

PHASEONE

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Monitoring Birds and Environmental Influences

Introduction

The Institute for Applied Eco-System Research (IfAÖ) is a privately held research and consulting company in Germany that monitors, analyses and evaluates terrestrial and aquatic ecosystems since 1993. IfAÖ provides research and consulting services for commercial clients as well as state and federal authorities, especially for the offshore windfarm development sector. Offshore wind farm projects require large-scale ecological surveys before, during and after construction, in order to assess potential effects on the distribution and abundance of protected species. The robustness of site-specific population estimates depends largely on the extent and design of spatial coverage and the accuracy of the applied census technique. Standard environmental assessment studies in Germany have so far included aerial visual surveys to evaluate potential impacts of offshore wind farms on seabirds and marine mammals.

A Growing Need for Digital Survey Method

Classical aerial visual surveys however are limited by low flight altitudes of 250ft, the challenges of real time visual classification/quantification for the observer, disturbance effects on sensitive bird species and has become a significant safety risk inside wind farms for the crew, due to the rotor-swept zone of the wind turbines. Aerial surveys, which can be carried out at higher (safer) flight altitudes beyond the swept zone, could technically solve these problems.

Digital survey techniques have been increasingly used since about 2007 in environmental impact studies with some limitations like moderate ground resolution, data density and high cost for equipment and maintenance. With the advent of medium format digital cameras and the availability of large digital archives, most of these challenges become manageable. The German Federal Maritime and Hydrographic Agency (BSH) in fact requires the use of aerial digital imaging methods for assessing the impact of offshore windfarms since 2013 and has stimulated the refinement of classical survey methods used by the IfAÖ.

Development of an aerial digital survey equipment- Integration of Phase One camera

The IfAÖ started to investigate digital aerial methods in March 2011 in a cooperation with the university Rostock department of Geo-science. The comparisons of simultaneous observer-based and digital aerial surveys generally in the Wismar Bight showed that relevant duck species can be detected and classified to species level in



images, captured with a digital camera and a PhaseOne P45+ back. To meet the requirements of the Standard Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK4) of the German Federal Maritime and Hydrographic Agency (BSH), the IfAÖ started a development program for a new survey equipment in December 2013.

The company consulted the GGS GmbH, a PhaseOne system integrator and hardware provider, with an excellent reputation for the development of aerial data acquisition systems, to tailor and build technical solution. With a survey area of 2000 sqkm, a coverage of 10% of this area that should be sampled in one day and an overlap of 30% between the images, the usage of a twin camera design with PhaseOne iXA180 medium-format cameras and 110mm lenses was proposed and tested. The equipment enables photographic flights at altitudes over 1300 ft (~400 m) with a ground sampling distance (GSD) of 2 cm. The cameras were mounted on a "GGS' AeroStab Twin" three axis gyrostabilized platform with GNSS-INS and a camera control interface. Important for the camera selection was the availability of a forward motion compensation (FMC) to achieve proper results for the high GSD.

In an ongoing process the IfAÖ assembled one team that managed the flight planning, image acquisition, technical maintenance and a second team with the focus on IT resources / hardware and software development to handle the anticipated investigation workflow like image processing, analysis, interpretation and quality assessment and control.

Testing the System

The first monitoring test was executed in February 2014 and took place in the Pomeranian Bight. During this time of the year the populations of Common Eider, Long-tailed Duck, Common Scoter and Velvet Scoter are extremely high and allows counting and distinguishing of the different species. To test the robustness and the suitability for the commercial use, the project included a coverage of 1500 sqkm with 10 flight lines – each of 50 km length. The survey



Unprecedented resolution of aerial images showing the objects of study and the ship for comparative counting

was carried out within six hours and 6300 images were captured from an altitude of 1400 feet above sea level with a cruising speed of 100 knots. The system performance was robust and the acquisition ran without any image loss. The later analysis show good results, exceeded the expectations in quality and resulted in a high match compared to the parallel running ship based observations. Further test surveys in Spring 2014 addressing the limits of light and weather conditions, the detection possibilities for marine mammals and the extension of the survey runtime up to 8 hours. Based on the exceptional results the remote sensing system was presented in march 2014 at the airport Rostock/Laage to commercial customers as well as state and federal authorities in the offshore wind energy development sector. In summer 2014 the deployment process reached the final stage with the establishment of two data centres with at least 24 workstations and the second team finished the first version of screening and identification software.

Main achievements

In autumn 2014 the remote sensing equipment now called DAISI became the standard tool for the IfAÖ and is used now on a monthly later weekly basis with robust functionality and extended performance (BSH requirements) including:

- A maximal size of survey area of 3000 sqkm and 10% coverage of this area
- A transect length of approx. 700 km at an operation velocity of 100-120 kn.
- Acquisition performance: 7500 images per camera, survey with max. eight hours operation time
- images have a footprint of 150x400 m with 2 cm GSD that allows the identification and classification of seabirds and marine mammals in general to species level.

Since July 2014 the remote sensing system DAISI was successful used in 9 monitoring programs and produces approximately 560000 images during 56 surveys. In

About Phase One

Phase One A/S is based in Copenhagen with offices in New York, London, Cologne, Tel Aviv, Tokyo and Hong Kong. Phase One Industrial is a division of Phase One and is dedicated to research, development and manufacturing of advanced hardware and imaging software solutions that meet the unique requirements of aerial photography users.

autumn 2015 the IfAÖ executed two surveys in the HelBird Project intercalibration and evaluation study of the Research and Technology Centre of the University Kiel/Büsum and the comparability to established British systems was confirmed by ecological experts. Since July 2016, the IfAÖ is participating in a further calibration/comparison program called PhoViComp for different sensor systems and tests the next PhaseOne camera generation iXU-RS 1000 in parallel.

A Glimpse Into the Future

In order to meet the challenges of growing annual flight campaigns, conceptual studies for a second remote sensing system are currently being carried out. The main objective is to design a new robust long-term running remote system. One key component is the new PhaseOne camera iXU-RS 1000. The iXU-RS 1000 is equipped with CMOS sensor technology and an innovative electromagnetic central leaf shutter that enhances the capture rate and speed. In addition with its precise image quality, the technical features promise convergence towards competing video systems while providing extremely high image resolutions and usability of classical aerial imaging and processing techniques. The increase of the sampling rate to 1Hz and ground sampling distance down to 1.7-1.5 cm at the same footprint of 150 x 400m, will improve the object identification process and image processing robustness. The associated increase in the image quantity influences the manual screening capacities for the identification of the avifaunistic features. To be able to manage this challenge, modern image processing methods for the exclusion of image parts with empty water surfaces and automatic object classification based on Deep Learning algorithms are therefore subject of current development work at the IfAÖ.

Take Away

Alexander Weidauer, project manager, said: "Phase One cameras based on the iXA180 are robust and easy to handle. They have a long time reliable performance and their Schneider Kreuznach lenses are easy to change and to calibrate. By the plug and play design for the multi head configuration using the Daisy Chain connection, which is an all over the Phase One family topic, different cameras can be arranged in an array specified for our needs. Looking at 2017 we are excited to move forward with Phase One and the iXU-RS1000 to grow our business even larger as ever before."

The integration of Phase One cameras with GGS' system supported the efforts of the IfAÖ to design and implement a solution that is tailored to their specific needs and challenges, and paved the way to a faster, more efficient and cost effective research of nautical and terrestrial based ecological systems.

To find out more about Phase One products, please visit <http://industrial.phaseone.com> and set up an appointment with one of our aerial photography experts for a demonstration.

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