

## **Annex 3 Presentations**

1. Gerald Millat: Aerial photographs as a tool for monitoring blue mussel beds in Lower Saxony
2. Marc Herlyn: Mussel stock in Lower Saxony in spring 2001
3. Tammo Bult: Mussel inventories by RIVO with emphasis on GIS
4. Bert Brinkmann: Habitat model for the Dutch Wadden Sea *[to be included]*

# 1. Aerial photographs as tool for monitoring blue mussel beds

Gerald Millat, National Park Administration, Wilhelmshaven

## 1. Working steps

- a. Planning the flight
- b. Interpretation of aerial photographs (analog)
- c. Digitize results
- d. Digital steps (GIS): maps, calculation of size

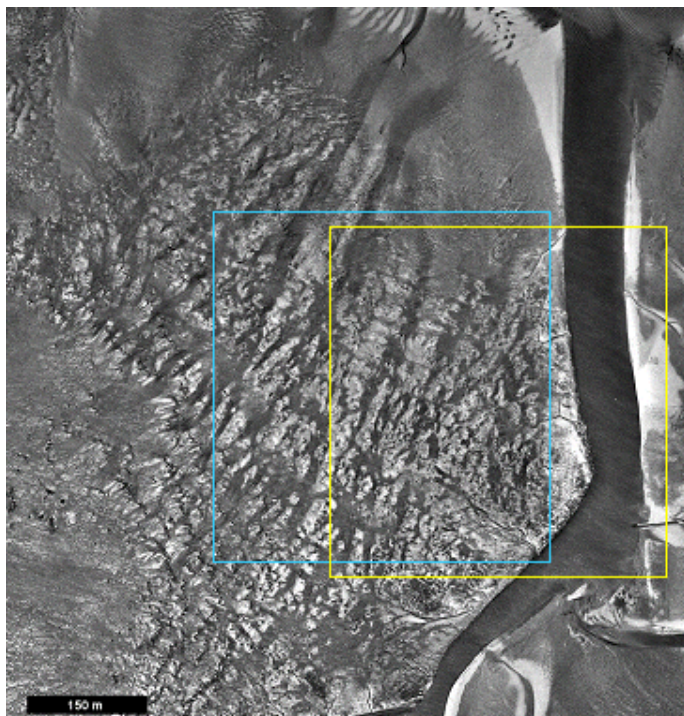
## 2. Aerial photographs

Two aerial photographs are taken as basis for the interpretation. The conditions are as follows:

- scale: 1:15.000
- overlapping: alongside 60 % , across 30 %
- stripes: east - west or west east
- period of flight: may / june (sept. - oct.)
- stand position of the sun:  $< 45^\circ$
- tide: low tide  $\pm 1$  h
- navigation system: dgps
- display on the edge: time, scale, no. of stripe, position, no. of picture, northarrow

About 950 aerial photographs (scale 1:15,000) are necessary to cover the whole Lower Saxon Wadden Sea. A higher resolution would result in too many photographs and would be too expensive. A lower resolution (lower than 1:15,000) was not sufficient to identify all mussel beds with an appropriate accuracy. Black and white photographs were chosen because they are sharper and show a better texture compared to color photographs.

Figure 1: Two aerial photographs of a mussel bed with 60% overlapping

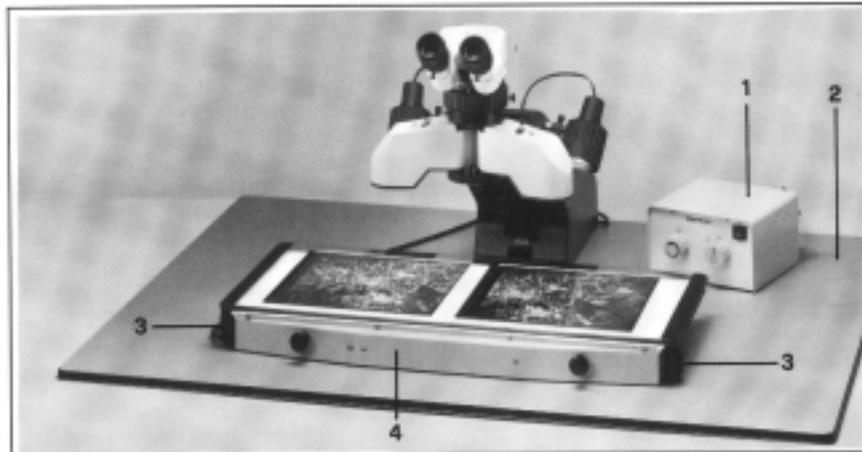


### 3. Interpretation of photographs

The interpretation of the aerial photographs are carried out by using a reflecting stereoscope (Figure 2). This makes it possible to identify the pattern (“Textur und Struktur”) of a mussel bed even when the bed is difficult to see on the photograph. The borders of a bed is then drawn on a transparency.

Figure 2:

APT2 with Transmitted-light unit



1 Control unit (transformer)  
2 Aluminium coated worktop

3 Carriage blocking levers  
4 Transmitted lighting

The results (Figure 3) are then transferred to a copy (scale 1:15,000) and digitized.

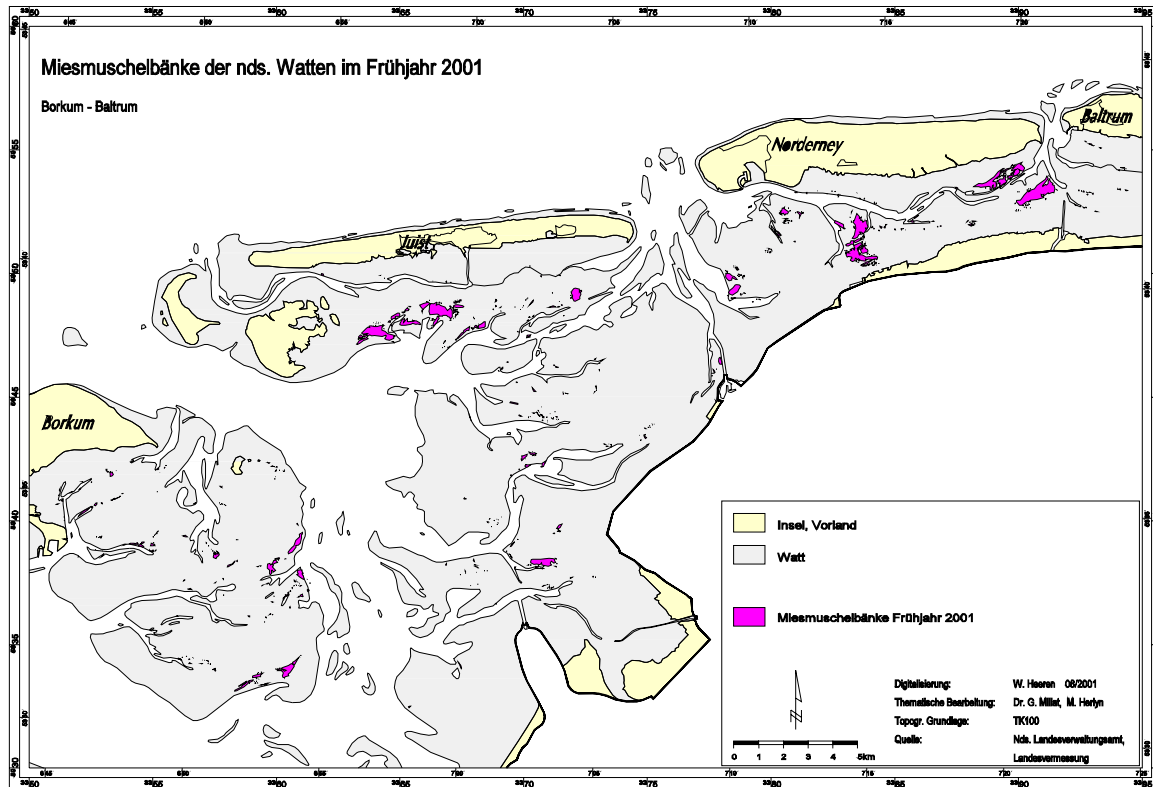
Figure 3:



#### 4. GIS Analysis

The results are analyzed using ArcInfo/ArcView and GIS maps are produced. Further GIS analysis are size calculation or combination of other information layers.

Figure 4: GIS map of blue mussel beds in the Lower Saxon Wadden Sea (Borkum, Juist, Norderney) in spring 2001.



**5. Results**

Figure 5: Mussel beds from surveys 1999 – 2001 are use to identify and characterize the development of mussel beds.

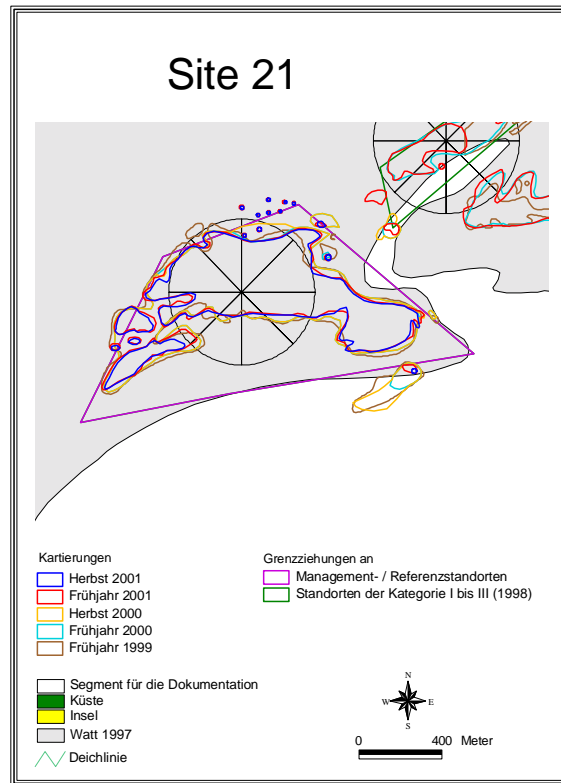


Figure 6: Size of intertidal mussel beds in Lower Saxony from 1975 to 2001 (F=spring, H=autumn, Flächengröße=size of beds in ha)

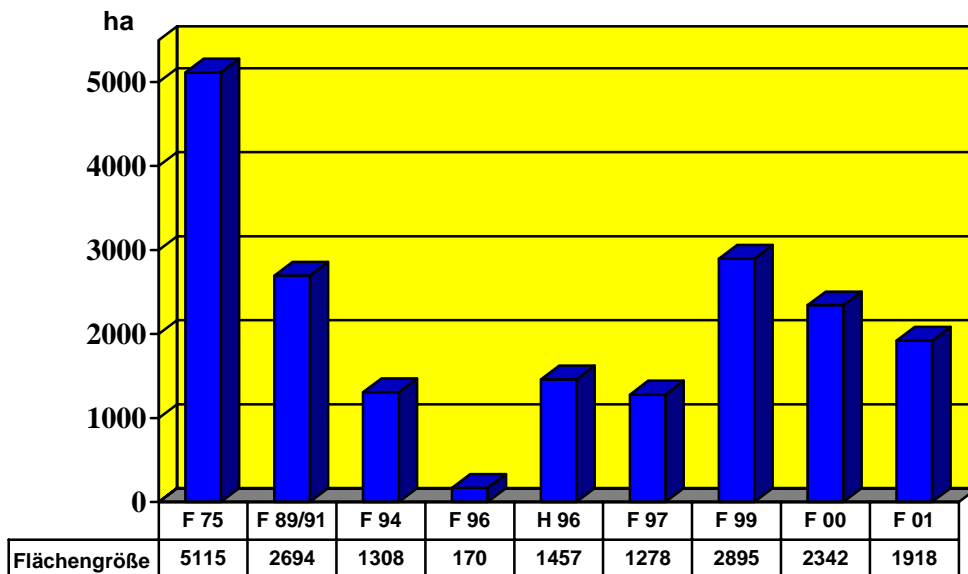
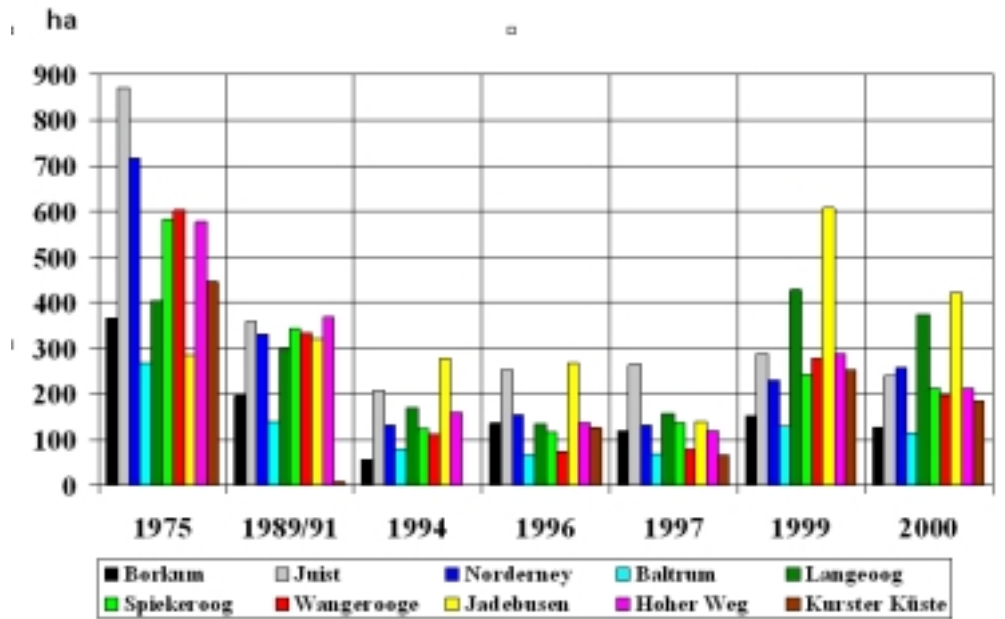


Figure 8: Size of intertidal mussel beds per year in sub-areas of the Lower Saxon Wadden Sea



## 2. Situation of the blue mussel stock in Lower Saxony in spring 2001

Marc Herlyn, ICBM - Uni Oldenburg, Wilhelmshaven

- Since 1999 decrease of total area of about 35 % (spring 2001: about 1918 ha)
- Since 1999 decrease of total biomass of about 45 % (spring 2001: about 55000 t)
- Since 1996 no heavy spatfall
- Mussels of the spatfall 1996 are still dominant ( $\approx$  10 mm shell length)

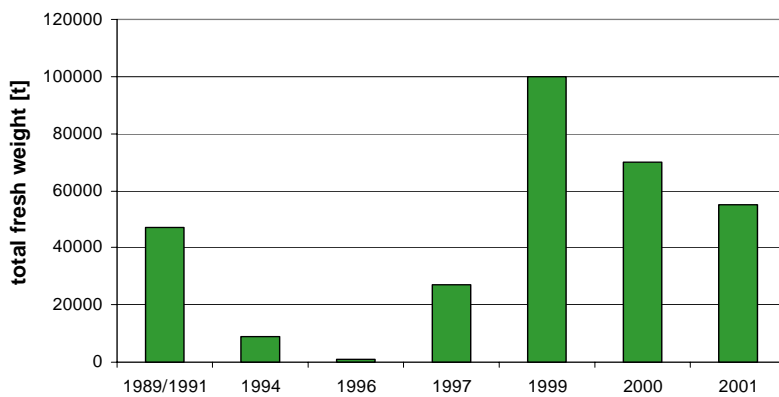


Figure 1: Total biomass (fresh weight) of the intertidal blue mussel beds of Lower Saxony (1989/91: MICHAELIS et al. 1995; 1994: ZENS et al. 1997; 1996 - 1999: MILLAT & HERLYN 1999; 2000 and 2001: HERLYN & MILLAT 2001)

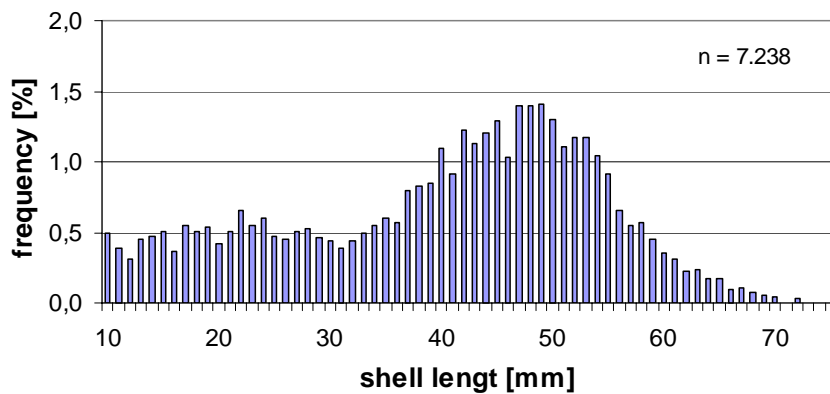


Figure 2: Length frequency distribution ( $\approx$  10 mm shell length) from intertidal mussel beds sampled in spring 2001 (30 sites), Wadden Sea of Lower Saxony

### 3. Mussel inventories by RIOV with emphasis on GIS

Tammo Bult, RIVO, Wageningen

#### 1. Tasks of RIVO

The work of the RIVO Center for Shellfish Research (CSO) is focusing on:

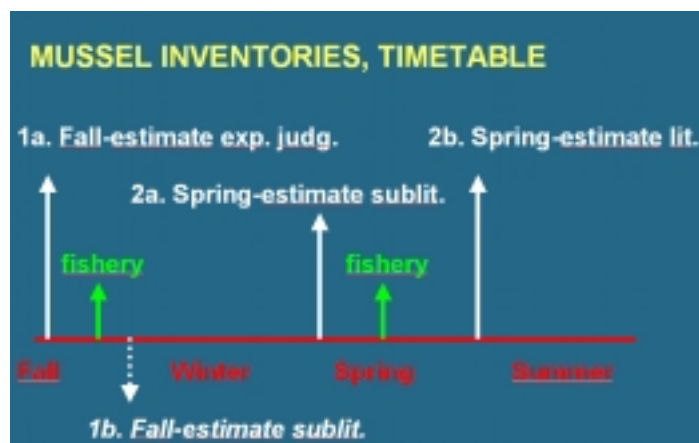
- distribution and abundance of shellfish,
- analysis of carrying capacity,
- monitoring of shellfish quality for consumer,
- specific questions of governmental organizations,
- R&D for shellfish companies,
- Information and education.

The objective of mussel inventories are:

- a. estimation of distribution and biomass of blue mussels,
  - mussel fishery: fishing plans & permits,
  - cockle fishery: avoidance of blue mussel beds,
  - nature conservation: bird food reservation (450,000 oystercatcher, 100,000 eider ducks),
- b. estimation of surface area of blue mussel beds (recently):
  - evaluation of ecotarget: presence of (stable) mussel beds (“2000 – 4000 ha (stable) mussel beds”).

#### 2. Mussel inventories

The surveys are carried out in the sublittoral and littoral parts mainly during spring and fall:



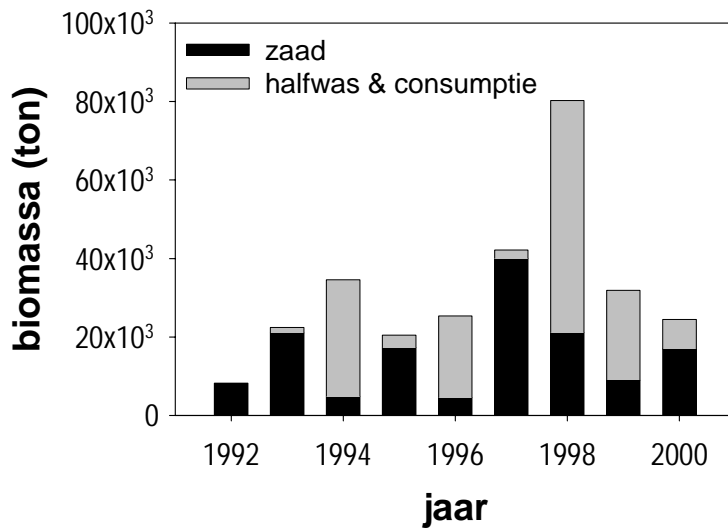
*Spring estimates sublittoral (2a.)*

Sampling with dredges and core sampler for biomass and distribution.

Stratified approach: more samples where mussels are expected (about 650 samples/year, since 1992) based on:

- previous surveys,
- info. cockle and mussel fishers,
- black box data fishers,
- fishery officers.

Figure 2: Results of spring estimates of blue mussel in sublittoral.



*Spring estimates littoral (2b.)*

i.) Sampling with dredges and core samplers for biomass and distribution

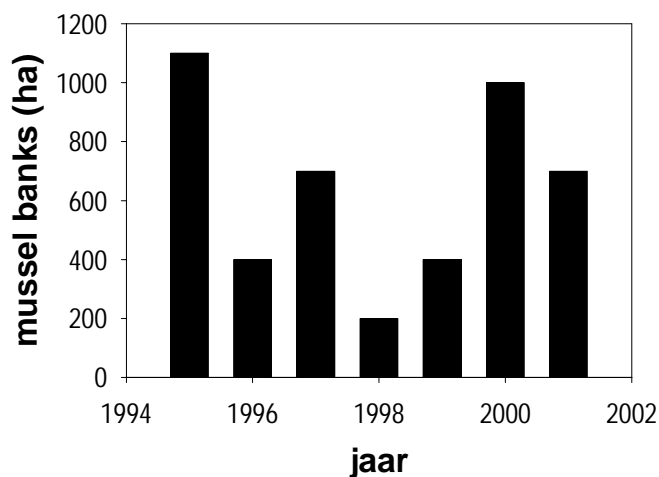
Stratified approach: more samples where mussels are expected (about 1600 samples/year, since 1992)

- previous surveys & fishers information
- fisheries officers information
- air photos (& satellite imagery)
- reconnaissance flights
- bank contours

ii.) GIS Data recorded by GPS (since 1994):

- bank contours
- exp. judg. bank parameters:
  - density (thin, thick, medium, ..)
  - mussel: seed, consumption
  - coverage (bedekking/bezetting)
  - general substrate descriptors: shells, hard/soft/mud etc.
  - structure of substrate and bank

Figure 3: Area of littoral mussel beds (spring surveys 1994 – 2001).



*Fall estimate – expert judgment (1a)*

## MEANS:

- Sublittoral survey - commercial mussel dredge
- Littoral survey – bank contours by GPS

## RESULTS:

- Biomass estimates
- Bank contours

*Fall estimate – sublittoral 2001 (1b)*

## MEANS:

- as of sublittoral survey spring
- fewer stations sampled (350 versus 650)

## RESULTS:

- Estimate of natural mortality over winter (in combination with spring sublittoral survey)

**3. Aerial photographs**

Aerial photographs are used to determine the contours of the littoral mussel beds.

## STRENGTHS:

- entire Waddensea is covered
- Combination: air surveys - ground truth - sampling
- fishermen are explicitly involved: support results

## WEAKNESSES:

- information on individual banks
- qualitative bank descriptors: standardization
- conditions for air photos seldom optimal

**4. Future work**

The determination of mussel bed contours by remote sensing and ground truth via GIS will be further developed by

- Standardization
  - training of select group of fishermen for sampling,
  - Database,
- Validation of expert judgment,
- Statistical linking of air photo, satellite imagery and ground truth/sampling data (ITC - Enschede),
- Linking survey and ecotarget.