1. Red tide case numbers is in the same level as previous several years
   2015, 236 cases with 44 harmful ones
   2016 Jan-Oct, ca. 180 cases with 23 harmful ones
2. Economic loss by red tides
   2013: 2.7M USD, 2014: 2.6M USD
   2015: 6.2M USD, 2016 Jan-Oct: 4.6M USD
3. Main harmful species are *Karenia mikimotoi*, *Chattonella antiqua*, *Cochlodinium polykrikoides* and *Heterosigma akashiwo*.
4. Often seaweed, *Pyropia* sp. growing on drifting-nets had damage of de-coloration. Dark reddish black color turned to pale green, because of lack of enough nutrients, especially DIP.
Numbers above bars show total case number of red tides, and those inside bar show those with economic losses.
5. Closure of harvesting shellfish by contamination of PSP toxins.
   - 2013: **10** plankton-feeding species in **22** cases
   - 2014: **12** species in **33** cases
   - 2015: **10** species in **33** cases
   - 2016 Jan-Nov: **08** species in **22** cases
   Causative plankton are *Alexandrium tamarense*, *A. catenella*,
   *A. tamaiyavanichii* and *Gymnodinium catenatum*.

5. DSP toxins are also recorded.
   - 2013: **03** species in **33** cases
   - 2014: **04** species in **14** cases
   - 2015: **03** species in **06** cases
   - 2016 Jan-Nov: **03** species in **06** cases
   Causative plankton are *Dinophysis fortii*, *D. acuminata*, and
   *D. norvegica*.

6. Amount of economic loss has not been calculated so far.
Change of harvesting closure case numbers by PSP and DSP toxins in the last 10 years
Change of PSP affected area

Serious economic loss, but no poisoning case
Major research topics (mainly for red tide)

1. Biology
   morphology and molecular characters to develop DNA markers to make an organism detection kit

2. Ecophysiology
   adaptation mechanisms to new environment with reduced nutrients and temperature change

3. Dynamics
   blooming mechanisms
   fish mortality mechanisms

4. Measures (ca. 1.5 M USD by Fisheries Agency)
   prevention of mass mortality using specific virus prevention of fisheries damage by information exchange (temperature and red tide distribution information)
   bloom modeling for early warning
   nutrient level monitoring to prevent de-coloration of seaweed provision of safe seafood monitored by reliable systems
De-coloration of *Pyropia* sp. growing on drifting-nets
Dark reddish black color turned to pale green, because of lack of enough nutrients, especially DIP.

Normal (left) and de-colored *Porphyra* on net
Normal (left) and de-colored *Porphyra* thali
Normal (left) and de-colored product

Frequent occurrence of de-coloration

Price per sheet (cent)
Production (M sheet)
Production (10M USD)

Main competitors with Nori *Porphyra* on nutrient uptake.
Above: *Coscinodiscus weilesii*
Left: *Eucampia zodiacus*