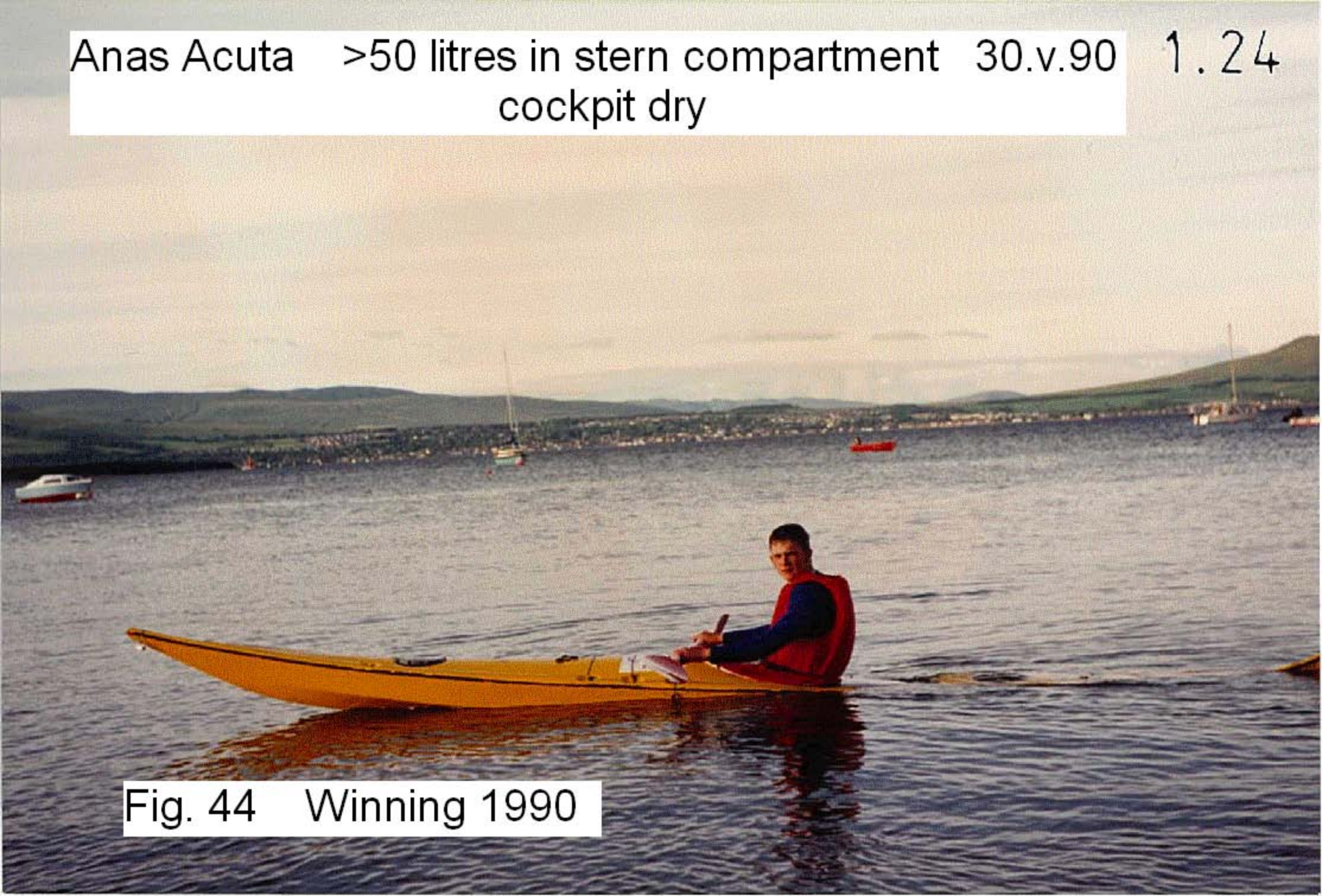


Fig. 44 Winning 1990

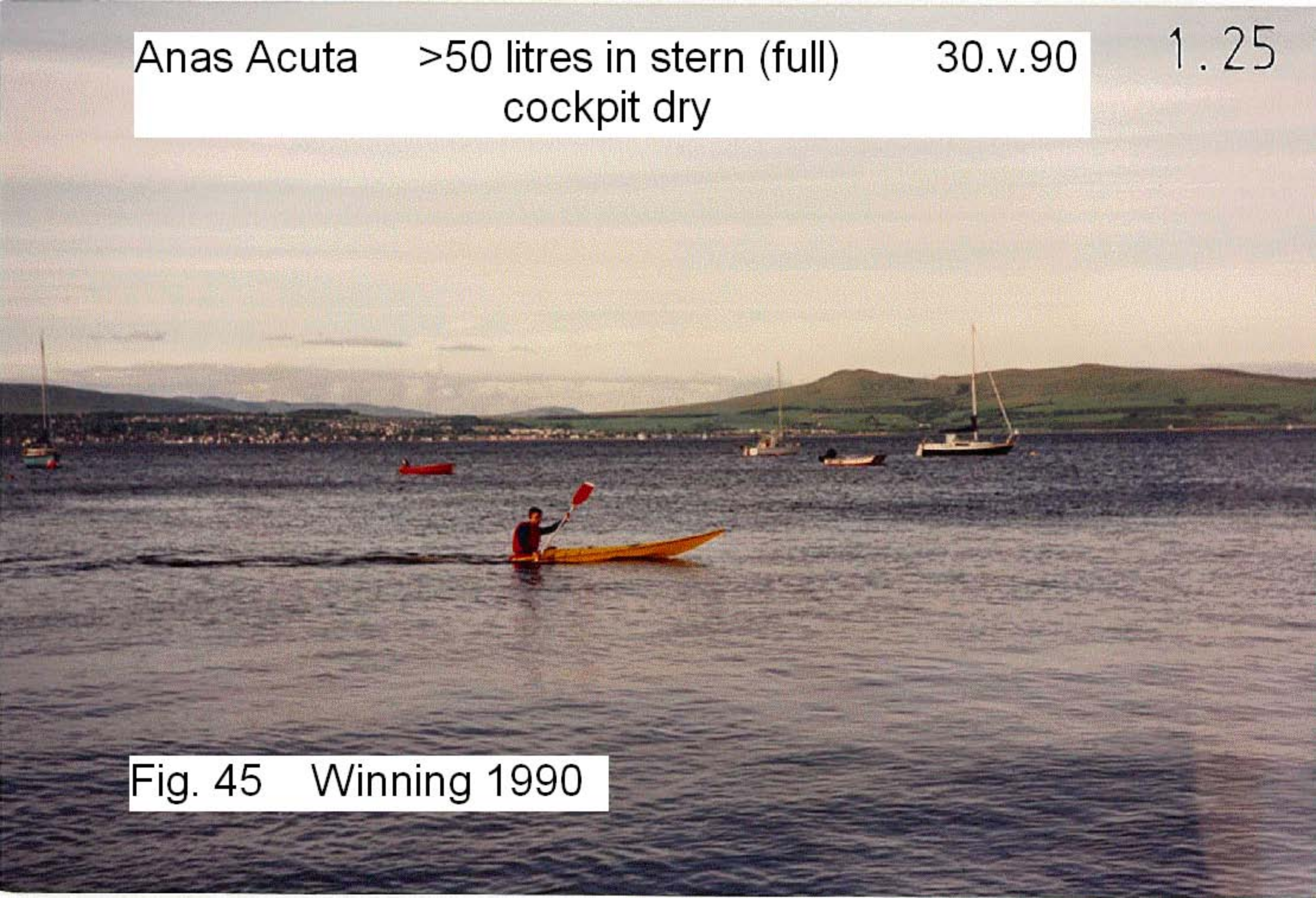


Fig. 45 Winning 1990

Anas Acuta >50 litres in stern + cockpit flooded 30.v.90
stern on sea bed

2.1

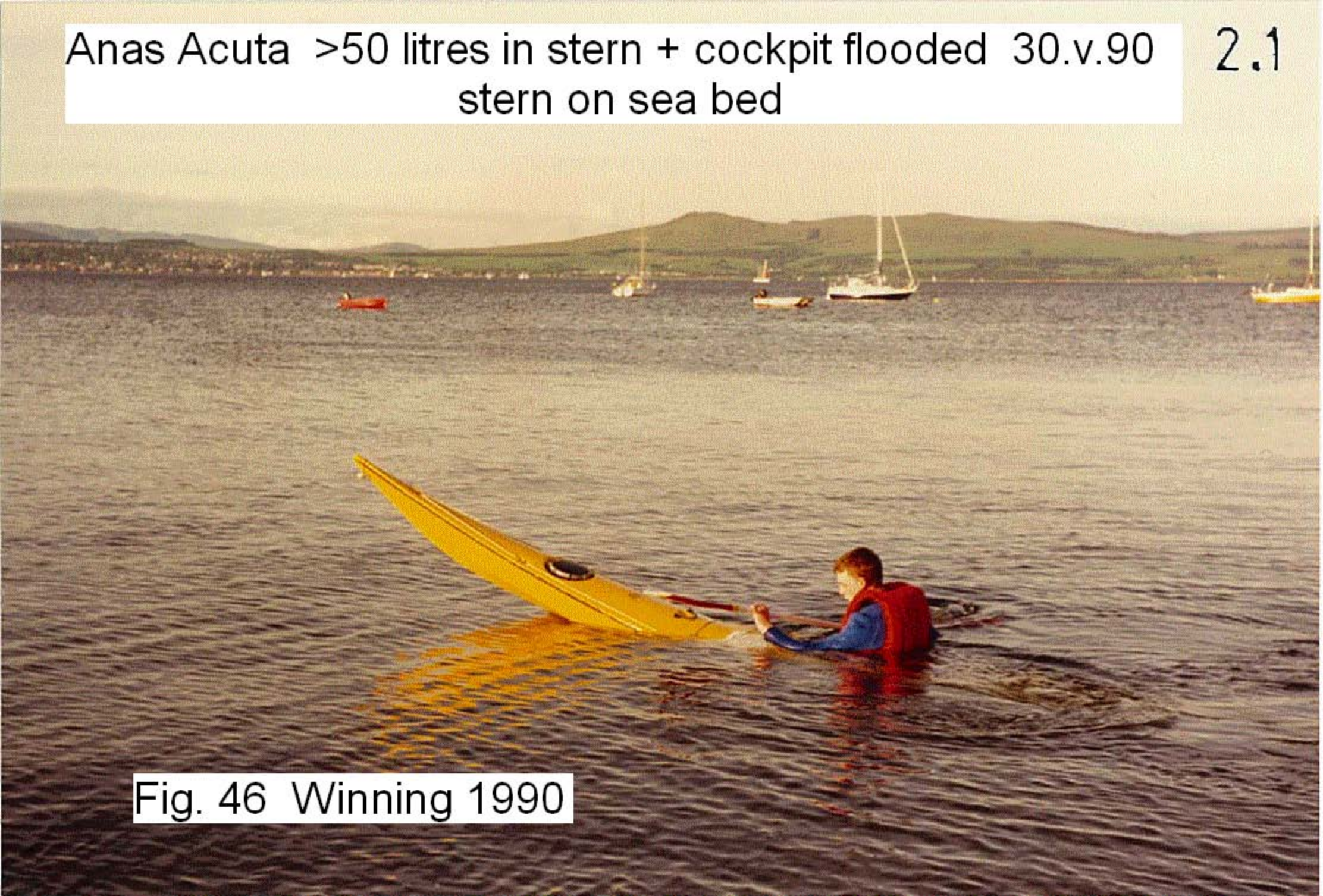


Fig. 46 Winning 1990

Nordkapp 0 litres 30.v.90 2.3

Fig. 47 Winning 1990

Nordkapp 20 litres in bow compartment 30.v.90 2.4

Fig. 48 Winning 1990

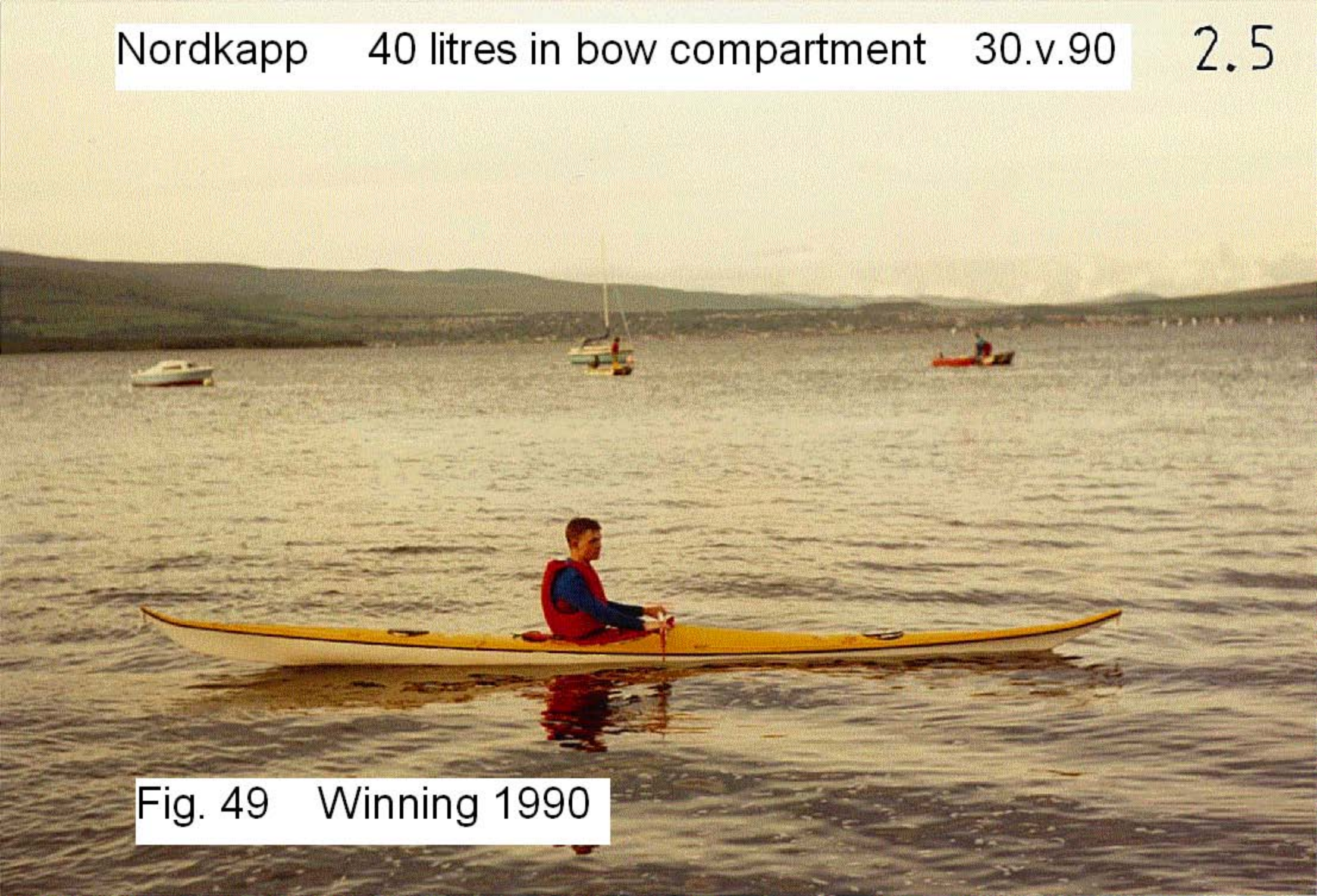


Fig. 49 Winning 1990

Fig. 50 Winning 1990

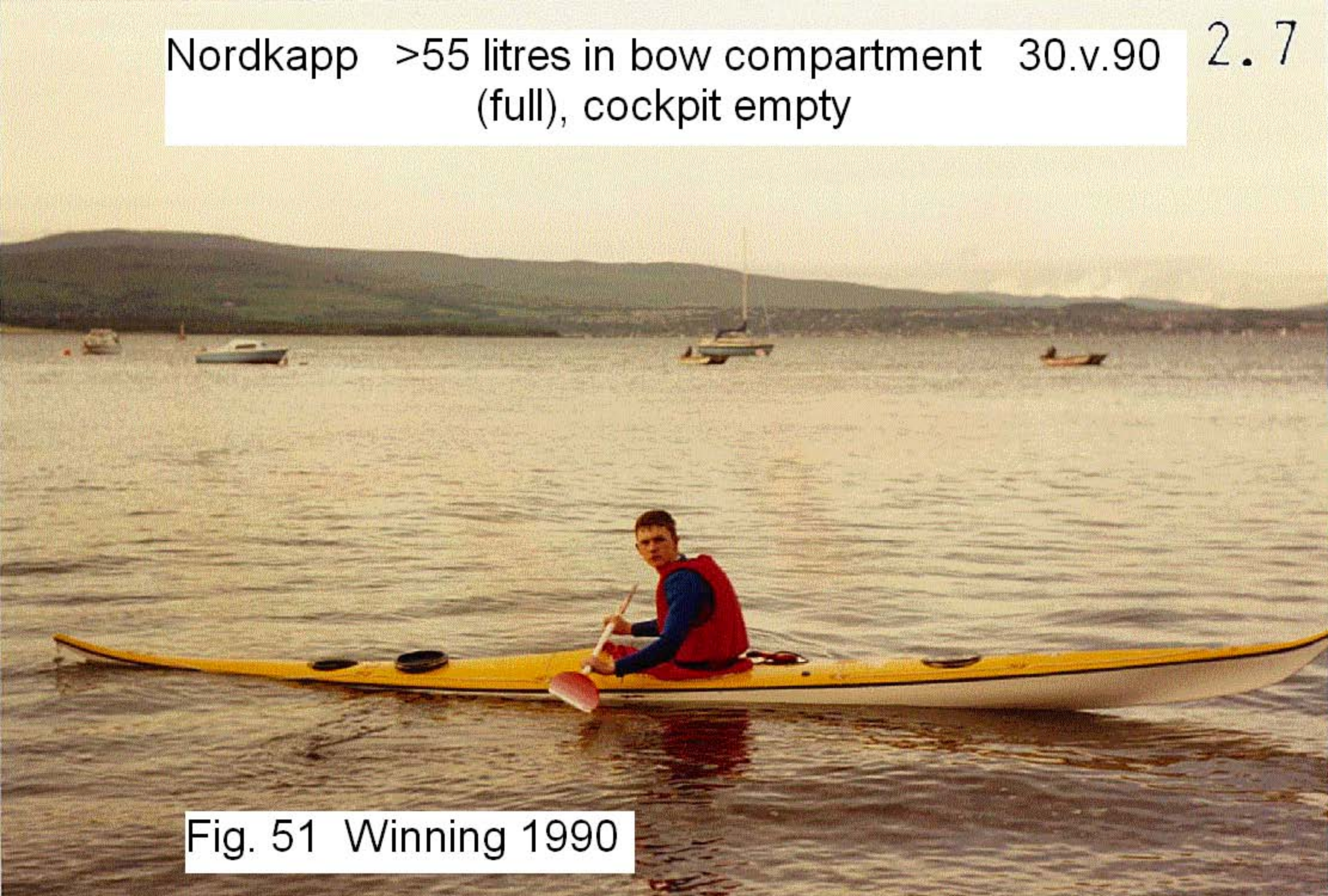


Fig. 51 Winning 1990

Nordkapp >55 litres in bow compartment 30.v.90
cockpit flooded, bow on sea bed

Fig. 52 Winning 1990

Nordkapp 20 litres in stern 30.v.90

Fig. 53 Winning 1990

Fig. 54 Winning 1990

Nordkapp 57 litres in stern 30.v.90

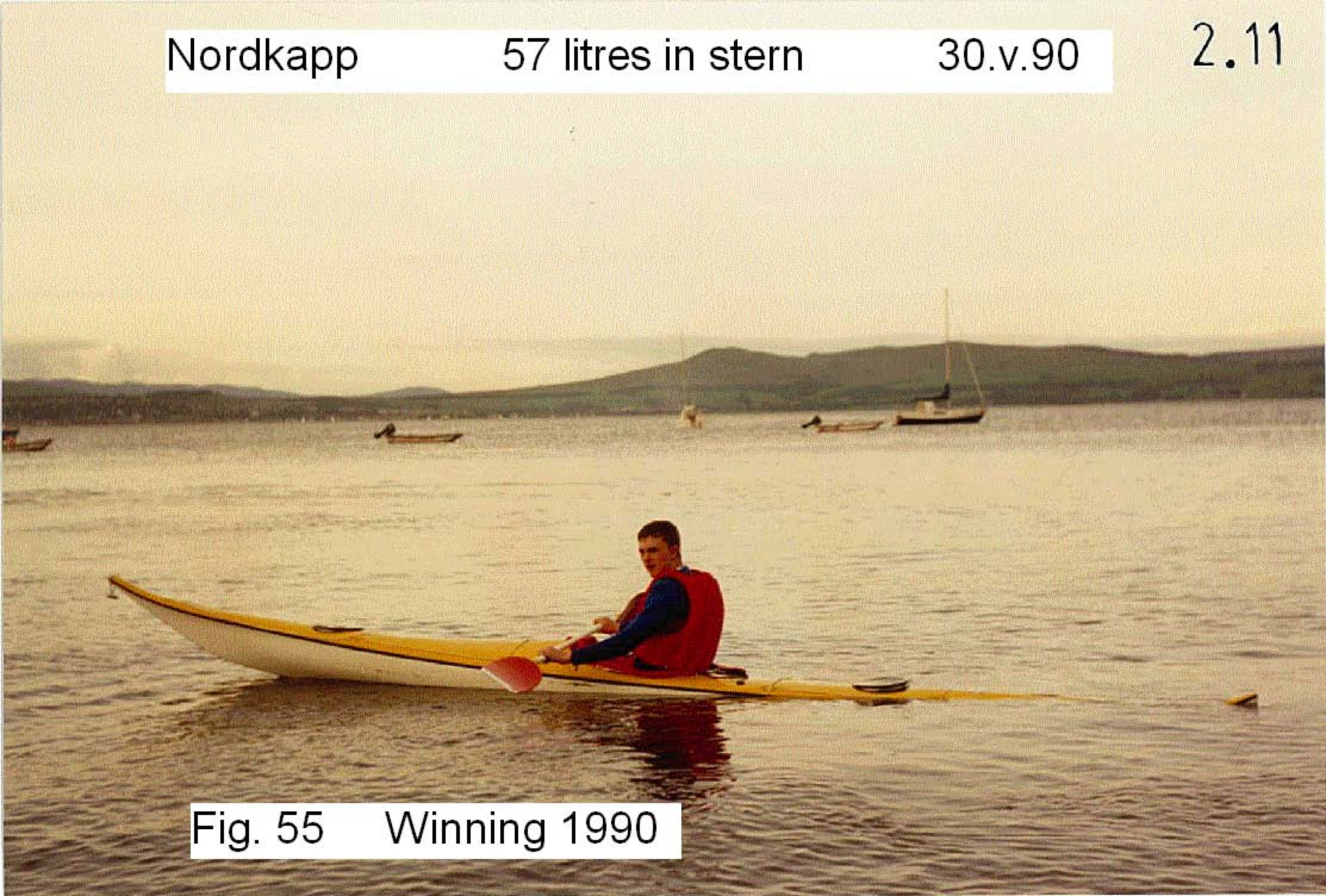


Fig. 55 Winning 1990

Nordkapp >57 litres in stern (full), cockpit empty 30.v.90 2.12

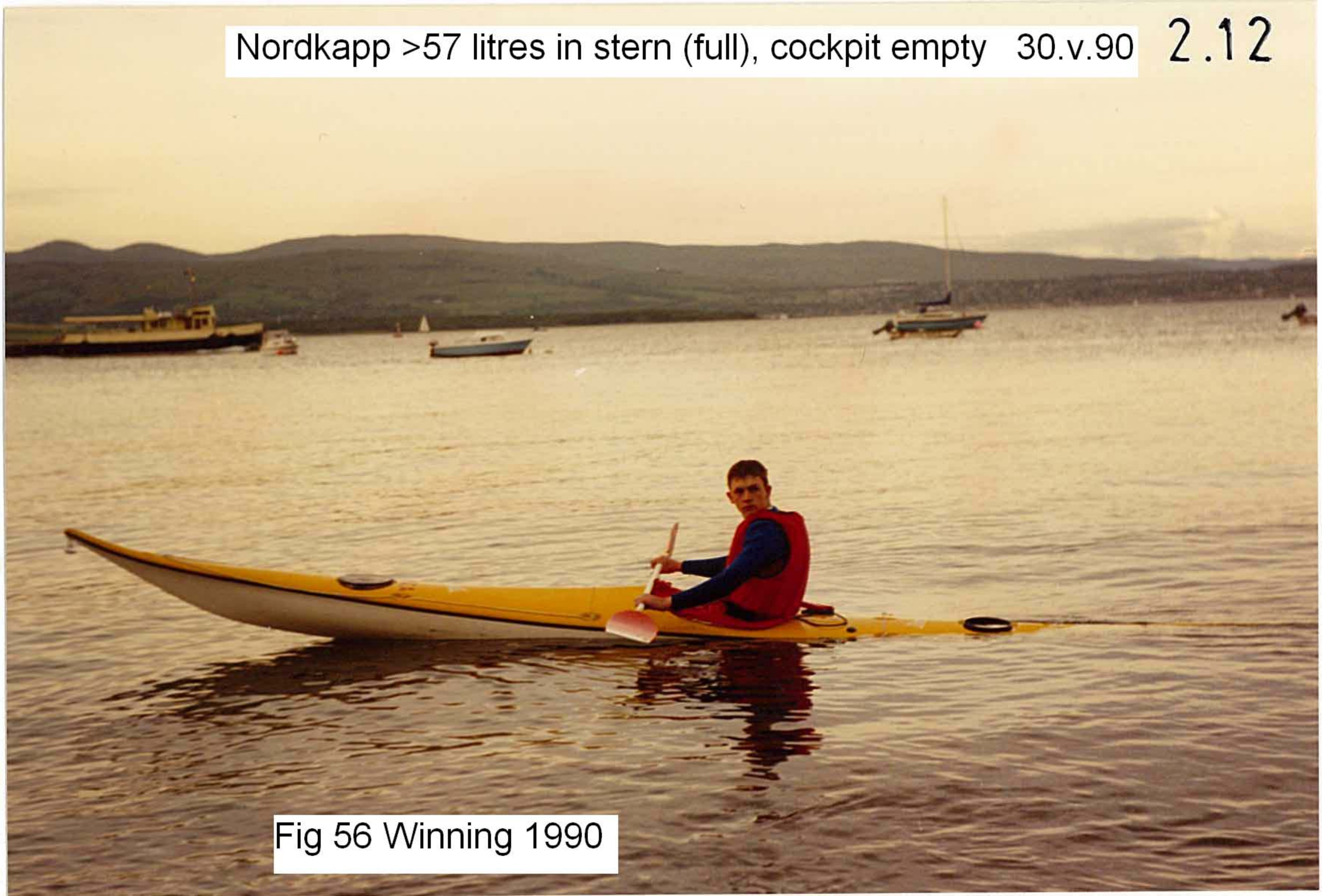


Fig 56 Winning 1990

Nordkapp >57 litres in aft compartment 30/v/90
+ cockpit flooded, stern on bottom

Fig. 57 Winning 1990

Nordkapp 40 litres in cockpit 30/v/90 2.14

Fig. 58 Winning 1990

Fig. 59 Winning 1990

Fig. 60 Winning 1990

Fig. 61 Winning 1990

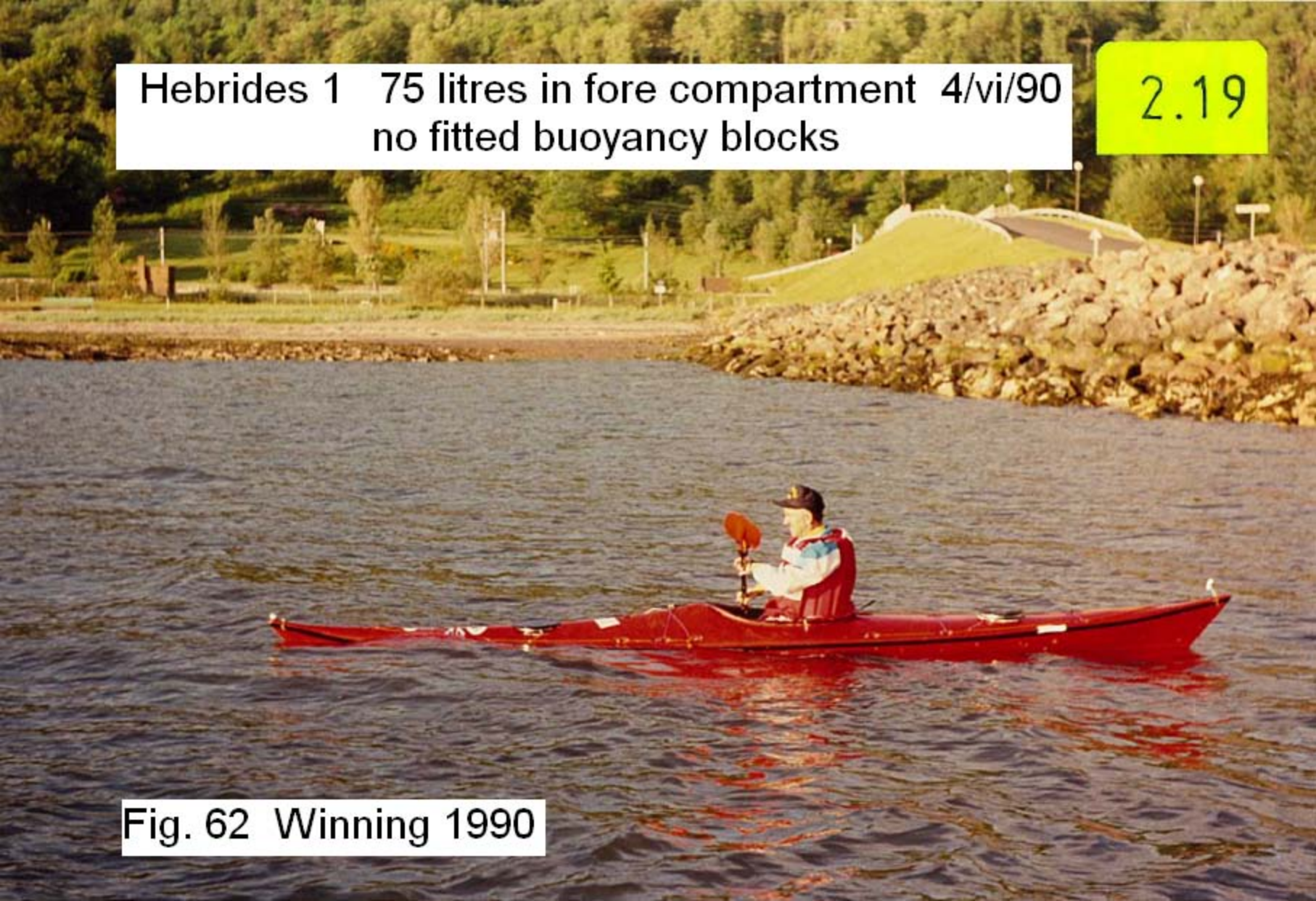


Fig. 62 Winning 1990

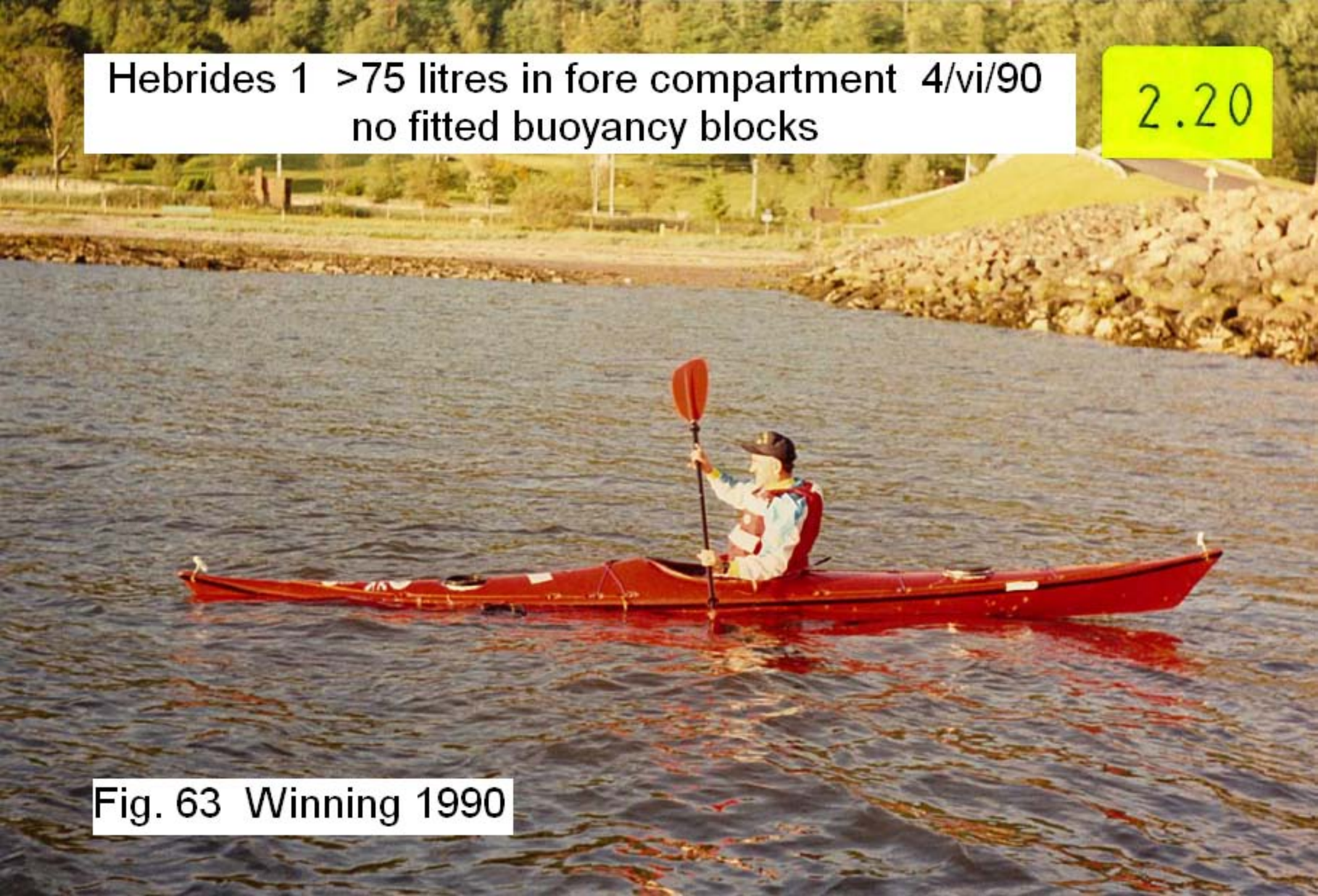


Fig. 63 Winning 1990

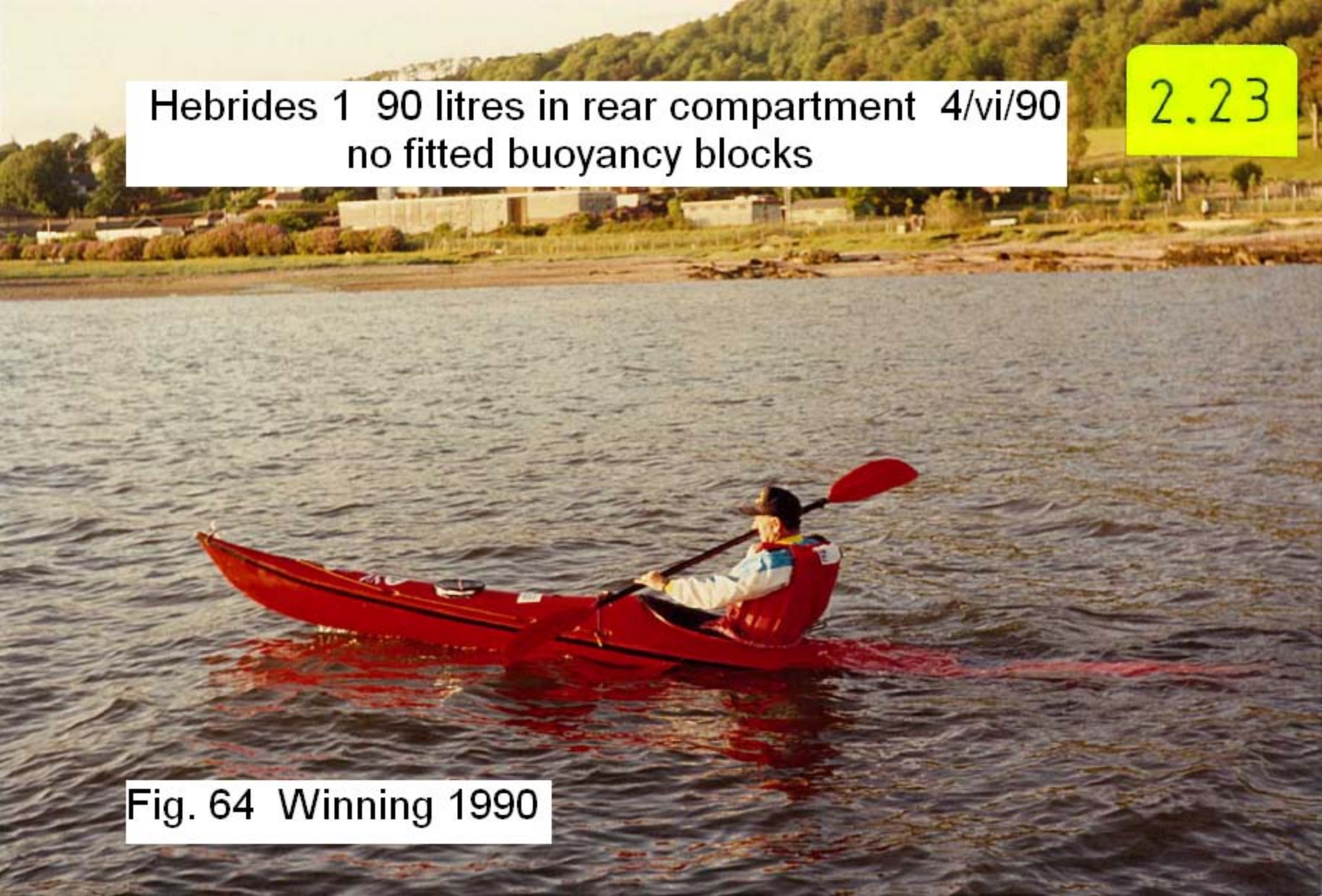


Fig. 64 Winning 1990

Fig. 65 Winning 1990

Fig. 66 Winning 1990

Hebrides 1 Flooded hull and cockpit 4/vi/90

no fitted bouyancy blocks - kayak sunk

3.6

Fig. 67 Winning 1990

Hebrides 2 Flooded hull and cockpit 4/vi/90 3.7
fitted buoyancy blocks providing flotation

Fig. 68 Winning 1990

Hebrides 2 cockpit flooded 4/vi/90 3.9

Fig. 69 Winning 1990

Fig. 70 Winning 1990

Fig. 71 Winning 1990

KW7 40 litres in hull 9/vi/90

Fig. 72 Winning 1990

KW7 60 litres in hull 9/vi/90

Fig. 73 Winning 1990

Fig. 74 Winning 1990

Fig. 75 Winning 1990

Fig. 76 Winning 1990

Fig. 77 Winning 1990

Fig. 78 Winning 1990

Fig. 79 Winning 1990

KW7 200 litres in hull 9/vi/90 4.13

Fig. 80 Winning 1990

Fig. 81 Winning 1990