

Sailing Research Vessel for the Wadden Sea: A Consequent Way of Environmental Data Acquisition

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1 Abstract

Research in the amphibic tidal and shallow Wadden Sea requires specifically designed vessels. The use of Sailing yachts as research vessels is proposed, not to spoil the environment to be studied. Specified plans are presented and some experiences are reported.

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2 The Wadden Sea

The Wadden Sea of the North Sea is a special type of coast found e. g. at the South-Eastern English shore, the Dutch, German, and South-West Danish shore. It extends up to some 10 miles to the sea. Sandy islands shield the area from the open North Sea. Large inlets and estuaries are cutting through. With a tide of 2-4 meters large areas fall dry at low tide. This gives a unique amphibic tidal muddy or sandy area with a large variety of complex tidal structures open to the varying but often strong winds and its tidal currents of up to 5 knots.

Research in this area has become necessary for studying the changing biology in a changing world, here the introduction of chemicals by the industrial polluted rivers, by air transport from distant industrial areas, by oil and gas spills from drilling and transport, by garbage and pollution from ships and tourism. The local mud erosion sensitivity is directly influenced by the biological activity of the mud. The tidal river and sandbar patterns are changing also due to large constructions such as new dams, harbours, pipe-lines. In addition there is some pollution of local origin due to ships in the area itself such as ferries, government and research vessels as well as sport boats.

In this article we dwell on the usefulness of sailing research vessels. Sailing vessels have been used worldwide all the time in history for research as well. Here we study a specified proposal of such a vessel WSSRV for the specific necessities of the Wadden Sea. It should complement the presently used research vessels used such as large motor vessels for the estuaries, converted fishing motor vessels, or even river ferries as a transport means for a fleet of auxiliary driven rubber dinghis.

3 Some Existing Sailing Research Vessels

In the old days of beginning ocean research all ship-bound one was done by sailing vessels.

There are Sailing research vessels at many places in the world, from e.g. Gdansk, to Brazil [1]. We are collecting information on sailing research vessels presently in use and are glad for respective informations.

In Germany, after an article in a newspaper [2], and a sailing sport journal [3] on the ISERN HINNERK, some public interest has set in on sailing research vessels.

We will give here some informations on two local and two offshore vessels.

3.1 the DELPHIN class

The DELPHIN class has been specifically mentioned in the literature [4] as an optimum boat type for the purpose of operating in the Wadden Sea. A boat of this type

has however, as well used for a global circumvention. In addition, its seaworthiness has been proven e.g. by a global circumvention [5]. The DELPHIN class was designed in 1958 by Th. Stölken, Hamburg, specifically for the needs of the Wadden Sea.

Some experiences with a boat of this type, the ISERN HINNERK as of Jemgum/Ems, (private owners: J. Diller and E. R. Hilf), are given in section *Experiences*.

The DELPHIN class has the following specifications:

overall length	9.75 m
draft	0.85/1.85 m (removable centerboard)
beam	2.85 m
weight	6.5 to
material	steel.

The shallow draft of less than three feet is most important for easy operating in all parts of the Wadden Sea. The steel construction is useful for the often rough working conditions e.g. hitting uncharted obstructions at night.

The hull shape is thus that the screw and rudder are completely shielded against e.g. picking inadvertantly lines or getting damaged by underwater obstructions.

The drop-shape center board allows for hitting obstructions or sand banks while drifting sideways (e.g. getting aground while tacking) without damage.

Getting stuck or aground is a routine manoeuvre in the Wadden Sea. Ship construction has to specifically cope with this. Sailing yachts are especially suited for this, since the draft of the boat can be effectively reduced in such case by heeling of the hull (using the sails, an anchor with a line from the top or alike), and since the boat is small enough to even be dugged out (which we once did for 65 meters off Fanö on the Hamburg Sand.

3.2 ALDEBARAN

The Institut für Meereskunde is said [6] to use the privately owned sailing yacht ALDEBARAN, of length 13 m, with a draft of 0.8 m and some catching equipment with a reported project to observe *phocaena phocaena* in the Baltic without disturbing them, as a motor vessel would do. We can confirm this, by coming very close to this little whale, while on an excursion with our ISERN HINNERK to the Baltic Sea island of Rügen this year.

3.3 ATAIR III

The Geologist K. Kurz had a specifically designed schooner-brigg ATAIR III built in Germany in 1992, with some equipment for taking mud-samples, as well as nets, and a small wet chemical laboratory. His privately owned brigantine has a length

overall of 21.50 meter and 160 sqm sail area with an air-cooled 100 HP auxiliary. She will be operated from Russell by the *Atair Sea Research Services* at Keri-Keri, Bay of Islands, New-Zealand. The *ATAIR III* is an intentional smaller replica of the famous *VARUA*, mentioned below.

3.4 VARUA

One of the most famous and scientifically successful sailing research vessels is the *VARUA*. The marine research done with her, especially on large sea mammals, without disturbing them has given innumerable important new insights, see the references in [7]. The *VARUA* has a length overall of 28 m and is operated year round in Alaskanian and Hawaiian waters for various research groups. She is run by the *Ocean Research under Sail*, later renamed to *Intersea Research* of R. Nilson, was built in 1942 Gloucester, USA, and designed by St. Burgess with a sailing gear by L. Francis Herreshoff. Her first owner, W. A. Robinson had circumnavigated the globe before in the 9.75 meter long *Svaap*.

3.5 Song of the Whale

Recently, the *Song of the Whale* was mentioned [8], to be used for *Physeter catodon* observation. Their research is funded by the International Fund for Animal Welfare (IFAW). Her skipper, J. Gordon, uses dedicatedly small sailing vessels for cetaceae-research since 1981. The *Song of the Whales* is a 14 meter ketch, with some hydrophone equipment and is operated in the Azores archipelago.

4 Experiences in the Wadden Sea

The vessel, presently used by us is the *ISERN HINNERK*, of the *DELPHIN*-class (see above). She is berthed in a small tidal harbor, Jemgum/Ems which dries out completely at low water, and with rather active and experienced members of its sailing club, LUV UP Jemgum.

The *ISERN HINNERK* was used by one of us (E.R.H.) in the last years for many inspection excursions, for sailing to conferences such as (ASMS, Amsterdam, 1991), *Mass Spectrometry of large, non-volatile molecules for marine organic chemistry* at Spiekeroog. [9]. Recently, her seaworthiness was demonstrated in the Helgoland area during the International Symposium on behalf of the 100 years anniversary of the Biologische Anstalt, The Challenge to Marine Biology in a Changing World). We took out some participants and the Conference Secretary to short cruises in sea conditions of wind force 6-7 (30 knots), when other research vessel cruises had been canceled because of 'stormy weather'. All maneouvers, including the ones in the harbour were done under sail. The sailing to and from Helgoland with wind force 6 already exceeded the Sea Workes Union restrictions for some other Wadden Sea

Research vessels presently in use.

Different types of sailing boats were used by one of us (E.R.H.) in the Wadden Sea over the last 37 years sailing some 50.000 nautical miles inspecting all parts of the Wadden Sea from Rye (UK) to Esbjerg (DK), as well as some inshore and offshore sailing, teaching, and examining for the German Sailing Association (DSV). For cruises in the Wadden Sea, to Bergen/Norway in October, and for an Atlantic crossing, the German Cruising Division (KA) linked one of their Cruising medals, respectively.

5 The Project of a WSSRV

We list some features of a Wadden Sea Research Vessel and present a concept for its realization.

5.1 Features

To operate year-round in a sufficient number of days the vessel must be seaworthy for navigation including the open estuaries up to eight Beaufort wind force (45 knots).

For access to all areas in the tidal amphibic waters of the Wadden Sea, the draft of the vessel should not exceed two to at most three feet. Only this enables e.g. down to half tide to navigate the inside main traffic lane along the coast.

The bottom of the vessel should be sufficiently flat to allow for routine falling dry during low tide periods.

The pollution from her eventual engine, such as oil, fuel, exhaust gases, cooling water, grease and noise should be minimized. For normal operation no motor is necessary in this area as there is sufficiently wind to use sail. Professional sailing (in contrast to sports) in this area has been done from the times of the large Roman fleets (of more than thousand vessels) entering this area to fight the Germans, to that of the vikings, and of centuries of commercial traffic. The modern sailing yachts are much more suitable due to their working powerfully even in windward tacking under a wide vairyty of wind conditions.

For falling dry, a routine operation in the Wadden Sea, the sediment destruction, caused by a boat's screw, or by the bottom of the ship should be minimized. Especially the maneuver of dragging the boat free from the mud with a powerful engine causes deep holes (we measured up to 2 meters depth) in the mud persistent for months.

The pollution from waste such as waste water or sewage should be minimized.

There should be no poisoning of the water by antifouling paint of the underwater hull. Large commercial or administration vessels are still allowed to use the extremely poisonous *organic tributyl-tin* [10], forbidden for sport boats which use now somewhat less poisonous tin-free copper compounds.

5.2 The Concept of a Wadden Sea Sailing Research Vessel WSSRV

We are in the planning stage in conjunction with a renowned wharf to specifically design and build a Wadden Sea Sailing Research Vessel WSSRV. This will be a prototype of a series to be sold worldwide by the wharf at a competitive prize.

Some of its dimensions and specifications are:

- *basic dimensions*: length: 45 feet; beam: 12 feet; draft: 2 feet; 20 tons dead weight;
- *propulsion*: 900 sq.ft. sail area; maximum speed: 10 kn; routine operation up to 45 knots wind, worldwide operation area; removable hydro-electric auxiliary 40 kW;
- *material*: steel;
- *structure*: bilge keel; center board (6 feet); removable mud-poles; shielded rudder and screw dwell; flat bottom of hull; flush working deck;
- *research equipment*:
 - crane at the stern;
 - tug-winch;
 - Comparatively large hatch (9 sq.ft) in the deck for direct hauling in of equipment containers (spectrometer, pp.) into the ship's laboratory compartment.
 - 10 sq.ft of removable hull side with a plexiglas inlet.
 - three dinghis;
- *Hull-coating*: poison-free silicate-coating;
- *wet Chemistry* laboratory compartment in the main section:
 - PTC device; various seacocks;
 - Sample acquisition by suck-in pipes;
- *Dry Compartment* in the fore-cabin:
 - Data handling
 - computers, plotter, printer, mass storage;
 - telephone line to the University Computer;

- *operating compartment* in the aft section: 3 pilot berths, sail locker, anchors, cables;
- *tank system*: closed waste-water system;
tanks for: high purity water, water, seawater;
- *electrical system*: High quality 220 V supply, generator; large set of batteries; 24 Volt net;
- *navigation equipment* such as radar, side-sonar, satellite navigation; VHF communication;
- *Winter-equipment*: Ice-resistant bow enforcement, heating system, second inside steering stand;
- *permanent Crew*: one.

The detailed plans are available upon request.

For this upcoming Wadden Sea Sailing Research Vessel project WSSRV requests and proposals are welcome. Institutions who see it as a possibly sensible instrument for their projects should specify their eventual additional requirements in time.

Applications and propositions for test excursions with the ISERN HINNERK are welcome.

The proposed type of research vessel should complement the other types of vessels already in use for various purposes.

6 Tasks for a WSSRV

Most present day research vessels are either designed for open Sea Ocean research, with its often necessary large equipment and are large vessels with a sizeable crew and costs. Many smaller research vessels used for the Wadden Sea are not specifically designed for that purpose but taken from other objectives such as fishing vessels or tugboats. Former marine Landing-boats or even former river ferries came into use because of their shallow draft and flat bottom, to serve as an operating platform for e.g. outboard driven rubber dinghis.

However, for many purposes, such as winter research, work in the estuaries, and to get a larger proportion of the days year-out a seaworthy vessel is necessary. The sailing vessels do have this property and can be operated including wind force 8 (45 knots) in the Wadden Sea.

Now we mention some tasks specifically suited to be taken care of by a Sailing Research Vessel, if specifically designed.

6.1 Sample Taking

Many scientific equipment nowadays is pretty much miniaturized, as e.g. Temperature or salinity measurements of water. Studies of these parameters in the regime of a mud creek gives important information on the variability of these biological input parameters. We did some measurements of tidal currents in mud creeks with a velocimeter of dedicated design for slow currents.

Sample taking for scientific purposes has been done for Desorption Mass Spectrometry of sediment samples from a remote place (higher part of the mud bank behind the Zimon Zand) [9].

Transport trips to and from permanently located scientific equipment e. g. on the sensitive and shallow mussel banks would be an ideal task for a WSSRV.

6.2 Chemical Analysis on the spot

The on-the-spot chemical analysis of oil spills, of TBT (Tributyl-tin organic compound antifouling paint) in the harbour sediments, and of many other wastes. Presently these large organic molecule samples are shipped to chemical laboratories at remote Research Institutions.

The German Science Ministry (BMFT) had funded a feasibility study for developing and adjusting a Mass Spectrometer of the new *Plasma Desorption Mass Spectrometry (PDMS)* type for routine use in Marine Organic Chemistry. It was shown, see ref. [9, 11], that this specific technique, because of its uniquely simple sample preparation, needing in many cases only little chemical preparation, and its miniaturizable technique would allow for a transportable mass spectrometer for in situ analysis especially for large involatile organic compounds.

6.3 Field Inspection Excursions

Throughout the year all parts of the Wadden Sea including the remote and drying high out parts should be inspected with a vessel which is capable of doing so but minimizes in this sensitive Natural Reserve the caused disturbance. This rules out any motor-driven vessel.

Seal counting and bird observation, which is presently undertaken airborne with its large scale acoustic impact, can be done unobstructively with a WSSRV. Our own experience is that sea mammals as seals with their bad vision at a distance but perfect acoustic sense take a moving sailing boat for some kind of strange whale species, due to the similar noise of propelling a heavy body on a steady course with a steady speed through the water. The alarm distances, less than 50 meters [7] are small as compared to motor vessels.

This is in contrast to birds with their extremely good vision at great distances. We

experienced alarm distances as large as 500 meters. Still, a small WSSRV, able to dry out at low tide anywhere, can be used as a movable hidden observation platform as well.

6.4 Acceptance studies of Government regulations

A possible task of the WSSRV should be to study the acceptance of Government regulations, by interviewing and informing water sport people in the harbours, by inspecting the acceptance and behaviour out in the Wadden Sea. These *Ranger duties* afford a vessel, which can enter all tidal Wadden Sea harbours, and in itself does not disturb the environment. In addition the interviewer should be accepted by his experience and understanding the answers in context. As an example we give here one of the boat countings we did in a Wadden Sea fairway through a Natural Reserve Zone I area.

6.5 Traffic counting in the Wadden Sea of Lower Saxony

Over the last years we did some routine patrol trips in the Wadden Sea of Lower Saxony . Some included traffic counting, the results are given elsewhere [12]. The last one of this kind was before sending off this manuscript was from 5th to 15th of November 1992 from Emden to Bremerhaven all through all of the East Frisian part of the Wadden Sea.

7 Summary

The highly sensitive ecosystem of the Wadden Sea needs for many research tasks described, a vessel which itself by its construction minimizes its negative impact on the ecosystem. Detailed plans for a Sailing Research Vessel have been presented.

8 Acknowledgements

The realization of the attendance of our sailing vessel at the Symposium *The Challenge to Biology in a Changing World* was made possible by the invitation of its chairman, Dr. Sperling, with Dr. A. Gebhardt moving away all obstacles of organization in an impeccable and cheerful way and even testing the boat on a short trip in Beaufort 6 winds in the rough waters of the Helgoland area. Mr. Stühmer from the *Bundesamt für Seeschifffahrt und Hydrographie BSH* we are thankful for the hospitality at the Helgoland port, providing a suitable berth for contacting the public as well as Dr. Nast from the BSH Hamburg for many valuable advices.

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