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PREDICTION OF CONCENTRATIONS OF TOXIC COMPOUNDS
WITH A WATER QUALITY SIMULATION PROGRAM:
A CASE STUDY IN THE PONG RIVER

Mr. Chanchai Sangsurasak

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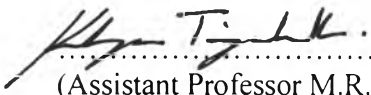
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
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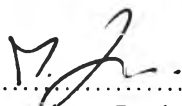
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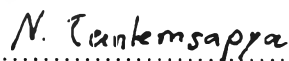
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ปัญหาปลาตายในแม่น้ำพองมีมานานกว่า 10 ปี สาเหตุการตายยังไม่สามารถระบุได้ เนื่องจากว่าแหล่งมลพิษ
ทั้งหมดเช่น ของเสียจากการเลี้ยงปลา รั้นออฟ (runoff) จากการเกษตรข้างแม่น้ำ และซากตะกอนของเสียเก่าซึ่งโรงงาน
กระดาษเคยปล่อยในบริเวณบึงจืดต้องมีการศึกษาพร้อมๆกัน การศึกษาครั้งนี้ประมวลของมูลของปี2542 - 43และ
พบว่าเมื่อ 1 อาทิตย์ก่อนการตายของปลาในปี 2542 ในแม่น้ำมีค่าบีโอดี5 และค่าดีไอที่สูงผิดปกติตลอดแม่น้ำ ซึ่งบ่ง
บอกว่าอาจมีการบลูมของสาหร่ายเป็นพิษ (algal bloom) เมื่อสาหร่ายเป็นพิษตายพร้อมๆกันสามารถทำให้เกิดค่าดีไอ
ต่ำและปลาตาย การศึกษานี้พิสูจน์การบลูมของสาหร่ายเป็นพิษด้วย GC/MS ควบคู่กับการเลี้ยงปลา การนับจำนวน
สาหร่ายเป็นพิษพร้อมๆกับการวัดระดับยูโทรฟิเคชั่น การตรวจวัดสารฟีนอล และโปรแกรมจำลองคุณภาพน้ำ นอกจากนี้ยัง
วัดสารอินทรีย์อันตรายเช่นยาฆ่าแมลงในระหว่างที่มีปลาตาย และประเมินโลหะเป็นพิษจากข้อมูลของกรมควบคุมมลพิษ
ก่อนสรุปสาเหตุการตายของปลา สำหรับโปรแกรมจำลองคุณภาพน้ำ โมเดลแบบไดนามิกถูกสร้างขึ้นด้วยวิธีการ
ประเมินรั้นออฟและการเทียบมาตรฐาน (calibrate) ค่าการไหล (flow) แบบใหม่ด้วยการใช้ลิกนินแทนนิน
(lignin/tannin) เป็นตัวเทียบ (conservative trace) ค่าสัมประสิทธิ์สหสัมพันธ์ (correlation coefficient) หรือ
 R^2 จากการเทียบมาตรฐานสูงพอสมควร ค่า root mean square error (RMSE) จากการเทียบมาตรฐานของการ
ไหลใกล้เคียงกับค่าอื่นๆซึ่งใช้ความเค็ม (salinity) เป็นตัวเทียบ ค่า RMSE จากการเทียบมาตรฐานและการตรวจความ
ถูกต้อง (validation) ของสารทั่วไป (conventional nutrient) ใกล้เคียงกับค่าของคนอื่นๆ โมเดลพยากรณ์ว่าการ
ตายของบลูมของสาหร่ายเป็นพิษ เป็นสาเหตุที่ทำให้ค่าดีไอต่ำ และนำไปเป็นเหตุให้ปลาตายในปี 2542 โมเดลแสดง
ความแม่นยำถึงระดับวัน ไม่ใช่เดือน และการใช้ลิกนินแทนนินเป็นตัวเทียบพิสูจน์ให้เห็นว่าเชื่อถือได้ การศึกษานี้ทดสอบ
ความสามารถในการพยากรณ์ค่าคลอโรฟิลล์ของโมเดล และพบว่าโมเดลยังพยากรณ์บลูมของสาหร่ายเป็นพิษ เพราะว่าค่า
การไหลและค่ารั้นออฟสองตัวเพียงพอที่ทำให้เกิดการบลูม การวิเคราะห์ยูโทรฟิเคชั่นพบว่าแม่น้ำพองและบริเวณบึงจืดอยู่
ภายใต้ยูโทรฟิเคชั่น และอาจเกิดการบลูมของสาหร่ายเป็นพิษได้ ผลจากการวัดค่าฟีนอลพิสูจน์ให้เห็นว่าซากตะกอนของ
เสียเก่าจากโรงงานไม่มีสารฟีนอลเพียงพอที่จะทำให้ปลาตายได้

สาขาวิชา การจัดการสิ่งแวดล้อม

ปีการศึกษา 2547

ลายมือชื่อนิสิต 

ลายมือชื่ออาจารย์ที่ปรึกษา 

ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....


4389656920 : MAJOR ENVIRONMENTAL MANAGEMENT

KEY WORD: WATER QUALITY/ FISH KILLS/ MODELING/ RUNOFF

CHANCHAI SANGSURASAK: PREDICTION OF CONCENTRATIONS OF TOXIC COMPOUNDS WITH A SIMULATION PROGRAM: A FISH-KILL STUDY IN THE PONG RIVER, THESIS ADVISOR: ASSOC. PROF. WANPEN WIROJANAGUD, Ph.D. THESIS COADVISOR: PROF. HSIN-NENG HSIEH, Ph.D. 254 PP. ISBN 974-17-4777-2.

A fish-kill problem has been in the Pong River, Thailand for over a decade. As the river was exposed to different pollution sources such as remnants of the past untreated wastewater's spill, aquacultural waste, and agricultural runoff, all possible fish-killing agents from these sources must be studied. From the 1999 and 2000 monitoring data, it was found that fish kills and low DO occurred at the same time. Moreover, a week before the fish kills in 1999, there were high BOD₅ and DO at all aquaculture sites, suggesting that there might be an algal bloom, which died off and subsequently caused low DO and fish kills. The presence of the algal bloom was proved indirectly with the use of GC/MS in conjunction with the experimental aquaculture, trophic state analysis with algal enumeration, and water quality modeling. A dynamic water quality model was developed with a new method for estimating the unavailable runoff data and calibrating the flow, using a combination of lignin and tannin as conservative trace. Results of correlation coefficients (R^2) from the runoff calibration were reasonably high. Root mean square error (RMSE) from the calibration of flow was comparable with the literature values, using salinity as conservative trace. RMSEs from the model calibration and validation of conventional nutrients were found to be comparable to literature values. The model predicted the bloom die-off which lowered DO and possibly caused fish kills on the same day in 1999, suggesting that the accuracy of the dynamic model was on a time scale of days, and that the use of lignin/tannin to calibrate the flow and runoff was justified. The predictive capability of the model for chlorophyll *a* was tested and the bloom was still predicted, suggesting that the flow and runoff were enough to cause the bloom. The analysis of the trophic state indicated that the Pong River and Chot lagoon, particularly the fish pond, were under eutrophication, and risk from the algal bloom. The monitoring of phenols also proved that remnants of untreated wastewater in the Chot lagoon did not contain significant amounts of phenols which could cause the fish kills.

Inter-department Environmental Management Student's signature 

Field of study Hazardous Waste Management Advisor's signature 

Academic year 2004 Co-advisor's signature

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GLOSSARY

AGNPS. Agricultural Non-point Source Pollution Model

ANSWERS. Areal Non-point Source Watershed Environment Response Simulation

BOD. Biochemical Oxygen Demand

BOD₅. Five-day Biochemical Oxygen Demand

CBOD. Carbonaceous Biochemical Oxygen Demand

Chl a. Chlorophyll a

CREAMS. Chemicals, Runoff, and Erosion from Agricultural Management Systems Model

DIW. Department of Industrial Works

DO. Dissolved Oxygen

DYNHYD5. Dynamic Estuary Model Hydrodynamic Model – Version 5

GIS. Geographic Information Systems

GPS. Global Positioning System

HSPF. Hydrological Simulation Program – FORTRAN

NEB. National Environmental Board

NH₃-N. Ammonia Nitrogen

NO₃-N. Nitrate Nitrogen

NO₂-N. Nitrite Nitrogen

NPS. Non-point source

ON. Organic nitrogen

PCD. Pollution Control Department

PO₄-P. Phosphate phosphorus

PS. Point Source

RID. Royal Irrigation Department

RMSE. Root Mean Square Error

SI. Sensitivity Index

SOD. Sediment Oxygen Demand

SWMM. Stormwater Management Model

TKN. Total Kjeldahl Nitrogen

TMDL. Total Maximum Daily Load

US. United States

US EPA. United States Environmental Protection Agency

USGS. United States Geological Survey

WASP. Water Quality Simulation Program