PHUKET MARINE BIOLOGICAL CENTER

Phuket, Thailand

RESEARCH BULLETIN NO. 16

PRIMARY PRODUCTION IN WATERS AROUND SURIN ISLANDS OFF THE WEST COAST OF THAILAND

by

Søren Wium-Andersen

PUBLISHED BY THE CENTER

Phuket, 1977

PRIMARY PRODUCTION IN WATERS AROUND SURIN ISLANDS OFF THE WEST COAST OF THAILAND

By SØREN WIUM-ANDERSEN

Phuket Marine Biological Center[1]

ABSTRACT

Primary production was measured by means of the C-14 method, ½ days experiments *in situ*, twice at a station in the southern bay of the north Surin Island and once at a station 24 km. west of the islands in the Andaman Sea. In the bay the depth of the photic zone was 30 m. with a maximum production of 85 mg C/m^3/day at 4 m. The production was measured on the 13th. and the 17th. of April to 1.09 and 1.45 g C/m^2/day respectively. On the latter date a bluegreen algae maximum was observed. The results show that the land run-off and the regeneration of nutrients in the shallow bay have a strong influence on the primary production. At the off-shore station the depth of the photic zone was more than 50 m. with a maximum production of 23 mg C/m^3/day at the surface. The production here was 690 mg C/m^2/day on the 14th. of April. Although few measurements were taken off-shore, the results indicate an area with a relatively high primary production which indicate upwelling. Net phytoplankton from all stations > 30 µ. were dominated by bluegreen algae and diatoms, in addition, dinophyceae were seen.

The heavy metals Cu and Hg are shown to inhibit photosynthesis with more than 50% in concentrations of 10 and 1.6 µg. per liter respectively.

INTRODUCTION

A joint expedition of terrestrial and marine biologists, organised by the Siam Society, visited the not very well known Surin Islands in the Andaman Sea for a period of 10 days during April 1976. The purpose of the expedition was to make preliminary descriptions of the fauna and flora of the islands and the surrounding sea. An investigation was carried out on the primary production of the sea as a part of this study. According to Koblenz-Mishke *et al.*, (1970) the primary production of the area should be in the range of 150–250 mg C/m^2/day.

MATERIALS AND METHODS

The measurements were carried out at Surin Islands, 97°50'E, 9°25'N, a small group of four islands 50 km. off the west coast of peninsular Thailand just south of the Burmese border. The investigations were made at two localities, one off-shore at a depth of 100 meters, 24 km. west of the islands, and the other in the southeast facing bay of the north Surin Island (Koh Surin Nua) at a depth of 40 meters. This station was located just outside a coral reef, see fig. 1.

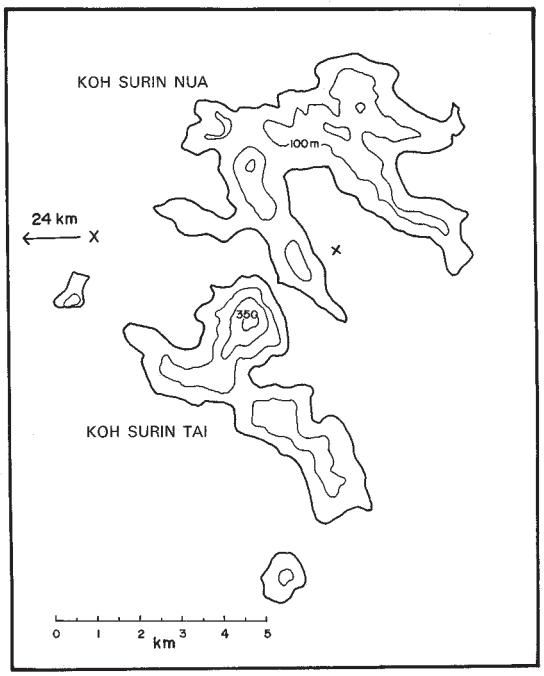

Fig. 1—Surin Islands, the crosses show where the bay experiments were carried out. The offshore station was placed 24 km. west of the islands.

[1]Present address : Freshwater Biological Laboratory, Copenhagen University, Helsingoersgade 51, DK-3400 Hilleroed, Denmark.

Primary production was measured, in situ, by means of the C-14 method, Steemann Nielsen (1965). The water samples were taken with a glass water sampler and the experiments were carried out in glass stoppered bottles with a volume of 112 ml. The experiments were carried out from noon to sunset and the samples were filtrated immediately after through a 0.2 µ. Sartorius membrane filter, the pressure being above ½ atmosphere. The results presented here are adjusted for respiration with + 5%. Dark uptake of C-14 measured at 3 meters depth were not exceeding 2.5% of maximum photosynthesis. The measurements were carried out during April about two weeks before the northeast monsoon changed.

The influence of the heavy metals Cu^{++}, Hg^{++} and Cr^{6+} on the photosynthesis was measured at a depth of 4 meters in a set of three experiments at the same localities. The heavy metals were added from stock solutions in amounts not-exceeding 25 µl. The amounts added were for Cu^{++} ($CuSO_4$) 10 µg. per liter, Hg^{++} ($HgCl_2$) 1.6 µg. per liter and Cr^{6+} (K_2CrO_4) 1666 µg. per liter.

RESULTS

Figure 2 shows the results of the experiments. From the curves it can be seen that there is a big difference in primary production at the two localities. When the experiments at the off-shore station were carried out there was a light cover of clouds so production at the surface was not inhibited. The highest primary production was 23 mg C/m³/ day. The production in the photic zone down to 50 m. was 690 mg C/m²/ day. The photosynthesis was 3–4 times higher at the bay station than at the off-shore station with values from 65–83 mg C/m³/ day. Depth of the photic zone was about 30 m. with a total production of 1.09 g C/m²/ day and 1.45 g C/m²/ day, the latter value being correlated with a bluegreen algae bloom of *Trichodesmium*.

The phytoplankton > 30 µ. were dominated by diatoms and bluegreen algae but, in addition a few dinoflagellates were seen.

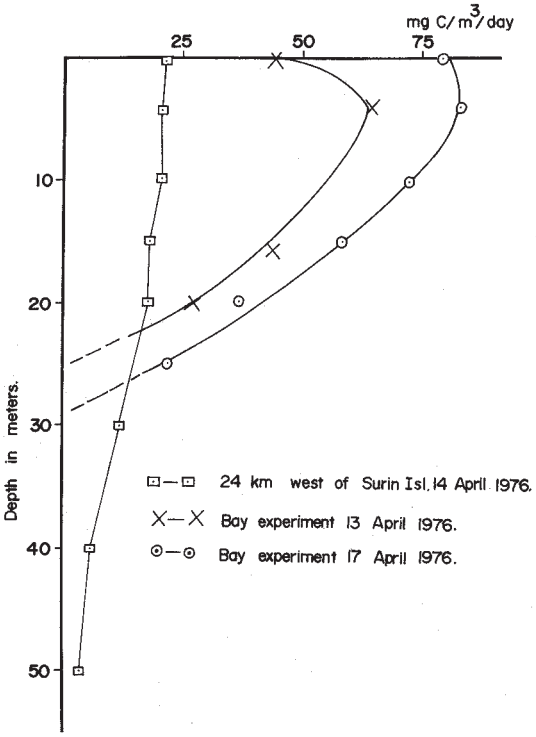

Fig. 2—Vertical distribution of primary production in the three photosynthetic experiments.

Results of experiments with heavy metals are presented in table 1.

DISCUSSION

The results shows that the waters surrounding Surin Islands, situated about 50 km. off-shore peninsular Thailand in the Andaman sea, are very productive with levels of primary production in the range from 0.7–1.45 g C/m²/ day, this being 3–6 times higher than the values mentioned by Koblentz-Mishke *et al.*, (1970) in the same area. Earlier measurements of the concentrations of phosphate in the Andaman Sea have shown rather high levels of phosphate, more than 12 µg-at/liter (Reddy *et al.*, 1968). These extremely high values of phosphate around the Andaman Islands correlated with "milky water" were not found around Surin Islands. According to Mr. Wootisathirapinyoe (personal communications) how-

ever, the concentrations of $PO_4^{3\div}$-P were 1.63 µg-at / liter and 7.18 µg-at / liter of $NO_4^{\div}$-N at a depth of 90 meters at the off-shore station. In the photic zone only trace of $PO_4^{3\div}$ and $NO_3^{\div}$ were found.

The measurements both of a high level of nutrients and high primary production in the off-shore waters seems to indicate an upwelling in the area. Wyrtki (1975) assumed that an upwelling occured occasionally in the Andaman Sea under favorable wind conditions during the NE monsoon period, but only further investigations can show whether the upwelling is a continuous process throughout the monsoon period from December to May.

The results from the bay show a very high value for the primary production from 1.1–1.45 g C/m^2/ day. Since the chemical measurements only showed trace of nutrients, the high production can only be interpreted as being due to a very high turnover rate of phosphate and nitrogen in this shallow bay. The tidal current, with an amplitude on 3.5 meters would also ensure a thorough mixing both of the regenerated nutrients and of the run-off waters from the islands which have a total area of 32 km^2 and a maximum elevation of 360 meters.

The results from the heavy metals investigations in table 1 show a very big decrease in photosynthesis when small amounts of Cu and Hg are added to the experimental bottles. A very strong influence of Cu on photosynthesis has earlier been shown by Steemann Nielsen and Wium-Andersen (1971) and Wium-Andersen (1974). In the latter paper the amount of Cu, Hg and Cr, which caused a decrease in photosynthesis on 50% of the two freshwater species *Nitzschia palea* and *Chlorella pyrenoidosa*, were presented. The results from Surin Islands show that the toxic effect of copper, also under natural conditions in saltwater is within these values. The results for Hg in the present studies show that this ion is even more poisonous for marine phytoplankton than for freshwater species. The influence of chromium is smaller than expected in view of the results from the ealier mentioned work. The decrease in toxicity might be explained by the complex formation of Cr in sea water.

Table 1. Decrease in primary production in per cent of untreated control when different concentrations of heavy metals were added.

	Average for all three experiments
Cu^{++} 10 µg. per liter	58%
Hg^{++} 1.6 µg. per liter	55%
Cr^{6+} 1666 µg. per liter	11%

The investigations show that the area around Surin Islands is very productive because of the land mass effect, and for the off-shore station, probably because of upwelling water. It should be stressed that this area, now completely unpolluted, ought to be protected because even slight pollution with, for example, heavy metals would have a strong influence on the ecosystem.

SUMMARY

1. Production around Surin Islands was 1.09 to 1.45 mg C / m^2/ day in April 1976. Depth of the photic zone was 30 meters.
2. Production 24 km. west of the islands was 690 mg C / m^2 / day in April 1976. Depth of photic zone was 50 meters.
3. The high offshore primary production indicate an area with upwelling.

REFERENCES

KOBLENTZ- MISHKE, VOLKOVINSKY and KABANOVA, 1973, In: *The biology of the Indian ocean.* 549 pp. B. Zeitzchel (ed.). London: Chapman & Hall.

REDDY, C.V.G., MURTY, P.S.N., & SANKARANARAYANAN, V.N., 1968, An incidence of very high phosphate concentrations in the waters around Andaman Islands. *Current Sciences* **37**(1) : 17–19.

STEEMANN NIELSEN, E., 1965, On the determinations of the activity in C-14 ampoules for measuring primary production. *Limnol. Oceanogr.* **10** (Suppl) : R247–R252.

STEEMANN NIELSEN, E. and WIUM-ANDERSEN, S., 1971, The influence of Cu on photosynthesis and growth in diatoms. *Physiol. Plant.* **24** : 480–484.

WIUM-ANDERSEN, S., 1974, The effect of chromium on the photosynthesis and growth of diatoms and green algae. *Physiol. Plant.* **32** : 308–310.

WYRTKI, K., 1973, Physical oceanography of the Indian ocean. In: *The biology of the Indian ocean.* pp. 18–36. B. Zeitzschel (ed.). London : Chapman & Hall.

(Manuscript received November 20, 1976)