

(HUANJING KEXUE)

# ENVIRONMENTAL SCIENCE

第39卷 第9期

Vol.39 No.9

2018

中国科学院生态环境研究中心 主办

斜 学 出 版 社 出版



## ENVIRONMENTAL SCIENCE

第39卷 第9期 2018年9月15日

## 目 次

长三角区域非道路移动机械排放清单及预测 黄成,安静宇,鲁君(3965)基于 COPERT 模型的江苏省机动车时空排放特征与分担率 李荔,张洁,赵秋月,李慧鹏,韩军赞(3976)上海典型燃烧源铅和汞大气排放趋势分析 杨静,陈龙,刘敏,孟祥周,张希(3987)广东省秸秆燃烧大气污染物及 VOCs 物种排放清单 孙西勃,廖程浩,曾武涛,张永波,梁小明,叶代启(3995)重庆市北碚城区气溶胶中水溶性无机离子的质量浓度及其粒径分布
济南市夏、冬季 PM <sub>2.5</sub> 中化学组分的季节变化特征及来源解析
聊城冬季一重污染过程 PM2.5 污染特征及成因分析
济南市夏、冬季 PM <sub>2.5</sub> 中化学组分的季节变化特征及来源解析
音城市冬季环境至气中挥及性有机物的污染特征及来源解析 
合肥市典型交通干道大气苯系物的特征分析
填埋场作业面 NMOCs 臭氧生成潜势及高贡献物质 李昊, 刘彦君, 陈坦, 闫秋鹤, 代辉祥, 王洪涛, 陆文静(4070) 北京市混凝土搅拌站风蚀扬尘排放特征 李贝贝, 韩凯丽,秦建平,王鑫,宋博,黄玉虎,张春来(4078) 基于源解析的傍河水源地污染风险季节性变化特征分析
透水路面-生物滞留池组合道路的城市面源污染控制效果评估
营曼莉,左俊杰,任心欣,赵洪涛,罗茜,廖云杰,李叙勇(4096) 黄河兰州段水体中有色溶解性有机质组成、空间分布特征及来源分析
伊洛河和浑太河春季水体光学吸收特征的对比····································
三峡水库十流沉积物及消落带土壤磷形态及其分布特征 张志永,万成炎,胡红青,彭建华,侯娟,丁庆秋,袁玉洁(4161) 蓄水前后三峡库区香溪河沉积物磷形态分布特征及释放通量估算
蓄水前后三峡库区香溪河沉积物磷形态分布特征及释放通量估算 
我国典型潮间带沉积物-水界面无机氮源汇效应
制革废水处理过程中磺胺类抗生素和抗性细菌的分布特征 胡亚茹,姜蕾,张天阳,雷丹丹,姜巍巍,张东,林匡飞,崔长征(4222)制革废水处理过程中磺胺类抗生素和抗性细菌的分布特征 花莉,李璐,杨春燕(4229)人工湿地不同基质和粒径对污水净化效果的比较 赵林丽,邵学新,吴明,姜小三,陆琳莹(4236)城市污水管网中不同生化作用的基质流向 姚翔译,石烜,桑浪涛,金鹏康,王晓昌(4242)微絮凝对腐殖酸超滤过程膜污染的减缓特性 王旭东,石彩霞,廖正伟,贺酰淑,王磊(4249)UV报准节整络6 指化过硫酸法氧化降解苯胺 韩东晖,李瑛,李开明,应光国(4257)
城市污水管网甲不同生化作用的基质流同
焦化废水 A/O <sup>2</sup> 和 A/O/H/O 处理工艺中多环芳烃的削减行为分析
长期侧流提取对 EBPR 系统除磷及其磷回收性能的影响
NaCl 盐度对 A <sup>2</sup> /O 工艺缺氧区胞外聚合物及生物絮凝性的影响 ····································
NaCl 盐度对 A²/O 上 乙缺氧区胞外聚合物及生物絮凝性的影响 张兰河,田蕊,郭静波,贾艳萍,张海丰,李正,陈子成(4281)温度和 pH 值对铁盐型氨氧化过程氮素转化的影响 陈方敏,金润,袁砚,李祥,黄勇,顾澄伟(4289)游离氨(FA)对氨氧化菌(AOB)活性抑制动力学试验 孙洪伟,于雪,高宇学,李维维,祁国平,许涓(4294)HRT 对厌氧氨氧化协同异养反硝化脱氮的影响 安芳娇,赵智超,黄利,黄剑明,邵兆伟,陈永志(4302)长期储存亚硝化絮状污泥活性的恢复 李田,魏凡凯,汪裕昌,沈耀良,吴鹏,宋吟玲(4310)广西西江流域农田土壤重金属含量特征及来源解析 宋波,张云霞,庞瑞,杨子杰,宾娟,周子阳,陈同斌(4317)紫色土壤有机碳活性组分对生物炭施用量的响应 罗梅,田冬,高明,黄容(4327)秸秆及生物炭还田对油菜/玉米轮作系统碳平衡和生态效益的影响
低积累水稻品种联合腐殖酸、海泡石保障重镉污染稻田安全生产的潜力 。

## 洱海流域乡镇尺度上人类活动对净氮输入量的影响

李影1, 刘宏斌1, 雷秋良1\*, 胡万里2, 王洪媛1, 翟丽梅1, 任天志3, 连慧姝1

(1. 中国农业科学院农业资源与农业区划研究所,农业部面源污染控制重点实验室,北京 100081; 2. 云南省农业科学院农业环境资源研究所,昆明 650205; 3. 农业部环境保护科研监测所,天津 300191)

摘要:人类活动引起的氮素过量输入已经成为引起水体富营养化及其他生态危害的主要原因.为了研究人类活动对流域氮素的影响,本文基于洱海流域 16 个乡镇行政单元的统计数据,考虑流动人口的影响,利用 NANI 模型估算洱海流域乡镇尺度的人类活动净氮输入量(net anthropogenic nitrogen inputs,NANI).结果表明,2014 年洱海流域 NANI 总量为  $29.81 \times 10^3$  t,单位面积输入强度(以氮计)为10.986 kg·(km²·a) $^{-1}$ ,显著高于我国平均水平. 当地旅游人口带入的食品氮输入为  $0.26 \times 10^3$  t,占到了流域居民食品氮输入的 8%. 从氮素的输入量的构成来看,肥料输入是最大的贡献源,占到了流域净氮输入的 47%,其次为食品饲料的净氮输入. 在空间分布上,乡镇单元的 NANI 分布呈现明显区域化特征,从流域整体上看呈现北高南低的特点. 耕地或人口集中的乡镇 NANI 强度偏高,洱海流域具有较大的氮素污染风险.

关键词: 洱海流域; 乡镇尺度; 氮素; 净氮输入量(NANI); 人类活动

中图分类号: X52 文献标识码: A 文章编号: 0250-3301(2018)09-4189-10 DOI: 10.13227/j. hjkx. 201712079

# Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) at Township Scale in Erhai Lake Basin

LI Ying<sup>1</sup>, LIU Hong-bin<sup>1</sup>, LEI Qiu-liang<sup>1\*</sup>, HU Wan-li<sup>2</sup>, WANG Hong-yuan<sup>1</sup>, ZHAI Li-mei<sup>1</sup>, REN Tian-zhi<sup>3</sup>, LIAN Hui-shu<sup>1</sup>

(1. Key Laboratory of Nonpoint Source Pollution Control, Ministry of Agriculture, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China; 2. Institute of Agricultural Resources & Environment, Yunnan Academy of Agricultural Sciences, Kunming 650205, China; 3. Agro-Environmental Protection Institute, Ministry of Agriculture, Tianjin 300191, China)

**Abstract:** Excessive nitrogen inputs from human activities have become the main cause of water eutrophication and related ecological hazards. In order to study the impact of human activities on nitrogen in the basin, and based on statistical data of administrative units in 16 towns and villages, this study used the NANI model to calculate net anthropogenic nitrogen inputs (NANI) at township scale in Erhai Lake basin. Results show that the total amount of NANI in Erhai Lake basin was 29.81  $\times$  10<sup>3</sup> t in 2014, and nitrogen input intensity per unit area was 10 986 kg·(km²·a)  $^{-1}$ , significantly higher than the national average. The input of nitrogen from food by the local tourist population was 0.26  $\times$  10<sup>3</sup> t, accounting for 8% of local food nitrogen input. Nitrogen input from chemical fertilizer is the largest NANI input source, accounting for 47% of net nitrogen input in the basin, followed by net nitrogen input of food and feed. The spatial distribution of NANI at township scale shows evident regionalization, with higher values in the north and lower values in the south of the basin. The intensity of NANI in towns with cropland or population is high. The corresponding risk of nitrogen pollution in Erhai Lake basin is therefore a primary concern, and will remain so in the near future.

Key words: Erhai Lake basin; township scale; nitrogen; net anthropogenic nitrogen inputs (NANI); human activities

目前,我国水体水质情况不容乐观,超过 40%的湖泊已经处于富营养化状态,水质的恶化,严重制约了城市的持续发展<sup>[1,2]</sup>.越来越多的研究显示,人类的耕作、养殖、食品贸易等活动引起的养分输出已经成为造成水体富营养化及其他生态危害的主要原因<sup>[3~5]</sup>,而在不同的地区,人类活动引起的氮的输入存在明显的空间变异性<sup>[6]</sup>.因此,了解和认识人类活动导致的养分输入特征对于指导流域氮素管理及环境政策制定具有重要意义.

目前主流的研究方法主要分为两种:机制模型和经验模型.基于物理原理的机制模型往往结构复

杂、参数及数据要求条件较高;而经验模型利用黑箱式的方法规避了产汇输移过程的复杂性与随机性,运算简单,所需参数少,计算方法具有普适性且能保证进一步分析所需的精度<sup>[7]</sup>. 为了评估人类活动对流域养分平衡的负面效应,Howarth等<sup>[8]</sup>首先提出人类活动净氮输入(net anthropogenic

收稿日期: 2017-12-11; 修订日期: 2018-03-12

基金项目: 国家自然科学基金项目(31572208); 公益性行业(农业)

科研专项(201303089)

作者简介:李影(1991~),女,硕士研究生,主要研究方向为环境

污染与修复, E-mail:liying9391@126.com

\* 通信作者,E-mail:leiqiuliang@caas.cn

nitrogen inputs, NANI)的概念,用来估算流域中由人类活动导致的不同氮源的输入强度. NANI 主要由人类活动导致的主要氮源输入的 4 个类型构成,其结果可以表征区域氮循环受人类活动的影响.目前,NANI 及其修正方法在美国、欧洲及亚洲地区的不同时空尺度上得到了广泛应用,并且有效地评估了流域人为氮素输入量及其与河流氮素输出之间的关系<sup>[9,10]</sup>. 近年来,我国学者先后对大陆地区、淮河流域、滇池流域、椒江流域、鄱阳湖流域、长江流域等地区进行了净氮输入量的研究,并且利用省级及县市级别的统计数据对人类活动造成的氮素输入进行了分析,不仅得到了人类活动净氮输入在时空尺度上的变异,还发现净氮输入与河流无机氮通量存在显著的相关关系<sup>[10~14]</sup>.

NANI 模型作为典型的经验模型, 在参数及实 测数据缺乏的地区具有较强的实用性及普适性. 然 而,以往的研究区域面积较大,且多基于县市级别 的数据[11,15],考虑到人类活动净氮输入量的计算 存在尺度转换上的不确定性, 因此在更精细的空间 尺度更加准确地计算 NANI, 分析其与土地利用、 经济、水质等各因素的关系更有意义. 洱海流域作 为初级富营养化湖泊的典型代表,了解人类活动对 其净氮输入量的影响,对于防治农业面源至关重 要. 因此本文以洱海流域为研究区, 在乡镇尺度上 并考虑流动人口的影响, 收集 2014 年乡镇级别的 统计数据以及相关参数进行 NANI 估算, 识别洱海 流域面源污染的重点源和关键区. 本文特别考虑 了: ①流动人口对于区域氮素循环的影响; ②同时 采用了更小尺度、更加精细的统计数据进行估算; ③对人类、养殖、耕地这3个子系统的输入输出进 行了核算.

#### 1 材料与方法

#### 1.1 研究区概况

洱海位于云南省大理白族自治州境内,湖面面积约250 km²,正常库容量为28.87×108 m³,属澜沧江水系. 洱海流域面积为2565 km²,是亚热带高原季风气候,干湿季明显,年均温度15.1℃,年平均降水量为1048 mm,为典型的山地丘陵地区.流域内主要的土地利用类型为林草地,占到了流域面积的68.90%,其次为耕地25.63%,而建设用地只有0.44%.

洱海流域地跨大理市和洱源县,包含了16个 乡镇、167个村,总人口约80万.流域北部属洱源 县的6个乡镇,为农业发达地区,城镇化程度只有33%;南部属大理市的10个乡镇,城镇化程度较高达到68%. 洱海流域16个乡镇的耕地占比从10%~35%,人口密度从(0.16~6)×10<sup>4</sup>人·km<sup>-2</sup>. 种植作物主要为水稻、蚕豆、油菜、大麦等高原作物,主要养殖种类为猪、牛、羊、禽类,以分散养殖为主. 洱海流域所在地区是我国著名的历史文化名城,优秀旅游城市,旅游总人次逐年攀升.

洱海水质从 20 世纪 90 年代开始急剧恶化,在 1996 年和 2003 分别暴发了蓝藻和水华,目前年均水质在 II ~ III 类,属于我国初期富营养化湖泊的典型代表.研究表明,农业面源污染是洱海水质恶化的主要原因,主要污染源为农村生活源、畜禽养殖源和农田种植源<sup>[16~18]</sup>.

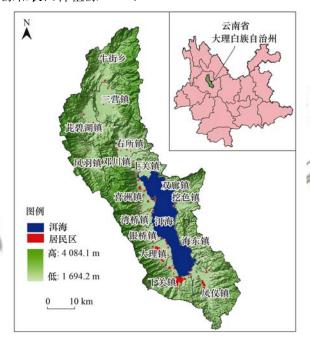


图 1 洱海流域行政区划示意

Fig. 1 Administrative map of Erhai Lake basin

#### 1.2 数据来源

本研究使用的数据如下.

- (1)2014年乡镇人口数量、畜禽养殖量、农产品产量、氮肥施用量,另外还包括了当地的旅游人次及平均停留时间(2.33 d).数据来源于当地的农业统计年鉴和当地国民经济和社会统计公报.
- (2)居民蛋白质摄入量(城镇居民每人69  $g \cdot d^{-1}$ , 农村居民每人64.6  $g \cdot d^{-1}$ )<sup>[19]</sup>、畜产品可食用部分比例(表1)<sup>[11,20]</sup>、畜禽氮素摄入(表1)<sup>[11,21,22]</sup>及排泄水平(表1)<sup>[21,23,24]</sup>、豆科作物固氮能力[本地区豆科作物主要为大豆和蚕豆,固氮能力分别为9600  $kg \cdot (km^2 \cdot a)^{-1}$ 和7500

kg·(km²·a)<sup>-1</sup>]<sup>[25, 26]</sup>、农产品含氮量(表2)<sup>[27]</sup>、氮 沉降[1 161.79 kg·(km²·a)<sup>-1</sup>]<sup>[28]</sup>等数据则通过查

阅资料获得.

(3)乡镇的面积根据 GIS 乡镇边界图计算得到.

#### 表 1 畜禽的氮素摄入及排泄水平和畜禽产品可食用部分比例

Table 1 Estimated livestock nitrogen intake, excretion rate, and edible proportion of livestock

畜禽种类	氮素摄入水平	氮素排泄水平	可食用部分比例
田內作矢	/kg·(头·a) <sup>-1</sup>	/kg·(头·a) <sup>-1</sup>	可良用即为比例
奶牛	126. 5	78. 30	0. 795
肉牛/役用牛	109. 4	37. 99	0. 795
猪	9. 5	7. 21	0. 871
家禽	0. 188	0. 10	0. 85
羊	14. 45	5. 69	0. 757

#### 表 2 食品中蛋白质的含量

Table 2 Estimated protein content in food of China

名称	蛋白质含量/%
小麦	12. 0
蚕豆	25. 4
马铃薯	2. 0
大麦	10. 2
稻谷	9.9
玉米	8.8
大豆	35. 1
油菜籽	24. 0
向日葵	23.9
蔬菜(以青菜、白菜计)	1.5
瓜类	0.6

#### 1.3 NANI 估算方法

净氮输入量 NANI 主要由 4 部分组成:

$$NANI = N_{im} + N_{fer} + N_{cro} + N_{dep}$$

式中,  $N_{im}$ :表示食品/饲料氮输入量,是人类及畜禽氮素摄入量与氮素产量的差值. 统计了当地主要的蚕豆、大麦、小麦、稻谷等农作物以及猪、牛、羊、家禽等畜禽品种,农作物及畜产品在转换为食物的过程中有 10% 的损失<sup>[11]</sup>.  $N_{fer}$ :直接采用统计年鉴中氮肥折纯量数据. 表示化肥氮输入量. 在此有机肥的氮输入看作系统内部循环,不计算在内.  $N_{ero}$ :表示作物固氮量. 通过种植面积与单位面积固氮量的乘积进行计算,根据地区种植情况只计算了大豆、蚕豆的固氮量.  $N_{dep}$ :表示大气氮沉降量. 由于流域范围较小,整个流域采用一个氮沉降数值.

其中,

$$N_{_{im}} \; = \; N_{_{hc}} \; + \; N_{_{lc}} \; - \; N_{_{lp}} \; - \; N_{_{cp}}$$

计算方法如下所示:

 $N_{hc} =$ 

$$\frac{\text{Pop1} \times 69 + \text{Pop2} \times 64.6 \times 365 + \text{Pop3} \times 69 \times 2.33}{6.25 \times 10^{6}}$$

式中, N<sub>hc</sub>:人类食品氮消费量. 由流域人口数量以及单位人口的氮摄入量来确定. Pop1:区域城镇人

口数量(人); Pop2:区域农村人口数量(人); Pop3: 区域接待旅游人次(人).

$$N_{le} = \sum_{i=1}^{n} (AN_i \times ANI_i \times 10^{-3})$$

式中, $N_{lc}$ :畜禽饲料氮消费量. 由流域内各类畜禽的养殖数量以及畜禽的氮素需求量计算得到. AN:区域畜禽养殖数量(头或只);n:表示区域养殖的畜禽种类数量;i:表示畜禽种类;ANI:氮素摄入水平[ $kg \cdot (y \cdot a)^{-1}$ ].

$$N_{lp} = \sum_{i=1}^{n} AN_{i} \times (ANI_{i} - ANO_{i}) \times r_{edi} \times 10^{-3}$$

式中, $N_{lp}$ :畜禽产品氮产量.即流域内畜产品总的氮含量.根据畜禽的数量、氮素需求以及氮素排泄水平来计算. ANO:畜禽氮素排泄水平[ $kg\cdot(\cdot,\cdot,a)^{-1}$ ]; $r_{edi}$ :畜禽可食用部分比例.

$$N_{cp} = \sum_{j=1}^{m} CP_j \times PC_j$$

式中,  $N_{cp}$ :作物氮生产量.根据作物产量及氮含量来确定.j:作物种类;m:区域作物种类的数量; CP:作物产量(t); PC:作物产品的含氮量(蛋白质含量除以蛋白质转化系数 6.25).

另外,对于流域氮素流通特征的计算中,还包括了进入大气及自然水体或者污水管网的氮素损失,主要是通过排放系数来进行估算.进入大气的含氮气体中,其中:来自化肥和有机肥的 NH<sub>3</sub>-N 损失,平均排放因子设置为总氮肥施用量的 25%; N<sub>2</sub>O-N 损失,排放因子为化肥氮施用量的 0.86% 和有机肥氮施用量的 1%.畜禽粪便在存储过程中有平均 27% 的氮以 NH<sub>3</sub>-N 形式排放,0.5% 的氮以 N<sub>2</sub>O-N 的形式排放,5% 的氮以 N<sub>2</sub> 的形式排放<sup>[29]</sup>.进入自然水体或污水管网的氮素,其中:人类的排泄物中城镇人口的进入污水管网,剩余部分计算同畜禽粪便;流域耕地的年水土流失量为11 420 t·km<sup>-2[30]</sup>.

每个乡镇的净氮输入强度为该乡镇单位面积上

的净氮输入量. 以上各项的计量单位采用 t·a<sup>-1</sup>或 kg·(km²·a) -1, 计算方法参照文献[11,31], 由于 本流域属于旅游热点地区, 因此在计算过程中考虑 了旅游人口对于当地人口净氮输入的影响. 某个乡 镇对流域的贡献为该乡镇 NANI 总量占流域 NANI 总量的比例.

#### 1.4 数据处理与统计分析

采用 Microsoft® Excel 进行数据统计与计算. 运用 IBM SPSS Statistics 17.0 对数据进行方差分析 和相关性分析. 采用 Excel 2016 与 ArcGIS 10.1 进 行处理数据与制图.

#### 2 结果与分析

#### 2.1 洱海流域社会生态系统氮素流通特征

由洱海流域氮素循环(图2)可以清晰地了解本 流域氮素的输入、输出及内部的社会生态系统氮素 流通特征. 氮素的输入来源主要为饲料氮的净输入 (需求的饲料氮量减去农产品中牧草的含氮量),占 到了总输入量的65.94%,其次为化肥氮投入,占到 了总投入量的31.54%;总输入的氮素中约有 22.08%的氮素转化为气态损失,约有31.54%的氮 素经过直接排放或者径流、侵蚀等途径进入下水道 或者自然水体,只有约11.77%的氮素作为产品输 出;约有34.61%的氮素存留在流域3个子系统内 部,其中,养殖子系统留存的氮素占比最大为 19.38%, 其次约有14.30%的氮素留存在了土壤中.

#### 2.2 总量特征

基于统计数据和核算方法, 计算得出(表3) 2014 年洱海流域 16 个乡镇人类活动净氮输入总量 为  $29.81 \times 10^3$  t(不包括洱海), 折合单位面积输入 强度为10 986 kg·(km²·a) -1; 洱海流域较全国平均 [2009 年 我 国 平 均 输 入 强 度 为 5013 kg·(km²·a) -1][10]水平高出一倍. 其中三营镇、茈 碧湖镇和右所镇为净氮输入总量最多的3个乡镇, 对整个流域的贡献超过了40%. 洱海水面净氮输入 总量为  $0.29 \times 10^3$  t 约占整个流域输入总量的 1%: 流域当地居民的食品输入总量为 3.24 × 106 kg, 当 地旅游人口每年带入的食品氮输入为 0.26 × 106 kg, 占到了流域当地居民食品氮输入的8%, 占到 了流域人类活动净氮输入总量的0.9%.

表 3 2014 年洱海流域各乡镇净氮输入总量及其 4 个组成部分

Total net nitrogen input and its components in townships of Erhai Lake basin in 2014

位置	食品/饲料输入	化肥氮输入	作物固氮	氮沉降	NANI 总量	对整个流域的贡献率
[五]	$\times 10^3/t$	/%				
下关镇	0. 79	0. 43	0.02	0. 22	1. 45	4. 88
大理镇	0. 12	1.01	0.01	0.11	1. 26	4. 22
凤仪镇	0. 33	0. 74	0.05	0. 35	1. 48	4. 97
喜洲镇	0.64	0. 94	0.06	0. 20	1. 84	6. 18
海东镇	0. 13	0. 85	0.02	0. 14	1. 14	3. 81
挖色镇	0.09	0. 32	0.02	0. 14	0. 56	1.88
湾桥镇	0. 22	0. 38	0. 04	0. 07	0.71	2. 38
银桥镇	0. 07	0. 53	0. 05	0. 08	0. 74	2. 47
双廊镇	0. 68	0. 48	0. 01	0. 21	1. 39	4. 66
上关镇	1.31	0. 28	0.06	0. 12	1. 78	5. 96
茈碧湖镇	1.51	2. 04	0. 12	0. 32	4. 00	13. 42
邓川镇	0. 67	0. 51	0.02	0. 07	1. 27	4. 26
右所镇	1.87	1. 42	0.07	0.30	3. 67	12. 30
三营镇	1.86	2. 33	0. 16	0. 29	4. 65	15. 59
凤羽镇	0. 67	1. 38	0. 03	0. 21	2. 29	7. 68
牛街乡	0.78	0. 42	0.08	0.30	1. 59	5. 33
整个流域	11.75	14. 07	0. 83	3. 15	29. 81	100

从洱海流域各个乡镇单元 NANI 强度及其 4 个 输入源在数值上的范围差距以及各项的标准差的差 异(表4), 均显示出洱海流域的氮源输入具有高度 的空间异质性. 其中 NANI 的 4 个组成部分中, 除 去氮沉降流域采用统一值外, 作物固氮的标准差及 数据范围最小:食品/饲料的净氮输入范围差和标 准差最大为 11 876 kg·(km²·a)<sup>-1</sup> 和 3 592 kg·(km²·a) -1, 说明在 4 个组成部分中食品/饲料 的净氮输入在空间上的差异性最大.

#### 2.3 空间分布特征

洱海流域人类活动净氮输入强度及其组成部分 的空间分布存在明显的空间差异(图3和图4), NANI 的高值出现在邓川镇、三营镇和右所镇, 其 中邓川镇的 NANI 最高, 达到了 21 074

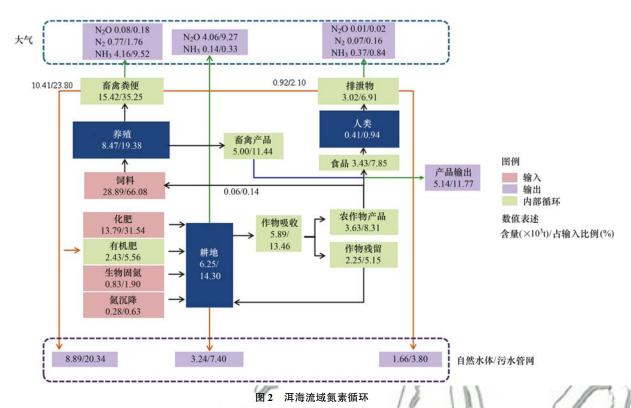


Fig. 2/ Nitrogen cycle of Erhai Lake basin

 $kg \cdot (km^2 \cdot a)^{-1}$ ; 最低出现在挖色镇,为4633  $kg \cdot (km^2 \cdot a)^{-1}$ .  $N_{lm}$ 的高值分布较为集中,出现在三营镇、右所镇、邓川镇和上关镇,最高的为上关镇 [12378  $kg \cdot (km^2 \cdot a)^{-1}$ ],最低的为挖色镇 [502  $kg \cdot (km^2 \cdot a)^{-1}$ ].  $N_{lm}$  [图4(a)]的空间分布可能与乡镇的发展程度有关; $N_{fer}$  [图4(b)]的高值较为分散,

出现在三营镇、邓川镇和大理镇,最高为大理镇  $10\,778\,\mathrm{kg}\cdot(\mathrm{km}^2\cdot\mathbf{a})^{-1}$ ; 低值出现在牛街乡,为 $1\,607\,\mathrm{kg}\cdot(\mathrm{km}^2\cdot\mathbf{a})^{-1}$ ,这是由各乡镇的施肥习惯所决定.  $N_{\mathrm{cro}}[\,\mathrm{B}\,4(\,\mathrm{c}\,)\,]$ 的分布与各乡镇的种植结构关系密切,最高值出现在银桥镇,为 $714\,\mathrm{kg}\cdot(\mathrm{km}^2\cdot\mathbf{a})^{-1}$ ;最低出现在双廊镇,为 $62\,\mathrm{kg}\cdot(\mathrm{km}^2\cdot\mathbf{a})^{-1}$ .

表 4 洱海流域 NANI 强度统计特征值/kg·(km²·a) -1

Table 4	Ctationical	characteristics of	C tarumahin agai	 	mituo oco	 :	Enlant	Lalea	basin/lea	. ( 1	2	- 1

输入项	范围	平均值/中值	标准差
氮肥施用	1 607 ~ 10 778	5 565/5 719	2 866
作物固氮	62 ~714	324/300	209
氮沉降	1 162	1 162/1 162	_
食品/饲料净氮输入	502 ~ 12 378	4 313/3 545	3 592
NANI	4 633 ~ 21 074	11 470/10 897	4 801

除了邓川镇、右所镇、牛街乡等6个乡镇最大的输入源为食品/饲料输入外,其余乡镇的最大输入源均为施用的化肥(图3). 从整个流域氮素输入量的构成(图3)来看, 化肥氮的输入是最大的贡献源,占到了净氮输入的47%,其次为食品饲料的净氮输入. 因此,施用的化肥是洱海流域氮素的主要输入源.

整体上来看(图3), 洱海流域净氮输入强度存

在明显的南北区域差异,北部在各组成(图 4)上都要高于南部,这与其他学者研究得出洱海流域北部为洱海的主要污染区的结果一致<sup>[32]</sup>,这可能是由于洱海流域南北城镇化发展不均衡造成的,洱海流域北部主要以农业为主城镇化水平只有33%,而南部却高达68%.从局部来看,洱海流域净氮输入的关键乡镇为三营镇、上关镇和邓川镇.此结果与陈纬栋得到的三营镇和上关镇是洱海流域农业面源

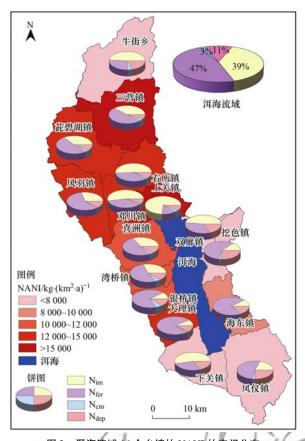


图 3 洱海流域 16 个乡镇的 NANI 的空间分布 及其 4 个组成部分所占比例

 $Fig. \ 3 \quad Spatial \ distribution \ of \ NANI \ in \ Erhai \ Lake \ basin \\ and \ the \ proportion \ of \ four \ components \ in \ 16 \ townships$ 

污染的关键区的分析结果相一致[33].

#### 2.4 结构特征

从 NANI 与其输入源的相关关系(图 5)看, NANI 与食品/饲料的氮输入的相关性最强[图 5 (a)],  $R^2$  达到 0. 6397 (P < 0. 01),仅此项就可解释 NANI 变化的 63. 97%,表明人口的食品消费对洱海流域氮通量有巨大影响. 其次,肥料的施用决定了净氮输入变化的 42. 21% [图 5 (b)],因此控制施肥对于削减洱海流域人类活动造成的氮输入具有重要意义. 相对而言,植物固氮与 NANI 的线性相关系数较低[图 5 (c)],这与它本身对 NANI 的贡献较小有关.

#### 2.5 人类活动与 NANI 的关系

为进一步分析人类活动对 NANI 空间分布的影响,本文分析了各乡镇居民地比例、耕地施肥强度、耕地面积占比与人口密度对 NANI 分布格局的影响. 研究发现,人类活动强度越大,NANI 越大.NANI 与总人口密度关系不显著,但与城镇人口密度显著相关[图 6(a)和图 6(b)]. 同时,由图 6(e)和图 6(d)可以看出人类的耕作活动对净氮输入强度的影响显著.上文提到施肥决定了净氮输入强度变化的42.21%,但是耕地上的施肥强度与净氮输入强度之间没有显著的相关关系[图 6(e)],所以相较于耕地的施肥强度,施肥面积是更主要的决定因素.

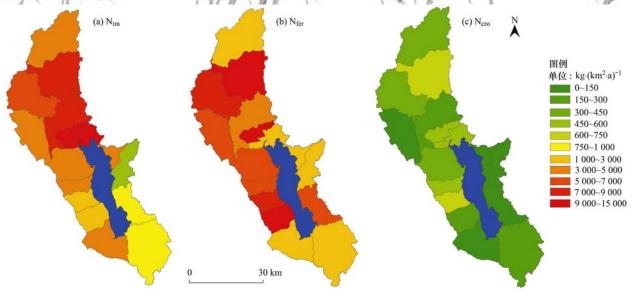


图 4 洱海流域 16 个乡镇的 NANI 各组成部分的空间分布

Fig. 4 Spatial distribution of NANI components in the 16 townships of Erhai Lake basin

#### 3 讨论

与我国的其它区域相同, 氮肥输入和食品的输入是两个主要的输入源, 但洱海流域的人为氮素输

入强度属于偏高水平. 例如,在 2009 年我国各省的人类活动净氮输入强度为 870~24 896 kg· $(km^2\cdot a)^{-1[10]}$ ; 洱海流域 NANI 高于长江流域6734.5~9618.7 kg· $(km^2\cdot a)^{-1[13]}$ 、滇池流域

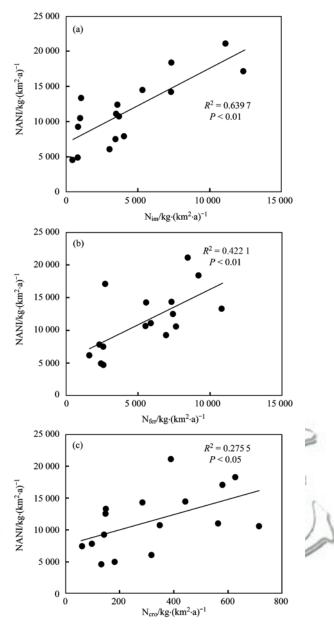


图 5 洱海流域 16 个乡镇的 NANI 及其构成的相关关系

Fig. 5 Correlation of NANI and its components in the 16 townships of Erhai Lake basin

12 600 kg·(km²·a) -1[34] 及鄱阳湖流域年均人为氮输入量为6 913 kg·(km²·a) -1[12], 低于淮河流域 [2010 年 NANI 为26 415 kg·(km²·a) -1][14].

此外, 洱海流域 NANI 强度也高于世界其他地区. 如在美国, 人为氮的输入强度为 560 ~ 4 900 kg· $(km^2 \cdot a)^{-1[35,36]}$ , 欧洲环波罗的海区域为 300 ~ 8 800 kg· $(km^2 \cdot a)^{-1[37]}$ , 印度全国平均为 4 616 kg· $(km^2 \cdot a)^{-1[38]}$ , 都远远低于洱海流域.

当前的研究表明,人类活动的净氮输入一部分暂时滞留在流域系统中,一部分会直接输出到水体中<sup>[39]</sup>,与河流营养输出相关关系显著<sup>[35, 36, 39-41]</sup>.

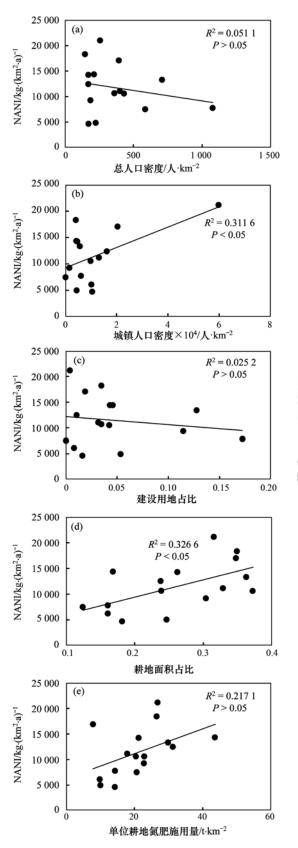


图 6 洱海流域 NANI 与人类活动的关系

Fig. 6 Correlation of NANI and human activities in Erhai Lake basin 人类活动导致的区域营养输入中约有 15% ~ 30% 的氮最终进入水体<sup>[41]</sup>. 洱海流域较高的氮输入间

接反映出该地区具有较大的氮素污染风险.

张汪寿等<sup>[15]</sup>在对已有的 NANI 研究进行总结分析发现:化肥施用是最主要的氮素输入源,占人类活动净氮输入总量的 79.0%,其次为作物固氮作用占 17.6%,食品/饲料氮净输入量占 - 14.5%,大气沉降占 15.7%。食品/饲料氮净输入量为负值说明区域的食品和饲料以出口为主。而在洱海流域氮肥的施用占到了 47%,也是主要的输入源,而食品/饲料的净氮输入占到了 39%,成为该地区的第二大输入源,主要是因为洱海流域的养殖业发达且多为分散养殖。

人类活动净氮输入(NANI)模型可以快速评估 区域氮源通量. 然而,目前人类活动净氮输入模型 的概念、内容和计算方法仍存在较大不确定性,核 算结果的可靠性也与数据准确度有很大关 系<sup>[14,31,41]</sup>. 在本研究中当地旅游人口食品氮素输 入占到了流域本土居民的8%,占到了流域人类活 动净氮输入总量的0.9%,对于更大尺度的研究流 动人口的影响可能更大. 因此,应该采用更精细、 更全面的数据进行分析,将会进一步提高估算结果 的可靠性.

#### 4 结论

- (1) 2014 年洱海流域人类活动净氮输入量为 29.81 ×  $10^3$  t, 折合单位面积输入强度为 10 986 kg· $(km^2 \cdot a)^{-1}$ , 当地旅游人口每年带人的食品氮输入为  $0.26 \times 10^3$  t, 占到了流域本土居民食品氮输入的 8%, 占到了流域人类活动净氮输入总量的 0.9%.
- (2) 洱海流域氮素转化为产品的效率不高,只有约11.77%的氮素作为产品输出,约有53.62%的氮素通过气体或径流、侵蚀等方式损失,约有34.61%的氮素存留在系统内部.
- (3) 从洱海流域整体上看,各乡镇单元的 NANI 强度呈现北高南低的特点.农业发达地区成为 NANI 高值区. 氮肥施用占输入总量的 47%,其次是食品/饲料输入. 化肥的施用是控制洱海流域人类活动氮通量的最重要因子,并且耕地的种植面积和施肥的总量相较于施肥强度是更主要的决定因素.
- (4) 不同乡镇单元的重点氮素输入源存在差异,有62.5%(10个)的乡镇单元以氮肥施用为最大氮素输入项,其余37.5%(6个)的乡镇单元以食品/饲料输入为主.

#### 参考文献:

- [1] 环境保护部. 2016 中国环境状况公报[EB/OL]. http://www.zhb.gov.cn/hjzl/zghjzkgb/lnzghjzkgb/, 2017-06-05.
- [2] 赵永宏, 邓祥征, 战金艳, 等. 我国湖泊富营养化防治与控制策略研究进展[J]. 环境科学与技术, 2010, **33**(3): 92-98.
  - Zhao Y H, Deng X Z, Zhan J Y, et al. Progress on preventing and controlling strategies of lake eutrophication in China [J]. Environmental Science & Technology, 2010, 33(3): 92-98.
- [3] Howarth R, Chan F, Conley D J, et al. Coupled biogeochemical cycles: eutrophication and hypoxia in temperate estuaries and coastal marine ecosystems [J]. Frontiers in Ecology and the Environment, 2011, 9(1): 18-26.
- [4] Howarth R W. Coastal nitrogen pollution: a review of sources and trends globally and regionally [J]. Harmful Algae, 2008, 8(1): 14-20.
- [5] Howarth R W, Anderson D, Church T, et al. Clean coastal waters; understanding and reducing the effects of nutrient pollution [M]. Washington, D. C.: National Academy Press, 2000.
- [6] Bricker S B, Longstaf B, Dennison W, et al. Effects of nutrient enrichment in the nation's estuaries: a decade of change [J]. Harmful Algae, 2008, 8(1): 21-32.
- [7] 李丽华, 李强坤. 农业非点源污染研究进展和趋势[J]. 农业资源与环境学报, 2014, **31**(1): 13-22. Li L H, Li Q K. The progress and trends of agricultural non-point source pollution research [J]. Journal of Agricultural Resources and Environment, 2014, **31**(1): 13-22.
- [8] Howarth R W, Billen G, Swaney D, et al. Regional nitrogen budgets and riverine N & P fluxes for the drainages to the North Atlantic Ocean; natural and human influences [J]. Biogeochemistry, 1996, 35(1): 75-139.
- [9] McIsaac G F, David M B, Gertner G Z, et al. Relating net nitrogen input in the Mississippi River basin to nitrate flux in the lower Mississippi River: a comparison of approaches[J]. Journal of Environmental Quality, 2002, 31(5): 1610-1622.
- [10] Han Y G, Fan Y T, Yang P L, et al. Net anthropogenic nitrogen inputs (NANI) index application in Mainland China [J]. Geoderma, 2014, 213: 87-94.
- [11] 高伟, 郭怀成, 后希康. 中国大陆市域人类活动净氮输入量 (NANI)评估[J]. 北京大学学报(自然科学版), 2014, **50** (5): 951-959.
  - Gao W, Guo H C, Hou X K. Evaluating city-scale net anthropogenic nitrogen input (NANI) in Mainland China [J]. Acta Scientiarum Naturalium Universitatis Pekinensis, 2014, **50** (5): 951-959.
- [12] 高伟,高波,严长安,等. 鄱阳湖流域人为氮磷输入演变及湖泊水环境响应[J]. 环境科学学报,2016,36(9):3137-3145.
  - Gao W, Gao B, Yan C A, et al. Evolution of anthropogenic nitrogen and phosphorus inputs to Lake Poyang Basin and its' effect on water quality of lake [J]. Acta Scientiae Circumstantiae, 2016, 36(9): 3137-3145.
- [13] Chen F, Hou L J, Liu M, et al. Net anthropogenic nitrogen inputs (NANI) into the Yangtze River basin and the relationship with riverine nitrogen export [J]. Journal of Geophysical Research: Biogeosciences, 2016, 121(2): 451-465.

- [14] 张汪寿, 苏静君, 杜新忠, 等. 1990—2010 年淮河流域人类 活动净氮输入[J]. 应用生态学报, 2015, **26**(6): 1831-1839
  - Zhang W S, Su J J, Du X Z, et al. Net anthropogenic nitrogen input to Huaihe River Basin, China during 1990-2010 [J]. Chinese Journal of Applied Ecology, 2015, 26(6): 1831-1839.
- [15] 张汪寿,李叙勇,杜新忠,等.流域人类活动净氮输入量的估算、不确定性及影响因素[J].生态学报,2014,34(24):7454-7464.
  - Zhang W S, Li X Y, Du X Z, *et al.* Accounting methods, uncertainties and influential factors of net anthropogenic nitrogen input (NANI) [J]. Acta Ecologica Sinica, 2014, **34** (24): 7454-7464.
- [16] 李凤香. 洱海面源污染治理现状及对策[J]. 环境科学导刊, 2008, 27(S1): 82-84. Li F X. Present situation of treatment of non-point source pollution and countermeasures in Erhai Lake[J]. Environmental Science Survey, 2008, 27(S1): 82-84.
- [17] 杨晓雪. 洱海总磷、总氮污染现状分析[J]. 云南环境科学, 2006, **25**(S1): 113-115, 112.

  Yang X X. Analysis on total phosphorus and total nitrogen pollution in Erhai Lake [J]. Yunnan Environmental Science, 2006, **25**(S1): 113-115, 112.
- [18] 黄凯. 洱源农村畜禽粪便氮磷流失规律及控制方案研究 [D]. 昆明: 昆明理工大学, 2011.

  Huang K. Research on the laws of nitrogen and phosphorus loss and control scheme in Eryuan rural [D]. Kunming: Kunming University of Science and Technology, 2011.
- [19] 翟凤英,何宇娜,王志宏,等. 中国城乡居民膳食营养素摄入状况及变化趋势[J]. 营养学报,2005,27(3):181-184.

  Zhai F Y, He Y N, Wang Z H, et al. The status and trends of dietary nutrients intake of Chinese population [J]. Acta Nutrimenta Siniea, 2005, 27(3):181-184.
- [20] 刘晓利, 许俊香, 王方浩, 等. 畜牧系统中氮素平衡计算参数的探讨[J]. 应用生态学报, 2006, **17**(3): 417-423.

  Liu X L, Xu J X, Wang F H, *et al.* Estimation parameters of nitrogen balance in stock farming system of China[J]. Chinese Journal of Applied Ecology, 2006, **17**(3): 417-423.
- [21] 肖林财, 沈维力. 蛋白质对鸡的营养作用及其需要量[J]. 养殖技术顾问, 2014, (1): 57.
- [22] 陈天宝,万昭军,付茂忠,等. 基于氮素循环的耕地畜禽承载能力评估模型建立与应用[J]. 农业工程学报,2012,28
  (2):191-195.
  Chen T B, Wan Z J, Fu M Z, et al. Modeling and application of livestock supporting capacity estimation of cropland based on

nitrogen cycling in southwest China [ J ]. Transactions of the

[23] 董红敏, 朱志平, 黄宏坤, 等. 畜禽养殖业产污系数和排污系数计算方法[J]. 农业工程学报, 2011, 27(1): 303-308. Dong H M, Zhu Z P, Huang H K, et al. Pollutant generation coefficient and discharge coefficient in animal production [J]. Transactions of the CSAE, 2011, 27(1): 303-308.

CSAE, 2012, 28(2): 191-195.

[24] 王方浩, 马文奇, 窦争霞, 等. 中国畜禽粪便产生量估算及环境效应[J]. 中国环境科学, 2006, **26**(5): 614-617. Wang F H, Ma W Q, Dou Z X, *et al*. The estimation of the production amount of animal manure and its environmental effect in China [J]. China Environmental Science, 2006, **26**(5):

- 614-617
- [25] 汤丽琳, 夏先林, 陈超, 等. 几种常见牧草叶蛋白营养物质含量研究[J]. 云南畜牧兽医, 2002, (1): 7-8.

  Tang L L, Xia X L, Chen C, et al. Study on the contet of nutritire matter about foliar-protein in the several kinds of common herbage [J]. Yunnan Journal of Animal Science and Veterinary Medicine, 2002, (1): 7-8.
- [26] 关大伟, 李力, 岳现录, 等. 我国大豆的生物固氮潜力研究 [J]. 植物营养与肥料学报, 2014, **20**(6): 1497-1504. Guan D W, Li L, Yue X L, *et al.* Study on potential of biological nitrogen fixation of soybean in China [J]. Journal of Plant Nutrition and Fertilizer, 2014, **20**(6): 1497-1504.
- [27] 杨月欣,王光亚,潘兴昌.中国食物成分表[M].(第二版). 北京:北京大学医学出版社,2009.
- [28] 许稳. 中国大气活性氮干湿沉降与大气污染减排效应研究 [D]. 北京: 中国农业大学, 2016.

  Xu W. Studies on dry and wet deposition of atmospheric reactive nitrogen and air pollution control effects in China [D]. Beijing: China Agricultural University, 2016.
- [29] Ma L, Ma W Q, Velthof G L, et al. Modeling nutrient flows in the food chain of China[J]. Journal of Environmental Quality, 2010, 39(4): 1279-1289.
- [30] 付斌. 不同农作处理对坡耕地水土流失和养分流失的影响研究——以云南红壤为例[D]. 重庆: 西南大学, 2009. Fu B. Research on soil erosion and nutrient loss under different farming measures from slope field—taking Yunnan red soil for example[D]. Chongqing: Southwest University, 2009.
- [31] Hong B, Swaney D P, Howarth R W. Estimating net anthropogenic nitrogen inputs to U.S. watersheds; comparison of methodologies[J]. Environmental Science & Technology, 2013, 47(10): 5199-5207.
- [32] Shang X, Wang X Z, Zhang D L, et al. An improved SWAT-based computational framework for identifying critical source areas for agricultural pollution at the lake basin scale [J]. Ecological Modelling, 2012, 226: 1-10.
- [33] 陈纬栋. 洱海流域农业面源污染负荷模型计算研究[D]. 上海: 上海交通大学, 2011.

  Chen W D. Research on modelling agricultural diffuse source pollution load of lake Erhai basin[D]. Shanghai: Shanghai Jiao Tong University, 2011.
- [34] Gao W, Howarth R W, Swaney D P, et al. Enhanced N input to Lake Dianchi Basin from 1980 to 2010; drivers and consequences [J]. Science of the Total Environment, 2015, 505; 376-384.
- [35] Howarth R W, Swaney D P, Boyer E W, et al. The influence of climate on average nitrogen export from large watersheds in the Northeastern United States [J]. Biogeochemistry, 2006, 79 (1-2): 163-186.
- [36] Schaefer S C, Alber M. Temporal and spatial trends in nitrogen and phosphorus inputs to the watershed of the Altamaha River, Georgia, USA[J]. Biogeochemistry, 2007, 86(3): 231-249.
- [37] Billen G, Silvestre M, Grizzetti B, et al. Nitrogen flows from European regional watersheds to coastal marine waters [A]. In: Sutton M A, Howard C M, Erisman J W, et al (Eds.). The European Nitrogen Assessment: Sources, effects and policy perspectives [M]. London: Cambridge University Press, 2011. 271-297.
- [38] Swaney D P, Hong B, Selvam A P, et al. Net anthropogenic

- nitrogen inputs and nitrogen fluxes from Indian watersheds; an initial assessment [ J ]. Journal of Marine Systems, 2015, 141: 45.58
- [39] Hong B, Swaney D P, Mörth C M, et al. Evaluating regional variation of net anthropogenic nitrogen and phosphorus inputs (NANL/NAPI), major drivers, nutrient retention pattern and management implications in the multinational areas of Baltic Sea basin[J]. Ecological Modelling, 2012, 227: 117-135.
- [40] Howarth R, Swaney D, Billen G, et al. Nitrogen fluxes from the landscape are controlled by net anthropogenic nitrogen inputs and by climate[J]. Frontiers in Ecology and the Environment, 2012, 10(1): 37-43.
- [41] Swaney D P, Hong B, Ti C P, et al. Net anthropogenic nitrogen inputs to watersheds and riverine N export to coastal waters; a brief overview [ J ]. Current Opinion in Environmental Sustainability, 2012, 4(2); 203-211.



# **HUANJING KEXUE**

Environmental Science (monthly)

Vol. 39 No. 9 Sep. 15, 2018

## **CONTENTS**

Vehich Endisch Endisch Characteristics of Their Corribtions in Jampa Protine  III., 2000; J. E., 1900; J. E., 1900; J. E., 1900; Daties in Investory of Atmospheric Polithates and VOC Species from Cop Bookhe Burning in Gaugelong Protines  S.N. Xi-Jo, 11,000 (Eng., 100. a), and a 1900; S.N. Xi-Jo, 11,000 (En	Emission Inventory and Prediction of Non-road Machineries in the Yangtze River Delta Region, China	HUANG Cheng, AN Jing-yu, LU Jun (3965)
Beission Remorter of Munophers Billmarts and NOS Species from Cope Bookhe Burning in Campdage Postures.  N.N. So. Decentrions and Six Des Forderies of Microschilds Engagine in the Stapelors, Companying. III Varies, BMO Quagin, WIN 2014.  Phyl., y Didnice Characteristics and Cases Analysis of a Water Inter Poly Policies Device. Lincheng Cip.  2110 Min-6, MEMO Jang-Rin, 1902 Zian-San, and 4 (493) Phyl., y Didnice Characteristics and Cases Analysis of a Water Inter Poly Policies Device. Lincheng Cip.  2110 Min-6, MEMO Jang-Rin, 1902 Zian-San, and 4 (493) Phyl., y Didnice Characteristics and Cases Analysis of Characteristics and Scares Apportune of Alaster Valued Coppins Compounds in Water in Indusing.  2110 Characteristics and Scares Apportune of Alaster Valued Coppins Compounds in Water in Indusing.  2110 Characteristics and Scares Apportune of Alaster Valued Coppins Compounds in Water in Indusing.  2110 Characteristics and Scares Apportune of Alaster Valued Coppins Compounds in Water in Indusing.  2110 Characteristics of Micropheric FiX man of Min Rod in Felf-Ci Cip.  2110 Characteristics of Micropheric FiX man of Min Rod in Felf-Ci Cip.  2110 Characteristics of Micropheric FiX man of Min Rod in Felf-Ci Cip.  2110 Characteristics of Micropheric FiX man of Min Rod in Felf-Ci Cip.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing.  2110 Characteristics of Wind-Evoled Due from Courses Backing Ham in Beijing Ham	Vehicle Exhaust Emission Characteristics and Their Contributions in Jiangsu Province	LI Li, ZHANG Jie, ZHAO Qiu-yue, et al. (3976)
Nact Conventione and See Destinition of Water-callelle Respuis Les in Managheia Armada in Belleti Destin, Changing IL Vane-di, BMO [Ingit], WNT Inc-use, at al. (2014) Ph., Chillaton Canacterization and Cases Analysis of Winter Barry Pollutin Dest., Lincheng Uty	Historical Trends of Atmospheric Pb and Hg Emissions from Fossil Fuel Combustion in Shanghai	YANG Jing, CHEN Long, LIU Min, et al. (3987)
Sausard Nurations in Chemical Constructions and Sauras of PMs., Indiang Sauras and Water in John City.  2 PML Sp. Delation Constructions and Sauras of PMs., Indiang Sauras and Water in John City.  2 PML Sp. John Constructions, Sauras, and Dy Operation Plans of Different Fount of Possphores in Quagha Actived in Sauras.  2 PML Sp. John M. Man, Sill John, et al. (4034)  Characteristics and Sauras Approximent of Archeet Valuate Organe Companys in Water in Inchenge  2 NANC, Fun., YA Y Yolong, CT Tumber, et al. (4034)  Characteristics and Sauras Approximent of Archeet Valuate Organe Companys in Water in Inchenge  2 NANC, Fund., 21400, 2013, 1013, et al. (4035)  Characteristics of Munophric RY Nova a Vain Rout in Hole City.  3 Nance Quantity and Control C	Emission Inventory of Atmospheric Pollutants and VOC Species from Crop Residue Burning in Guangdong Province	······ SUN Xi-bo, LIAO Cheng-hao, ZENG Wu-tao, et al. (3995)
Pd., y Blainto Characterization and Lione Analysis of a Winter Heavy Pollation Event, Lincheng Cry.  Contentions, Same, and Polyposition flower of Allerhor From & Pollation Event, and Very Royal and (2004) Characterized with the Composition of Co	Mass Concentrations and Size Distributions of Water-soluble Inorganic Ions in Atmospheric Aerosols in Beibei District, Chongqing	LI Yan-pei, HAO Qing-ju, WEN Tian-xue, et al. (4002)
Pd., y Blainto Characterization and Lione Analysis of a Winter Heavy Pollation Event, Lincheng Cry.  Contentions, Same, and Polyposition flower of Allerhor From & Pollation Event, and Very Royal and (2004) Characterized with the Composition of Co	Analysis of Seasonal Variations in Chemical Characteristics and Sources of PM <sub>2, 5</sub> During Summer and Winter in Ji'nan City	··· LIU Xiao-di, MENG Jing-jing, HOU Zhan-fang, et al. (4014)
Generationien, Samers, and Dys Dyssians Hawes of Different Forms of Phosphores in Quigals Across in Samers —— YAMO Fan, YAM Yorkey, G. Varie, et al. (4082) Entricinent Levels and Compedenciave Polithian Assessment Obst Bleary Medis in Water in Bejing —— XMOG Qualin, ZHAO Weepi, it Lli-jun, et al. (4861) Characteristics of Atmospheric EIX near a Main Boal in Helde Gry —— MENN Enabus, (NS Min, LLANC Stanistic, et al. (4860) Characteristics of Atmospheric EIX near a Main Boal in Helde Gry —— MENN Enabus, (NS Min, LLANC Stanistic, et al. (4860) Characteristics of Almospheric EIX near a Main Boal in Helde Gry —— Medis in Water in Heling —— MENN Enabus, (NS Min, LLANC Stanistic, et al. (4860) Ferinator Characteristics of Delithic Helde in Helde in Helde in Helder Enabus Head of Characteristics of Public Delithic In Helder in Helder Enabus Head of Helder Enabus Head of Delithic Helder in Helder Enabus Head of the Yellow Recor —— CHARACTER		
Caracteristics and Sonce Approximent of Authient Vollacie Organic Congounds in Winter in Riching  VION. Quality, "ANY Velong, GE Yamés, et al. (4851)  Caracteristics of Atmospheric Pillware is Assessment of Dath Heavy Meals in Winter in Reiging  VION. Quality, "March Computer of Management Pollation Assessment of Dath Heavy Meals in Winter in Reiging  WID. Familson, QUAIN, "Law Shamist", et al. (4865)  Once Constation Resential and Highly Compliciting Substances of NOMEs from Localid Working Face  II Host, III Yamjin, GHR Ying, et al. (4805)  Emission Characteristics of Well-brief of Bios in Reiscoich Sumer Anna Robert of Particing Parties in Reiging  II Belderi, HAN Nacia, (70) Biosphing, et al. (4805)  Sensoral Warning of Philaton Robert of Rebins in Reiscoich Sumer Anna Robert of Parties of Parties of Commenter (1806)  Enchantin of Effect of Union Nove-paint Sumer Pollution Canada on Porsons Aphale discretentian Carbard Balash.  GONN March 220 Indige J. Ber Xin-in, et al. (4806)  Caracterization of Dissoched Organic Matthe Fractions in the Ning Meng Soction of the Yellow River and Relationship with Netal Ions  WAN You Walk Time, et al. (4115)  Caracterization of Dissoched Organic Matther Fractions in the Ning Meng Soction of the Yellow River and Relationship with Netal Ions  WAN You Walk Time, et al. (4112)  Caracterization and Caracterization of Organic Matther Fractions in the Ning Meng Soction of the Yellow River and Relationship with Netal Ions  WAN You Walk Time, et al. (4112)  Caracterization and Caracterization of Organic Matther Fractions in the Ning Meng Society of the Vallow River and Relationship with Netal Ions  WAN You Walk Time, et al. (4112)  Caracterization and Goneil Monephore in Balabo Communication in Fraction Spring and the Nillian River Rivial  Proceedings of the Walk Time, et al. (4112)  Caracterization and Goneil Monephore in Hamilton Spring and the Nillian River Rivial  Proceedings of the Walk Time, et al. (4112)  Procedenment and Evaluation of a Sestimated Long-spring Act of Matther		
Berchenzel Lords and Comprehense Pollation Assessment of Dea Heavy Meda in Witter in Beijing MONG (Seilin, 2210) Weisji, L. Disym, et al. (4981) Conne Generation Revential and Highly Controlleting Substances of A WONG from Landfill Working Fave		
Oune Generation Ostensien (Attemplement RN) Four a Main Bool in Irlei Gip	Enrichment Levels and Comprehensive Pollution Assessment of Dust Heavy Metals in Winter in Beijing	XIONG Qiu-lin, ZHAO Wen-ji, LI Da-jun, et al. (4051)
Emission Characteristics of Wind-Erdold Date fine Course Berling Plants in Beijang		
Emission Characteristics of Wind-Erdold Date fine Course Berling Plants in Beijang	Ozone Generation Potential and Highly Contributing Substances of NMOCs from Landfill Working Face	LI Hao, LIU Yan-jun, CHEN Tan, et al. (4070)
Sessonal Variation Characteristics of Pollution Rick in a Riemside Source Appendish Bost relation of Elicet of Urban Proposition Characteristics and Source Appendish Bost relation Combined Roads (200 Mane R., 200 June je., REN Navior, et al. (4096) Composition, Spatial Distribution Characteristics and Source Assignable Bost relation of Distribution of Distribution in the Ning-Meng Section of the Yellow River (2014) Characterization of Discovered Organic Matter Fractions in the Ning-Meng Section of the Yellow River (2014) Characterization of Discovered Organic Matter Fractions in the Ning-Meng Section of the Yellow River and Relationship with Metal loss (2014) Market State (2014) Research Water Characteristics and Material Assignable Rose and Human River Raises (2014) Research Water Characteristics and Relationship with Metal loss (2014) Research Water Characteristics and Relationship with Metal loss (2014) Research Water Characteristics and Relationship of the Malian River Raises (2014) Review of the Yellow River (2014) Relationship with Metal loss (2014) Re		
Feature of Elbert of Urban New-point Source Pollution Cantrol on Porous Angeloid-Ric-reteation Canizole Reads — GONG Marshi, ZiU Jun-jie, REN Xin-sin, et al. (406) Composition, Spatial Distribution Characteristics and Source Analysis of Composition, Spatial Distribution Characteristics and Source Analysis of Composition of the New York and Relationship with Metal June — XI Yaw, RANG Ting, NJ Jian-ma, et al. (4105) Characterization of Dissolved Organic Matter Fractions in the Ning-Meng Section of the Vellow River and Relationship with Metal June — XI Yaw, RANG Ting, NJ Jian-ma, et al. (4112) Seconal Variations in River Water Chemical Weathering and list Influence Factors in the Malian River Bissis — WANG Yu-shun, RIAM Stampelson, DENG Qi-jian, et al. (4132) Seconal Variations in River Water Chemical Weathering and list Influence Factors in the Malian River Bissis — WANG Yu-shun, RIAM Stampelson, DENG Qi-jian, et al. (4132) Seconal Variations in River Water Chemical Weathering and list Influence Factors in the Malian River Bissis — WANG Yu-shun, RIAM Stampelson, DENG Qi-jian, et al. (4142) Development and Evaluation of a Statisticalle Long-selease Carbon Material Applied for In-Situ Remediation of Geometister Nitrogen Pollution — ZHANG Wen, YIN Lin, ZHOU Nim-qing (4180) Physiophore Stems and Distribution Characteristics in the Seliment and Sol of the Water-Level-directualing Zone in the Malian Steams of the Three Googes Reservoir  — ZHANG Zein-joug, AN AN Ceng-yan, HE Hong-qing, et al. (4161) Distribution Characteristics and Release Flaxes of Hoopkons Forms in Xiangsi Ray Sediments in the Three Googes Reservoir Before and After Imponalment — ILL Xian-yau, SONG Lin-vu, Ji Bue-bin, et al. (4165) Distribution Characteristics on Net Authoropogesis Nitrogen Imputs (NANI) at Township Seale in Educit Lake Rasin — ILL Xian-yau, SONG Lin-vu, Ji Hue-bin, et al. (4167) Imput of Homan Activities on Net Authoropogesis Nitrogen Imputs (NANI) at Township Seale in Educit Lake Rasin — ILL Xian-yau, NANC Din-qu, Ji Hue-bin, et al.		
Composition, Spatial Distribution Characteristics and Source Analysis of Chromophoric Dissolved Organic Matter in the Lambous Reach of the Yellow River — 2HAN Zus-ting, IJ Shan, WANG Zhao-weit, et al. (4105) Characteristics of Dissolved Organic Matter Fractions in the Ning-Merg Section of the Yellow River and Relationship with Meal loss — N Vac, WANG Ting, M Jinewer, et al. (4114) Comparative Characteristics of Opical Absorption in Waters from Yilno River and Huntai River in Spring — II Liu-joung, SH40 Tina-tina, ZHANG Xin, et al. (4122) Seasonal Variations in River Water Chemical Weathering and Its Influence Factors in the Malian River River Basin — WANG Ye-aban, HAN Shang-glon, DENG (pijm, et al. (4122) Development and Evaluation of a Sistainable Long-release Carbon Material Applied for In-Situ Remediation of Cocombeater Nitegers Pollution — ZHANG Wen, YIN Lin, ZHOU Nine-qing (4150) Phasphoras Forms and Distribution Characteristics in the Sediment and Soil of the Water-Level-ductuating Zone in the Main Stream of the Three Coages Reservoir — ZHANG Zhi-yong, WAN Coeng-yan, HII Hong-qing, et al. (4161) Distribution Characteristics and Release Fluxes of Phosphoras Forms in Xiaopai Bay Sediments in the Three Coages Reservoir Before and After Impoundment — III Xiaopain, was also an advantage of the Conference		
### Caracterization of Dissalved Organic Matter Fractions in the Ning-Meng Section of the Yellow River and Relationship with Metal lons		
Compensive Characteristics of Dissolved Ogganic Matter Functions in the Ning Meng Section of the Yellow River and Relationship with Metal Ions  II Lie-yang, SHAO Tian-tian, ZHANG Xin, et al. (4122)  Sessoral Variations in River Water Chemical Weathering and Ils Influence Factors in the Malian River in Spring.  WANG Yu-shan, HAN Shamg-kao, DFRO Gyan, et al. (4142)  Development and Evaluation of a Sestainable Long-release Carbon Material Applied for In-Shu Remediation of Gooundwater Nitrogen Pollution  ZHANG Wen, YIN Lin, ZHOU Nian-qiang (4150)  Phosphorus Forms and Distribution Characteristics in the Seliment and Scil of the Water-Level-fluctuating Zone in the Main Stream of the Three Gorges Reservoir  ZHANG Wen, YIN Lin, ZHOU Nian-qiang (4150)  Phosphorus Forms and Distribution Characteristics in the Seliment and Scil of the Water-Level-fluctuating Zone in the Main Stream of the Three Gorges Reservoir  ZHANG Chilayong, WAN Cheng-yan, HU Hong-qiang, et al. (4161)  Distribution Characteristics and Release Fluxes of Phosphorus Forms in Xiangxii Bay Sediments in the Three Gorges Reservoir Refere and After Imponential Properties on the Main Activities on Net Auftropogenic Nitrogen Inputs (NAN) at Tomoship Scule in Ethni Lide Besin History Seliment HE Sv-qi, ZHANG Wei, LIN Jan-wei, et al. (4169)  Effect of Zuronium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  HE Sv-qi, ZHANG Wei, LIN Jan-wei, et al. (4169)  Effect of Zuronium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  HE Sv-qi, ZHANG Wei, LIN Jan-wei, et al. (4169)  Effect of Appaculture on Annovais-ordizing Pollutyrotes in Sediments for Testenter of Nan Jan-devin Pollute River Sediment  HE Sv-qi, ZHANG Lin Jan, et al. (4169)  Effect of Appaculture on Annovais-ordizing Pollutyrotes in Sediments for Testenter of Mining Water Source in Essent Like Tabla  CHU Via, HE Xiao-wei, ZHANG Jan, et al. (4200)  Distribution Characteristics of Sulfocumides and Sul		ZHAO Xia-ting, LI Shan, WANG Zhao-wei, et al. (4105)
Gemparative Chameteristics of Optical Absorption in Waters from Yiloo River and Huntai River in Spring		
Seasonal Variations in River Water Chemical Weathering and Its Influence Factors in the Malian River Basin WANG Yu-shan, HAN Shaung-kao, DENG (0;-jun, et al. (4132) Characteristics and Genesis of Wo, Type Water in Stallow Commbuter in Lujiang Basin XU In, IEI Jiang-tao, PENC Cong., et al. (4142) Development and Evaluation of a Stutainable Long-release Carbon Material Applied for In-Stin Remediation of Commbuter Nitrogern Pollution  ZHANG Wen, YIN Lin, ZHOU Ninn-qipi (4150) Phosphorus Forms and Distribution Characteristics in the Sediment and Soil of the Water-Level-discutating Zoro in the Main Stream of the Three Gages Reservoir Although the Common Characteristics and Release Fluxes of Phosphorus Forms in Xiangei Bay Sediments in the Three Garges Reservoir Before and After Impoundment  LIU Xin-yuan, SONG Lin-ou, II Dou-lin, et al. (4169)  Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immedilization in Heavily Polluted River Sediment  III Vin-yuan, SONG Lin-ou, II Dou-lin, et al. (4179)  Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NAN) at Township Scale in Ethai Lake Basin  LI Ying, LIU Hong-bin, LEI Qiu-liung, et al. (4189)  Simulation of Imaganic Nitrogen Places at the Sediment-souter Interface in a Typical Intertial Zone, Eastern China  NR Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4195)  Effects of Aquaculture on Ammonia in Welland Sediments for Treatment of Mining Water Source in Esst China  Characteristics of Sulfonumide Authoria Resistance Genes in a Drinking Water Source in Esst China  HU Xa-nu, JIANG Lie, ZHANG Tian-yang, et al. (4222)  Effects of Different Substrates and Particle Sizes on Wastewater Furtification  ZHAO Lin-li, SHAO Xus-vin, WU Ming, et al. (4235)  Substrate Flow by Different Bookenical Activities in the Lithan Seonges Network  YAO Xiang-qi, SHI Xian, SANG Lang-tao, et al. (4242)  Effects of Department of Polycyclic Annual Phylogenetic Authoria in the Presence of UV and Ferri Cudalate  HAN Doug-qiu, II Ying, II Kais-ming, et al. (4237)  Effec		, , , , , , , , , , , , , , , , , , , ,
Characteristics and Genesis of NO <sub>3</sub> Type Water in Shallow Gnoundwater in Liujiang Basin  XU Jin, HE Jiangstoo, FENG Cong, et al. (4142) Development and Evaluation of a Sustainable Lang-selecase Carbon Material Applied for In-Situ Remediation of Gnoundwater Nitogen Pollution  ZHANG Wen, YIN Lin, ZHOU Nian-qing (4150) Phosphorus Forms and Distribution Characteristics in the Sediment and Soil of the Water-Level-fluctuating Zone in the Main Stream of the Three Gerges Reservoir  ZHANG Zia-yang, WAN Cheng-yan, HU Hong-qing, et al. (4161) Distribution Characteristics and Release Flaxes of Phosphorus Forms in Xiangsi Bay Sediments in the Three Gorges Reservoir Before and Inter Impundment  IU Kin-yana, SONG Lin-sui, JI Duo-lin, et al. (4169) Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immediatation in Heavily Polluted River Sediment  HE S-iqi, ZHANG Wei, LIN Jian-svi, et al. (4179) Impact of Human Activities on Net Authropogenic Nitogen Inputs (NANI) at Toweship Scale in Ethni Jake Basin  11 Ying, JIU Hong-lin, LDI Qui-ling, et al. (4189) Simulation of Inagenic Nitogen Playari (NANI) Public Polary and Activities on Net Authropogenic Nitogen Inputs (NANI) at Toweship Scale in Ethni Jake Basin  11 Ying, JIU Hong-lin, LDI Qui-ling, et al. (4189) Effects of Aquaculture on Ammonia in Welland Sediments for Treatment Infection in Typical Interdial Zane, Eastern China  NE Jia-qiin, AWAN Chang-qi, Elfex Jia, et al. (4205) Distribution Characteristics of Sudimunides and Sulfamethoanole-Resistant Reactive in Tamery Wasternation of Aumonia in Welland Sediments for Treatment of Mining Wasterstant  Birtholian Characteristics of Sudimunides and Sulfamethoanole-Resistant Reactive in Tamery Wasternation  Birtholian Characteristics of Sudimunides and Sulfamethoanole-Resistant Reactive in Tamery Wasternation  Birtholian Characteristics of Sudimunides and Sulfamethoanole-Resistant Reactive in East China  Birtholian Characteristics of Sudimunides and Sulfamethoanole-Resistant Reactive in China  Birtholian Charac		
Development and Evaluation of a Sostainable Long-release Carbon Material Applied for In-Situ Remediation of Groundwater Nitrogen Pollution  ZHANC Zimps, MAN Cheng-yan, HU Hong-qing, (4150) Phosphorus Forms and Distribution Characteristics in the Sodiment and Sail of the Water-Level-fluctuating Zone in the Main Stream of the Three Gorges Reservoir  ZHANC Zimps, WAN Cheng-yan, HU Hong-qing, et al. (4161) Distribution Characteristics and Release Fluxes of Phosphorus Forms in Xiangci Bay Sediments in the Three Gorges Reservoir Before and Affer Impoundment  LIU Xin-yuan, SONG Lin-sur, II Dao-hin, et al. (4169)  Effect of Zirconium-modified Zeslite Addition on Phosphorus Release and Immodalization in Heavily Polluted River Sediment  Effect of Zirconium-modified Zeslite Addition on Phosphorus Release and Immodalization in Heavily Polluted River Sediment  Effect of Agnacoluture on Aumonia-cudizing Prokaryotes in Sediment-water Interface in a Typical Intertial Zone, Eastern China  NE Jia-qin, WANC Doneqvi, CHEN Be, et al. (4199) Effects of Aquacoluture on Aumonia-cudizing Prokaryotes in Sediments of Eastern Lake Tailhu  CHU Yu, HE Xian-wei, ZENG Jin, et al. (4205) Distribution Characteristics of Sulfonamides and Sulfoments for Treatment of Mining Wastewater  WANG Hai-bo, MA Ding, YUE Zheng-bo, et al. (4215) Distribution Characteristics of Sulfonamides and Sulfomenthosance-Resistant Racteria in Tamery Wastewater Treatment Processes  HU ALi, Li Li, Ji Li, YANC Cham-yan (4229) Effects of Different Substantes and Pations Characteristics of Sulfonamides and Sulfomenthosance-Resistant Racteria in Tamery Wastewater Treatment Processes  HU ALI, Li Li, Ji Li, YANC Cham-yan (4229) Effects of Different Substantes and Pations Mining Wastewater Variation Process  WANG Xa-dong, SHI Cai-sia, LIAO Dieng-wei, et al. (4242) Enhanced Degradation of Amiline by IS Oxidation in the Urban Sewage Network  YAO Xiang-yi, SHI Xian, SANC Lang-tao, et al. (4243) Enhanced Degradation of Polyspeic Anomatic Phylosophorus Removal and Recovery Performan	ů .	
Phosphorus Forms and Distribution Characteristics in the Sediment and Sül of the Water-Level-fluctuating Zano in the Main Stream of the Three Gorges Reservoir    ZHANG Zhi-yong, WAN Cheng-yan, HU Hong-qing, et al. (4161)   Distribution Characteristics and Release Fluxes of Phosphorus Forms in Xiangxi Bay Sediments in the Three Gorges Reservoir Before and After Impoundment   LIU Xin-yuan, SONG Lim-xu., JI Dan-Jim, et al. (4169)   Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immohilization in Heavily Pulluted River Sediment   LIU Xin-yuan, SONG Lim-xu., JI Dan-Jim, et al. (4179)   Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) al Township Scale in Ethai Lake Basin   LI Ying, JILI Hong-bin, JEJ Qiu-liang, et al. (4189)   Simulation of Inorganic Nitrogen Fluxes at the Sediment-water Interface in a Typical Intertibal Zone, Eastern China   NE Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4199)   Effects of Aquaculture on Annomain evaluation of Prolaryotes in Sediments of Eastern Lake Taila   CHU Yu., HE Xino-wei, ZENG Jin, et al. (4195)   Effects of Mannomain in Wetland Sediment-Sediment of Mining Water Source in East China   CHU Yu., HE Xino-wei, ZENG Jin, et al. (4215)   Distribution Characteristics of Sulforamide Antibiotic Resistance Genes in a Diraking Water Source in East China   HU Ya-ru., JIANG Lei, ZHANG Tian-yang, et al. (4222)   Distribution Characteristics of Sulforamides and Sulfamerboacade-Resistant Bacteria in Tamery Wastewater Treatment Processes   HUA Ji., Li., I., XANG Chun-yan, (4229)   Distribution Characteristics of Sulforamides and Sulfamerboacade-Resistant Bacteria in Tamery Wastewater Treatment Processes   HUA Ji., Liu, Ji., XIANG Chun-yan, (4229)   Effects of Different Biochemical Activities in the Urban Seauge Network   Yang Chun-yang, et al. (4236)   Reducing Membrane Fouling from Micro-Piocculation in a Humic Acid Ultrafiltration Process   WANG Xi-slong, SHI Cai-sia, JIAO Zheng-wei, et al. (4236)   Reducing Membrane Fouling from Micro-Piocculat	* ··	
Phosphorns Forms and Distribution Characteristics in the Sediment and Soil of the Water-Level-fluctuating Zone in the Main Stream of the Three Gorges Reservoir Months of the Three Gorges Reservoir Before and After Impoundment  LI Vin-yuam, SONG Lin-xu, Ji Dau-bin, et al. (4169)  Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  HE Si-qi, ZHANG Wei, LIN Jian-wei, et al. (4179)  Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) al Township Scale in Erbai Lake Basin  LI Ying, LIU Hong-bin, LEI (Jui-lang, et al. (4189)  Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  HE Si-qi, ZHANG Wei, LIN Jian-wei, et al. (4179)  Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) al Township Scale in Erbai Lake Basin  LI Ying, LIU Hong-bin, LEI (Jui-lang, et al. (4189)  Effects of Augusculture on Ammonia-sculizing Prokaryotes in Sediments of Eastern Lake Tailus  CHU Vu, HE Xian-wei, ZENG Jin, et al. (4206)  Transformation of Ammonia in Wetland Sediments for Treatment of Mining Wassecuter  WANG Hai-bo, MA Ding, YUE Zhong-bo, et al. (4222)  Distribution Characteristics of Sulfonamide Antibiotic Resistance Genes in a Drinking Water Source in East China  HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222)  Effects of Different Substrates and Particle Sizes on Wastewater Purification  ZHAO Lin-li, SHAO Xue-xin, Wu Ming, et al. (4226)  Substrate Foot lap Different Biochemical Activities in the Urban Seoage Network  TAO Xiang-si, SHI Xuan, SANC Lang-sio, et al. (4226)  Substrate Foot lap Different Substrates and Particle Sizes on Wastewater Purification Process  WANG Androg, SHI Xuan, SANC Lang-sio, et al. (4227)  Behavior and Degradation of Polycyclic Anomatic Hydrocarbors (PAHs) in Coking Wastewater of ArO <sup>2</sup> and ArOrli/O Processes  WANG Androg, SHI Xuan, SANC Lang-sio, II Xuan-sio, et al. (4287)  Effect of Naca Salinity on Extracellular Polymeric	beveropinent and Evaluation of a Sustantaine Long-telease Garbon material Applied for in-Sult itelitediation of Groundwater (strogen	
ZHANG Zhi-yong, WAN Cheng-yan, HU Hong-qing, et al. (4161) Distribution Characteristics and Release Fluxes of Phosphorus Forms in Xiangxi Bay Seliments in the Three Gorges Reservoir Before and After Impoundment  LIU Xin-yuan, SONG Lin-xu, JI Dao-bin, et al. (4169)  Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  HE S-rip, ZHANG Wei, LIN Jian-wei, et al. (4199)  Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) at Township Scale in Erhai Lake Basin  LI Ying, LIU Hong-hin, LEI Qiu-liang, et al. (4189)  Simulation of Inorganic Nitrogen Fluxes at the Sediment-soler Interface in a Typical Interfidal Zone, Eastern China  NEE Jia-qin, WANC Dong-qi, CHEN Jie, et al. (4199)  Effects of Aquaculture on Ammonia-oxidizing Prokaryotes in Sediments of Eastern Lake Tailu  CHU Yu, HE Xiao-wei, ZENG Jin, et al. (4206)  Distribution of Ammonia in Welland Sediments for Treatment of Mining Water Source in East China  HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222)  Distribution Characteristics of Sulfonamide Antibiotic Resistance Genes in a Drinking Water Source in East China  HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222)  Distribution Characteristics of Sulfonamides and Particle Sizes on Wastewater Purification  ZHAO Lin-li, SHAO Xue-xin, WU Ming, et al. (4226)  Sulstrate Flow Different Biochemical Activities in the Urban Sevage Network  YAO Xiang-syi, SHI Gai-xia, LIAO Zheng-wei, et al. (4226)  Enhanced Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A'O² and A'O'H/O Processes  WANG Xu-dong, SHI Gai-xia, LIAO Zheng-wei, et al. (4287)  Effects of Long-term Side Stream Extraction on Phosphorus Removal and Recovery Performance of EBPR System  YU Xiao-pin, LI Jie, ZHOU Meng, et al. (4287)  Effect of NaCl Salimity on Extracellular Polymen's Substances and Bioliocarbanis Studge in A'O'O Process  CHEN Fang-min, JIN Run, YUAN Yan, et al. (4294)  Effect of Temperature and pH on Nitrogen Conversion in Fea		
Distribution Characteristics and Release Fluxes of Phosphorus Forms in Xiangi Bay Sediments in the Three Corges Reservoir Before and After Impoundment  11 UX Innyam, SONG Lin-au, JI Dao-bin, et al. (4169)  Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  11 Ying, Lil Hong-bin, LEI Qual-lang, et al. (4179)  Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) at Township Scale in Erhai Lake Basin  11 Ying, Lil Hong-bin, LEI Qual-lang, et al. (4199)  Simulation of Inorganic Nitrogen Fluxes at the Sediment-water Interface in a Typical Intertidal Zone, Eastern China  Nic Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4199)  Effects of Aquaculture on Anmonia in Welland Sediments for Tesatment of Mining Wastewater  CHU Yu, HE Xine-wei, ZENO Jin, et al. (4206)  Transformation of Ammonia in Welland Sediments for Treatment of Mining Wastewater  WANG Hai-bo, MA Ding, YUE Zheng-Bo, et al. (4215)  Distribution Characteristics of Sulfonamide Autibioric Resistance Genes in a Drinking Waster Source in East China  HU Ya-ru, JIANC Lei, ZHANG Tian-yang, et al. (4220)  Distribution Characteristics of Sulfonamides and Sulfamethouxzole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HU Xa-ru, JIANC Lei, ZHANG Tian-yang, et al. (4220)  Effects of Different Substrates and Particle Sizes on Wastewater Partification  ZHAO Lin-li, SHAO Xue-xin, WU Ming, et al. (4236)  Reducing Membrane Fooling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-xia, JIAO Zheng-wei, et al. (4242)  Enhanced Degradation of Polycyclic Anomatic Hydrocarbons (PAHs) in Goking Wastewater of A/O² and A/O/H/O Processes  WANG Xu-dong, SHI Liu, SHAO Xue-xin, et al. (4287)  Effects of Long-term Side Stream Extraction on Phosphorus Removal and Recovery Performance of EBPR System  YU Xiao-pin, Lil Jie, ZHOU Meng, et al. (4287)  Effects of Tong-tadure and pH on Nitrogen Conversion in Fearman Process  CHER Sagnin, JIN Run, YUAN Yan, et a	Thosphorus Forms and Distribution Characteristics in the Secument and Son of the water-Lever-nuctuating Zone in the main Sucain C	THANC This word WAN Changs you HII Hongs ging at al. (4161)
Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment HE Seqi, ZHANG Wei, LIN Jian-wei, et al. (4179) Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NATI) at Township Scale in Erhai Lake Basin LI Jing, LIU Hong-lain, LEI Qiu-liang, et al. (4189) Simulation of Inoquaine Nitrogen Phases at the Sediment-water Interface in a Typical Interdial Zone, Eastern China NRE Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4199) Effects of Aquaculture on Ammonia-coxidizing Prokaryotes in Sediments of Eastern Lake Taihu ————————————————————————————————————		
Effect of Zirconium-modified Zeolite Addition on Phosphorus Release and Immobilization in Heavily Polluted River Sediment  HE Si-qi, ZHANG Wei, LIN Jian-wei, et al. (4179) Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NANI) at Tourship Scale in Ethai Lake Basin  LI Ying, LIU Hong-hin, LEI Qiu-liang, et al. (4189) Simulation of Inorganic Nitrogen Fluxes at the Sediment-vater Interface in a Typical Intertical Zone, Eastern China  NE Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4199) Effects of Aquancular on Anmonia in Wetland Sediments for Treatment of Mining Wastewater  Effects of Aquancular on Anmonia in Wetland Sediments for Treatment of Mining Wastewater  WANG Hai-bo, MA Ding, YUE Zheng-bo, et al. (4205) Distribution Characteristics of Sulfonamide Antibotic Resistance Genes in a Drinking Water Source in East China  HU Ya-m, JIANG Lei, ZHANG Tan-yang, et al. (4222) Distribution Characteristics of Sulfonamides and Sulfanethoxazole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HUA Li, LI Lu, YANG Churyan (4229) Distribution Characteristics of Sulfonamides and Sulfanethoxazole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HAND Lin-li, SHAO Xue-sin, Wu Ming, et al. (4236) Substrate Flow by Different Biochemical Activities in the Urlan Sewage Network  PAO Xiang-qi, SHI Xuan, SANG Lang-lao, et al. (4249) Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-sia, LIAO Zheng-wei, et al. (4249) Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-sia, LIAO Zheng-wei, et al. (4247) Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-sia, LIAO Zheng-wei, et al. (4249) Reducing Membrane Fouling from Micro-Flocculation in the Presence of UV and Ferric Oxalate  Hand Dong-hui, LI Ying, LI Kai-ming, et al. (4249) Reducing Membrane Fouling from Micro-Flocculation in the Presence of UV and Ferric Oxalate	Distribution Characteristics and release Princes of Prosphorus Politis in Alangai Day Secuments in the Three Gorges Reservoir Defore	and Arter impoundment
Impact of Human Activities on Net Anthropogenic Nitrogen Inputs (NAM) at Township Scale in Erhai Lake Basin II Ying, LIU Hong-bin, LEI Qiu-liang, et al. (4189) Simulation of Inorganic Nitrogen Fluxes at the Sediment-water Interface in a Typical Intertidal Zone, Eastern China NE Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4206) Effects of Aquaculture on Ammonia-oxidizing Prokaryotes in Sediments of Eastern Lake Taihu CHU Yu, HE Xiao-wei, ZENG Jin, et al. (4206) Transformation of Anumonia in Wetland Sediments for Treatment of Mining Wastewater WANG Hai-bo, MA Ding, YUE Zheng-bo, et al. (4215) Distribution Characteristics of Sulfonamides Antibiotic Resistance Genes in a Drinking Water Source in East China HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222) Distribution Characteristics of Sulfonamides and Sulfamethoxazole-Resistant Bacteria in Tamery Wastewater Treatment Processes HUA Li, Li Lu, YANG Chun-yan (4229) Effects of Different Substrates and Particle Sizes on Wastewater Purification ZHAO Lin-li, SHAO Xue-xin, WU Ming, et al. (4236) Substrate Flow by Different Biochemical Activities in the Urban Sewage Network ANG Xu-dong, SHI Cai-xia, LIAO Zheng-wei, et al. (4242) Echanced Degradation of Aniline by PS Oxidation in the Presence of UV and Ferric Oxalate Enhanced Degradation of Aniline by PS Oxidation in the Presence of UV and Ferric Oxalate HAND Dong-hui, LI Ying, LI Kai-ming, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of ArO² and ArOr/HrO Processes WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of ArO² and ArOr/HrO Processes WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of ArO² and ArOr/HrO Processes WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of ArO² and ArOr/HrO		
Simulation of Inorganic Nitrogen Fluxes at the Sediment-water Interface in a Typical Intertidal Zone, Eastern China  NIE Jia-qin, WANG Dong-qi, CHEN Jie, et al. (4199)  Effects of Aquaculture on Ammonia-oxidizing Prokaryotes in Sediments of Eastern Lake Taihu  CHU Yu, HE Xiao-wei, ZENG Jin, et al. (4206)  Transformation of Ammonia in Welland Sediments for Treatment of Mining Wastewater  WANG Hai-bo, MA Ding, YUE Zheng-bo, et al. (4215)  Distribution Characteristics of Sulfonamides and Sulfamethouxazole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HU Xa-n, JIANG Lic, ZHANG Tian-yang, et al. (4222)  Distribution Characteristics of Sulfonamides and Sulfamethouxazole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HU Xi. Ji. Lia, YANG Chun-yan (4222)  Effects of Different Substrates and Particle Sizes on Wastewater Purification  ZHAO Lin-li, SHAO Xue-xin, WU Ming, et al. (4236)  Substrate Flow by Different Biochemical Activities in the Urban Sewage Network  YAO Xiang-yi, SHI Xuan, SANG Lang-tao, et al. (4242)  Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-xia, LIAO Zheng-wei, et al. (4249)  Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/HO Processes  WH Haizben, SUN Sheng-li, LIU Guo-xin, et al. (4257)  Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/HO Processes  WH Haizben, SUN Sheng-li, LIU Guo-xin, et al. (4274)  Effect of NaG Salinity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A²/O Process  ZHANG Lan-be, TRAN Rui, GUO Jing-bo, et al. (4274)  Effect of Temperature and pH on Nitrogen Conversion in Fearmox Process  CHEN Fang-min, JIN Run, YUAN Yan, et al. (4289)  Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4294)  Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage		
Effects of Aquaeulture on Ammonia-oxidizing Prokaryotes in Sediments of Eastern Lake Taihu  CHU Yu, HE Xiao-wei, ZENG Jin, et al. (4206)  Transformation of Ammonia in Welland Sediments for Treatment of Mining Wastewater  WANG Hai-bo, MA Ding, YUE Zheng-bo, et al. (4215)  Distribution Characteristics of Sulfonamide Antibiotic Resistance Genes in a Drinking Water Source in East China  HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222)  Distribution Characteristics of Sulfonamides and Sulfamethooxazole-Resistant Bacteria in Tamery Wastewater Treatment Processes  HU Ai-Li, Li Lu, YANG Chun-yan (4222)  Effects of Different Substrates and Particle Sizes on Wastewater Purification  ZHAO Lin-Li, SHAO Xia-xi, WU Ming, et al. (4236)  Substrate Flow by Different Biochemical Activities in the Urban Sewage Network  YAO Xiang-yi, SHI Xuan, SANG Lang-tao, et al. (4242)  Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-xia, LIAO Zheng-wei, et al. (4249)  Enhanced Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4265)  Effects of Long-term Side Stream Extraction on Phosphorus Removal and Recovery Performance of EBPR System  YU Xiao-jun, Li Jic, ZHOU Meng, et al. (4274)  Effect of Nacl Salimity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A²/O Process  ZHANG Lan-he, TIAN Rui, GUO Jing-bo, et al. (4289)  Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4302)  Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  CHEN Fang-min, JIN Rum, YUAN Yan, et al. (4302)  Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  LIO Mei, TIAN Dong, GAO Ming, et al. (4302)  Effect of Grame Removal Using ANAMMOX and Heterotrophic Deminification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302)  Effects of Dirigent Re		
Transformation of Ammonia in Wetland Sediments for Treatment of Mining Wastewater  WANG Hai-bo, MA Ding, YUE Zheng-bo, et al. (4215) Distribution Characteristics of Sulfonamide Antibiotic Resistance Genes in a Drinking Water Source in East China  HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222) Distribution Characteristics of Sulfonamides and Sulfamethooxaole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HUA Li, Li Li, YANG Chun-yan (4229) Effects of Different Substrates and Particle Sizes on Wastewater Purification  ZHAO Lin-li, SHAO Xue-xin, WU Ming, et al. (4236) Substrate Flow by Different Biochemical Activities in the Urban Sewage Network  YAO Xiang-yi, SHI Xuan, SANG Lang-tao, et al. (4249) Enhanced Degradation of Amiline by PS Oxidation in the Presence of UV and Ferric Oxalate  HAN Dong-hui, Li Ying, Li Kai-ming, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LiU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LiU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LiU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LiU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LiU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LiU Guo-xin, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN		
Distribution Characteristics of Sulfonamide Antibiotic Resistance Genes in a Drinking Water Source in East China  HU Ya-ru, JIANG Lei, ZHANG Tian-yang, et al. (4222) Distribution Characteristics of Sulfonamides and Sulfamethoxazole-Resistant Bacteria in Tannery Wastewater Treatment Processes  HUA Li, Li Li, YANG Chun-yan (4229) Effects of Different Substrates and Particle Sizes on Wastewater Purification  ZHAO Lin-li, SHAO Xue-xin, WU Ming, et al. (4236) Substrate Flow by Different Biochemical Activities in the Urban Sewage Network  YAO Xiang-yi, SHI Xuan, SANG Lang-tao, et al. (4242) Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-xia, LIAO Zheng-wei, et al. (4249) Enhanced Degradation of Anilline by PS Oxidation in the Presence of UV and Ferric Oxalate  HAN Dong-hui, LI Ying, LI Kai-ming, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PaHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LIU Cuo-xin, et al. (4265) Effects of Long-term Side Stream Extracton on Phosphorus Removal and Recovery Performance of EBPR System  YU Xiao-jun, LI Jie, ZHOU Meng, et al. (4274) Effect of NaCl Salinity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A²/O Process  ZHANG Lan-he, TIAN Rui, GUO Jing-ho, et al. (4281) Effect of Temperature and pH on Nitrogen Conversion in Feanmon Process  CHEN Fang-min, JIN Run, YUAN Yan, et al. (4289) Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4291) Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Dentification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4310) Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317) Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LIUO Mei, TIAN Dong, HUANG Rong, et al. (433		
Distribution Characteristics of Sulfonamides and Sulfamethoxazole-Resistant Bacteria in Tannery Wastewater Treatment Processes		
Effects of Different Substrates and Particle Sizes on Wastewater Purification		
Substrate Flow by Different Biochemical Activities in the Urban Sewage Network YAO Xiang-yi, SHI Xuan, SANG Lang-tao, et al. (4242) Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process WANG Xu-dong, SHI Cai-xia, LIAO Zheng-wei, et al. (4249) Enhanced Degradation of Aniline by PS Oxidation in the Presence of UV and Ferric Oxalate HAN Dong-hui, LI Ying, LI Kai-ming, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4265) Effects of Long-term Side Stream Extracton on Phosphorus Removal and Recovery Performance of EBPR System YU Xiao-jun, LI Jie, ZHOU Meng, et al. (4274) Effect of NaCl Salinity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A²/O Process ZHANG Lan-he, TIAN Rui, GUO Jing-bo, et al. (4281) Effect of Temperature and pH on Nitrogen Conversion in Fearmon Process CHEN Fang-min, JIN Run, YUAN Yan, et al. (4289) Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB) SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4294) Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Denitrification An Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302) Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage LI Tian, WEI Fan-kai, WANG Yu-chang, et al. (4317) Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar Liuo Mei, TIAN Dong, CAO Ming, et al. (4327) Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System LIUO Mei, TIAN Dong, HUANG Rong, et al. (4327) Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System LIUO Mei, TIAN Dong, HUANG Rong, et al. (4338) Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid,		
Reducing Membrane Fouling from Micro-Flocculation in a Humic Acid Ultrafiltration Process  WANG Xu-dong, SHI Cai-xia, LIAO Zheng-wei, et al. (4249) Enhanced Degradation of Aniline by PS Oxidation in the Presence of UV and Ferric Oxalate  HAN Dong-hui, LI Ying, LI Kai-ming, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4265) Effects of Long-term Side Stream Extracton on Phosphorus Removal and Recovery Performance of EBPR System  YU Xiao-jun, LI Jie, ZHOU Meng, et al. (4274) Effect of NaCl Salinity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A²/O Process  ZHANG Lan-he, TIAN Rui, GUO Jing-bo, et al. (4281) Effect of Temperature and pH on Nitrogen Conversion in Feammox Process  CHEN Fang-min, JIN Run, YUAN Yan, et al. (4289) Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4294) Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Denitrification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302) Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  LI Tian, WEI Fan-kai, WANG Yu-chang, et al. (4310) Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317) Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LIUO Mei, TIAN Dong, GAO Ming, et al. (4327) Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System  LIUO Mei, TIAN Dong, HUANG Rong, et al. (4328)  Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves  ZHOU Hui-min, LI Pin, GAO Feng, et al. (4356)  Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment		
Enhanced Degradation of Aniline by PS Oxidation in the Presence of UV and Ferric Oxalate  HAN Dong-hui, LI Ying, LI Kai-ming, et al. (4257) Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes  WU Hai-zhen, SUN Sheng-li, LIU Guo-xin, et al. (4265) Effects of Long-term Side Stream Extracton on Phosphorus Removal and Recovery Performance of EBPR System  YU Xiao-jun, LI Jie, ZHOU Meng, et al. (4274) Effect of NaCl Salinity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A²/O Process  ZHANG Lan-he, TIAN Rui, GUO Jing-bo, et al. (4281) Effect of Temperature and pH on Nitrogen Conversion in Feanmox Process  CHEN Fang-min, JIN Run, YUAN Yan, et al. (4289) Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4294) Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Denitrification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302) Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  LI Tian, WEI Fan-kai, WANG Yu-xia, PANG Rui, et al. (4310) Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317) Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LUO Mei, TIAN Dong, GAO Ming, et al. (4327) Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System  LUO Mei, TIAN Dong, HUANG Rong, et al. (4388) Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves  ZHOU Hui-min, LI Pin, GAO Feng, et al. (4366) Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Behavior and Degradation of Polycyclic Aromatic Hydrocarbons (PAHs) in Coking Wastewater of A/O² and A/O/H/O Processes		
Effects of Long-term Side Stream Extracton on Phosphorus Removal and Recovery Performance of EBPR System		
Effect of NaCl Salinity on Extracellular Polymeric Substances and Bioflocculation of Anoxic Sludge in A <sup>2</sup> /O Process  ZHANG Lan-he, TIAN Rui, GUO Jing-bo, et al. (4281)  Effect of Temperature and pH on Nitrogen Conversion in Fearmox Process  CHEN Fang-min, JIN Run, YUAN Yan, et al. (4289)  Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4294)  Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Denitrification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302)  Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  LI Tian, WEI Fan-kai, WANG Yu-chang, et al. (4310)  Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317)  Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LUO Mei, TIAN Dong, GAO Ming, et al. (4327)  Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System  LU Jiao, TIAN Dong, HUANG Rong, et al. (4338)  Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid, and Sepiolite  XIE Xiao-mei, FANG Zhi-ping, LIAO Min, et al. (4348)  Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves  ZHOU Hui-min, LI Pin, GAO Feng, et al. (4359)  Effects of Different Levels of Irrigation with Reclaimed Water on Soil Enzyme Activity and Distribution of Thermotolerant Coliforms  HAN Yang, LI Ping, QI Xue-bin, et al. (4366)  Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Effect of Temperature and pH on Nitrogen Conversion in Feammox Process		
Inhibitory Kinetics of Free Ammonia (FA) on Ammonia-oxidizing Bacteria (AOB)  SUN Hong-wei, YU Xue, GAO Yu-xue, et al. (4294)  Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Denitrification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302)  Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  LI Tian, WEI Fan-kai, WANG Yu-chang, et al. (4310)  Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317)  Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LUO Mei, TIAN Dong, GAO Ming, et al. (4327)  Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System  LI Jiao, TIAN Dong, HUANG Rong, et al. (4338)  Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid, and Sepiolite  XIE Xiao-mei, FANG Zhi-ping, LIAO Min, et al. (4348)  Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves  ZHOU Hui-min, LI Pin, GAO Feng, et al. (4366)  Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Effect of HRT on Nitrogen Removal Using ANAMMOX and Heterotrophic Denitrification  AN Fang-jiao, ZHAO Zhi-chao, HUANG Li, et al. (4302) Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage  LI Tian, WEI Fan-kai, WANG Yu-chang, et al. (4310) Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317) Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LUO Mei, TIAN Dong, GAO Ming, et al. (4327) Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System  LI Jiao, TIAN Dong, HUANG Rong, et al. (4338) Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid, and Sepiolite  XIE Xiao-mei, FANG Zhi-ping, LIAO Min, et al. (4348) Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves  ZHOU Hui-min, LI Pin, GAO Feng, et al. (4366) Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Reactivation Performance of Nitrosation Flocculent Sludge After Long-term Storage	·	
Analysis of Characteristics and Sources of Heavy Metals in Farmland Soils in the Xijiang River Draining of Guangxi  SONG Bo, ZHANG Yun-xia, PANG Rui, et al. (4317)  Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar  LUO Mei, TIAN Dong, GAO Ming, et al. (4327)  Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System  LI Jiao, TIAN Dong, HUANG Rong, et al. (4338)  Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid, and Sepiolite  XIE Xiao-mei, FANG Zhi-ping, LIAO Min, et al. (4348)  Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves  ZHOU Hui-min, LI Pin, GAO Feng, et al. (4366)  Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar — LUO Mei, TIAN Dong, GAO Ming, et al. (4327)  Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System — LI Jiao, TIAN Dong, HUANG Rong, et al. (4338)  Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid, and Sepiolite — XIE Xiao-mei, FANG Zhi-ping, LIAO Min, et al. (4348)  Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves — ZHOU Hui-min, LI Pin, GAO Feng, et al. (4359)  Effects of Different Levels of Irrigation with Reclaimed Water on Soil Enzyme Activity and Distribution of Thermotolerant Coliforms — HAN Yang, LI Ping, QI Xue-bin, et al. (4366)  Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment — LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System	, , , , , , , , , , , , , , , , , , , ,	
Potential to Ensure Safe Production from Rice Fields Polluted with Heavy Cadmium by Combining a Rice Variety with Low Cadmium Accumulation, Humic Acid, and Sepiolite	Soil Organic Carbon of Purple Soil as Affected by Different Application of Biochar	LUO Mei, TIAN Dong, GAO Ming, et al. (4327)
	Effects of Straw and Biochar Addition on Soil Carbon Balance and Ecological Benefits in a Rape-maize Rotation Planting System · · · ·	LI Jiao, TIAN Dong, HUANG Rong, et al. (4338)
Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves ZHOU Hui-min, LI Pin, GAO Feng, et al. (4359)  Effects of Different Levels of Irrigation with Reclaimed Water on Soil Enzyme Activity and Distribution of Thermotolerant Coliforms HAN Yang, LI Ping, QI Xue-bin, et al. (4366)  Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)		
Effects of Different Levels of Irrigation with Reclaimed Water on Soil Enzyme Activity and Distribution of Thermotolerant Coliforms		······· XIE Xiao-mei, FANG Zhi-ping, LIAO Min, et al. (4348)
Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Risk Assessment  LI Fa, XU Ying-ming, WANG Lin, et al. (4375)	Interactive Effects of Ozone and Drought on Antioxidant Enzyme Activities of Poplar Leaves	ZHOU Hui-min, LI Pin, GAO Feng, et al. (4359)
LI Fa, XU Ying-ming, WANG Lin, et al. (4375)	Effects of Different Levels of Irrigation with Reclaimed Water on Soil Enzyme Activity and Distribution of Thermotolerant Coliforms	······ HAN Yang, LI Ping, QI Xue-bin, et al. (4366)
LI Fa, XU Ying-ming, WANG Lin, et al. (4375)	Characteristics of Heavy Metals in Chicken Manure Organic Fertilizers in the Huang-Huai-Hai Region and related Environmental Ris	k Assessment
Heavy Metal Content of Rural Living Solid Waste and Related Source and Distribution Analysis		LI Fa, XU Ying-ming, WANG Lin, et al. (4375)