

# Community-Based Stock Enhancement of Topshell in Honda Bay, Palawan, Philippines

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## Introduction

Many coral reefs are located nearshore, hence they are readily accessible to exploitation by coastal dwellers. This makes reef resources vulnerable to over collecting, especially shells which are either slow moving or sessile. Depleted populations of valuable shells are difficult to restore because their growth rate is slow (Nash 1985) and the larvae have relatively short planktonic life that limits the range of their distribution (Heslinga 1981). Depletion of coral reef and associated resources due to unregulated or poorly regulated harvesting is of increasing concern not only in the Philippines, but also in the Indo-West Pacific.

In Palawan, Philippines, observed reduction of trochus shell resource in various areas was due to unregulated harvest mainly by compressor (hookah) divers and free diving fishers from other provinces. The latter migrate to Honda Bay for greater livelihood prospects (Gonzales 2004), increasing the population of coastal communities along the Bay. According to fishers in Honda Bay, their shellfish resources were bountiful until traders and divers from other parts of the country came to Palawan in the 1970s, depleting topshell *Trochus niloticus* and other species.

One of the objectives of Coastal Resource Management (CRM) is the regeneration of

depleted resources and their sustainable use. On the other hand, the socio-economic objectives are: a) to alleviate poverty in coastal communities through added income and, b) to encourage responsible use of coastal resources through active participation of coastal communities in decision-making, planning, and implementation.

In the above context, both objectives could be attained through restocking or stock enhancement (Gonzales 2002a; Bell and Garces 2004) using community based-CRM approaches, where populations of severely overexploited resources are restored through active participation of local governments and communities. Hence Community-Based Stock Enhancement (CBSE) was introduced as a CRM strategy. The community-based topshell stock enhancement in Barangay Binduyan was assisted by the Fisheries Resource Management Project (FRMP) of the Bureau of Fisheries and Aquatic Resources of the Department of Agriculture (DA-BFAR).

The objectives of this paper are to: 1) describe the processes in a community-managed stock enhancement project; 2) document monitoring and evaluation of the project; and 3) give recommendations to improve future community-managed stock enhancement project.

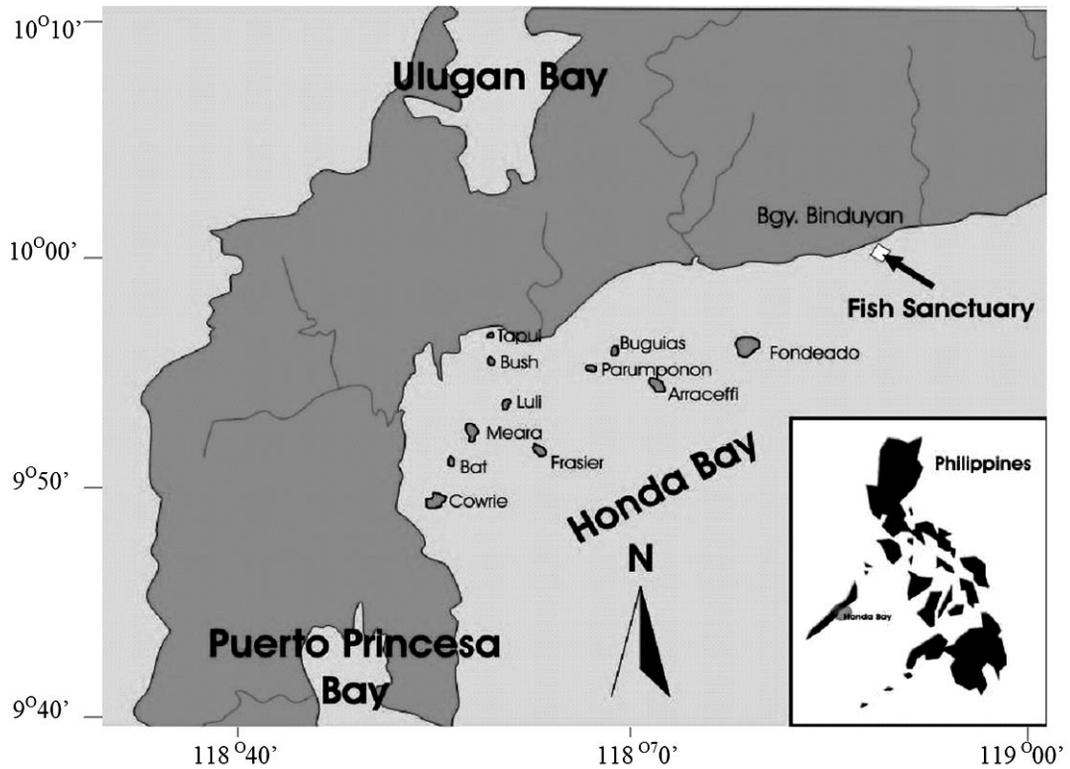


Fig. 1. Map of the Philippines (inset) and Honda Bay showing location of study site, fish sanctuary in Bgy. Binduyan, Palawan City, Puerto Princesa.

### Topshell

Native to countries of the Western Pacific, the topshell has been introduced to many locations throughout the Pacific Islands (Smith 1987). This shell is collected and exported for button making, jewelry, and other decorative items (Mcgowan 1970) while the meat is processed by salting or smoking, thereby providing an important source of income for rural fishing communities.

In recent years, the market value of trochus shell has increased markedly, hence the level of exploitation has also increased in many Pacific Island countries. It is feared that present levels of harvesting will not be sustainable with serious resource depletion if management regimes are not instituted. Depletion of trochus shell due to unregulated harvest has been observed in various areas in the Philippines (Gonzales 2005).

The World Conservation Union (IUCN) has placed *T. niloticus* on its list of commercially threatened invertebrates. In the Philippines, this species was classified under highly regulated shells under Fisheries Adm. Order 157 and Fish Game Adm. Order 11, but is now categorized by Fisheries Adm. Ordinance 208 (May 2001) as a threatened species whose catch or collection is prohibited.

The selection of species of the Bureau of Fisheries and Aquatic Resources-Fisheries Resource Management Project (BFAR-FRMP) was based on information that topshell resources are depleted in Sabang Reef, Palawan because many fishermen collect topshells for livelihood. Moreover, a survey revealed that the fish sanctuary in Sabang Reef is a natural habitat for topshells, and lastly, there is a topshell hatchery in the locality. The selection of topshell also followed the species selection criteria

developed by BFAR-FRMP (Gonzales 2005). These criteria are biodiversity, technology, socioeconomics, and research.

## Materials and Methods

The project site is located in Bgy. Binduyan and Sabang Reef in Honda Bay, Palawan in western Philippines (Fig. 1). Data on the stock enhancement effort were obtained from management plans, minutes of *barangay* (village) meetings, city ordinances and barangay resolutions, assessment and survey reports, BFAR-FRMP reports, interviews and personal observations.

The impact assessment survey was done from July to October 2004. The assessment was conducted pre- and post- intervention in both impact and control areas for biophysical changes in time and location (Osenberg and Schmitt 1996).

Two methods were used to determine abundance, distribution, and sizes of topshells inside and outside the fish sanctuary – the permanent quadrat and belt transect (English et al. 1997) with slight modifications (Galon et al. in press). Two 5 x 200 m belt transects were used in deep water stations both inside and outside the fish sanctuary, while one 20 x 200 m quadrat was used in intertidal stations of both inside and outside the fish sanctuary. Surveys were conducted using SCUBA in the deep-water station, and by walking inside the quadrat of the intertidal stations (Figs. 2 and 3).

The sociological survey was based on interviews of 70 respondents (of a total 77 fishermen in Binduyan) to evaluate the impact of the restocking initiative using indicators such as change in size of gleaning area, length of time spent gleaning, abundance and size of gleaned shells, and awareness and attitudes toward restocking and protection.

Results of the interview were pooled together and a descriptive analysis of the



Fig. 2. Measuring basal diameter of topshell.

data was done. The responses of the members of the community were described through percentage.

## Results and Discussion

### Chronological events

The chronology of events in the establishment of the fish sanctuary, and community preparations for the stock enhancement project are listed in Table 1 starting with social and technical preparations in 1999 up to project evaluation in 2004.

The passing of the ordinance for the sanctuary declaration took time due to the modification of the shape and area of the sanctuary. Additionally, changes in the political leadership affected activities in the field.

The Barangay Council passed a resolution to implement stock enhancement only after the training was conducted. When community members recognized the value and importance of topshell stock enhancement, the project should have strengthened its community information and education efforts.

Surveys of potential release reefs and microhabitat sites were conducted prior to actual experimental releases of juvenile topshells (Table 1) (Gonzales 2002b). Presentation of such results to the community helped explain the condition of their resources and the benefits of stock enhancement.

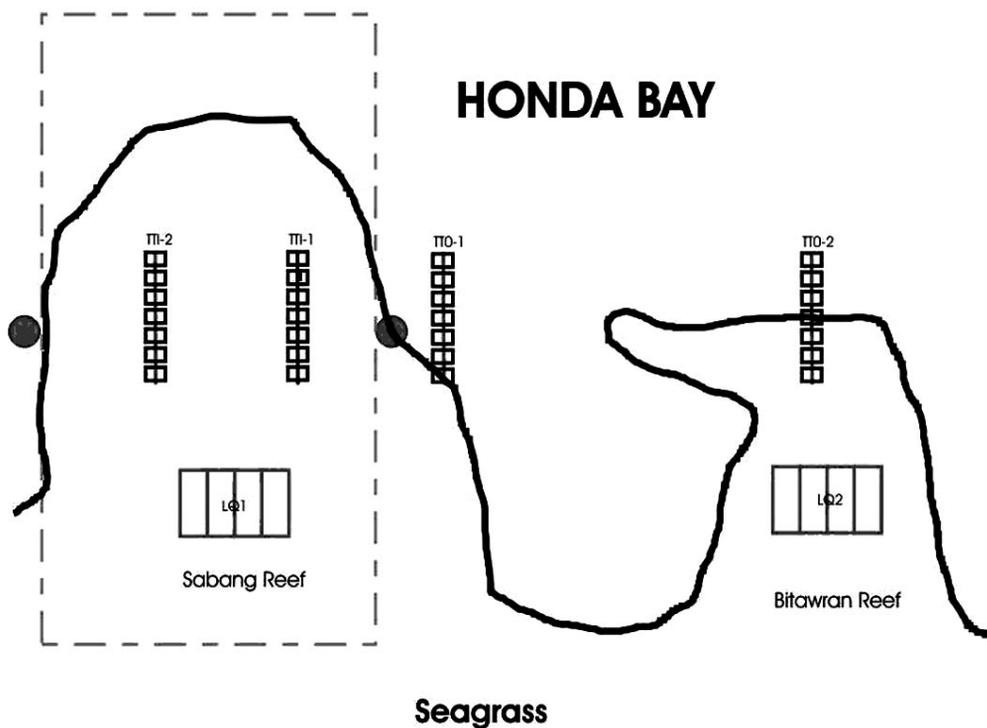


Fig. 3. Location of quadrats in intertidal and belt transects in deepwater stations for topshell density assessment in protected (Sabang Reef) and unprotected (Bitawran Reef) areas. TTI-1 represents Traverse Transect Inside no. 1; TTI-2, Traverse Transect Inside no. 2; TTO-1, Traverse Transect Outside no.1; TTO-2, Traverse Transect Outside no. 2; LQ1, Low water Quadrat no. 1; LQ2, Low water Quadrat no. 2.

Juvenile topshells donated by the Iris Marine Development Corp. (operator of topshell hatchery) were released in the Sabang Reef Fish Sanctuary during the launching and end-of-stock enhancement trainings. Community members and partners were enjoined to participate in the releases not only to learn skills but also to encourage commitment to the project.

Two markers were tested on released juvenile topshells. Plastic markers glued to the shell (using marine epoxy) lasted not more than three months. Some shells were recovered without tags but with remains of the epoxy glue. The diet tag formulated by SEAFDEC/AQD (see Okuzawa et al, this volume) proved more reliable than the

glued plastic. However, the local hatchery cannot afford to produce this tag because it requires 24 h running water, and the hatchery has electrical power only during the day.

### Groundwork to sustainability

The Participatory Coastal Resource Assessment (PCRA), which requires the active participation of stakeholders in information gathering and analysis prior to planning and management, was used. The Sanctuary Management Board (SMB) of Bgy. Binduyan was empowered through training, onsite practicum, and close assistance in the development and implementation of the Fish Sanctuary Management Plan and Stock Enhancement Management Plan.

Table 1. Main chronological events in the establishment of fish sanctuary and implementation of community-managed stock enhancement in Bgy. Binduyan, Palawan City, Puerto Princesa.

<b>Event</b>	<b>Date</b>	<b>Remarks</b>
REA for site selection	6 Sept. 1999	BFAR divers
Public hearing	11 Oct. 1999	City Agriculture Office
Training on Establishment and Management of Fish Sanctuary	23-25 Aug. 2000	Project Consultants and City Government
Signing of City Fisheries Ordinance No. 192	11 Feb. 2002	City Council passed Ordinance
Development of IRR for fish sanctuary	23 May 2002	Morning session -Fish sanctuary and topshell management workshop
Workshop on Agreements on the Implementation and Management of Topshell Stock Enhancement	23 May 2002	Afternoon session - Fish sanctuary and topshell management workshop
Election of SMB officers, presentation of site baseline assessment results to the community	May to July 2002	Haribon-Palawan, BFAR-FRMP, City Government, Iris Marine Dev. Corp.
Survey of release sites in fish sanctuary and setting up of marker buoys	20-22 May 2002	SMB, Barangay Council, FRMP, Haribon-Palawan, CAO
Ceremonial release of juvenile topshells	24 July 2002	SMB, BFAR-FRMP, Iris Marine Dev. Corp
Induction of SMB Officers	26 July 2002	BFAR-RO-IVB, FRMP, CAO, Iris Marine Dev. Corp.
Launching of fish sanctuary and topshell stock enhancement projects	27 July 2002	BFAR-RO-IVB, FRMP, CAO
Training on Sanctuary and <i>Trochus</i> Shell Management, practicum on topshell release and monitoring	18-20 Feb. 2003	SEAFDEC/AQD researchers, BFAR-FRMP
Binduyan Barangay Council approval of Topshell Stock Enhancement Project	1 Aug. 2003	Resolution passed by Barangay Council
Assessment of CBSE impacts	July-Sept. 2004	FRMP, Western Philippines Univ., CAO, Haribon-Palawan

REA - Resource Ecological Assessment; BFAR - Bureau of Fisheries and Aquatic Resources; FRMP - Fisheries Resource Management Project; RO - IVB - Regional Office No. 4B, CAO - City Agriculture Office; IRR - Implementing Rules and Regulations; SMB - Sanctuary Management Board; SEAFDEC/AQD - Southeast Asian Fisheries Development Center, Aquaculture Department; CBSE - Community - Based Stock Enhancement

Establishing partnerships, identifying counterparts, and sharing were applied in every activity to instill in the community the sense of responsibility, accountability, ownership, and sustainable operation of the CBSE. After completion of the project, the community partners (City Government, academe, private sector, and NGO) are expected to continue stock enhancement activities.

The Sanctuary Management Board made the Stock Enhancement Project Agreements during the Workshop on Implementation and Management of Topshell *Trochus niloticus* Restocking in Sabang Reef Fish Sanctuary, Bgy. Binduyan, Puerto Princesa City, 23 May 2002.

In the workshop, it was agreed that the collection of re-stocked shells will be 4-5 years later (2006) and only shells with diameter of 7.6 cm and above shall be collected outside the core zone.

Shell collection shall be for six months per year only, from July to December. The area will be closed for harvest from January to June. Collectors will be divided into six groups and will be allowed to gather shells in certain areas to be identified by SMB. The volume of harvest will also be determined by SMB.

Gleaning of topshells is prohibited even outside the release area (FAO 208), unless clearance and proper permits are obtained. Collectors must register with the SMB, and the Secretary shall facilitate registration.

Harvest of re-stocked shells is exclusive to Binduyan residents, especially fisherfolk while the Iris Marine Development Corporation will buy the harvested topshell.

In terms of benefits and beneficiaries, the stakeholders agreed that an area would be reserved for the youth sector (15 years and below). On the other hand, women

and tribal members will be hired by the Iris Marine Development Corporation to extract and process topshell meat.

It was also proposed that a) barangay tax of PhP2/kg will be collected from the topshell gatherers. PhP1 will go to the barangay and the remaining PhP1 will be used for the operations and maintenance of the CBSE project. The suggested selling price of topshell will be less 10% of the prevailing price when sold to Iris Marine Development Corp.

### **Community-based stock enhancement impact assessment**

#### *Biophysical*

In the intertidal area, results indicate that the abundance and sizes of topshell (Table 2) in the protected area (4.58 cm) are significantly bigger ( $t=2.03$ ,  $p=0.05$ ,  $n=39$ ) than those in the unprotected area (2.95 cm).

In the deepwater stations, no topshells were observed in the unprotected area whereas in the protected area, topshells had a density of 190.0 ind/ha and mean basal diameter of 10.63 cm. In the intertidal area, the density was 70.0 ind/ha and 27.5 ind/ha in the protected and unprotected areas, respectively.

Data from the Iris Marine Development Corp. showed that topshells in deepwater stations had a mean basal diameter of 4.98 cm (range: 4.6-7.4 cm) in 2002 and 9.59 cm (range 8.30-11.20 cm) in 2003 (Table 3).

Analysis of variance revealed that the mean basal diameter of topshells was significantly greater in 2003 and 2004 than in 2002.

The density of topshells in the protected intertidal area of the sanctuary increased significantly from 40 ind/ha in May 2002 to 70 ind/ha in September 2004 (Table 3),

Table 2. Size and abundance of topshells in protected/unprotected, and intertidal/deep water stations (values in parentheses are ranges).

Size and abundance	Intertidal (0-2 m)		Deepwater (4-21 m)	
	Protected	Unprotected	Protected	Unprotected
Mean basal diameter $\pm$ SD (cm)	4.58 $\pm$ 1.43 (2.00-6.70)	2.95 $\pm$ 1.24 (1.00-4.90)	10.63 $\pm$ 0.57 (6.50-16.50)	none
Density (ind/ha)	70.00	27.50	190.00	0.00

an increase of 75%. The size of topshell (mean basal diameter) however did not change.

Sizes of topshell in the deep water station were significantly higher after restocking was implemented. Mean basal diameter increased from 4.98 cm in September 2002 to 9.59 cm in 2003 and 10.63 cm in 2004.

### Sociological

A survey administered by interview (n=70 respondents) evaluated the sociological impact of restocking in the protected area. Majority (71%) of the respondents believed that their gleaning area remained the same size while 19% said they had a wider area. However, 9% of the respondents believed that restocking and protection encroached on their gleaning area.

The length of time spent for gleaning decreased for 37% of the respondents, increased for 31%, but remained the same for the remaining 31%. About the changes in abundance of topshells, majority (70%)

said they gleaned more topshells after the restocking effort, 9% were gleaning less topshells, and 17% observed no change. Majority (61%) of respondents believed the size of topshells increased, 19% reported no change, and 20% did not respond.

Almost all (96%) of the respondents knew that topshells were being released in the protected area; only 3% were not aware of the initiative. Of those who knew about the initiative, only 89% were aware of the prohibition in gathering topshells, 7% were not aware, and 4% had no response. Almost all (94%) of the respondents were in favor of the prohibition. Because some gleaners claim they cannot distinguish juvenile topshells from other similar shells, identification should also be included in the training.

### Coral reef sanctuaries for *Trochus* shells

Using the community-based approach to stock enhancement, Meñez et al (1998) recommended limited exclusive use of an area for grow-out culture or stock enhance-

Table 3. Population density and sizes of topshell from 2002 (before stocking) to 2004 (after restocking) (data from Iris Marine Development Corp.).

Year	Intertidal Station (0-2 m)	Deep Station (4-21 m)		
	Density (ind/ha)	Basal diameter (cm)		
		Mean $\pm$ S.D.	Minimum	Maximum
2002	40	4.98 $\pm$ 0.54	4.60	7.40
2003	no available data	9.59 $\pm$ 0.58	8.30	11.20
2004	70	10.63 $\pm$ 0.57	6.50	16.50

ment of the sea urchin *Tripneustes gratilla*. This approach has been encouraged by Heslinga et al (1984) and applied in this study. The data in this study validate the perceptions of the community that restocking combined with protection generally improves livelihood because they are now gleaning more and bigger topshells.

The community-based approach has led to the establishment of a fish sanctuary with legal framework for law enforcement, and has motivated the community to create other law enforcement schemes to protect the sanctuary. Nevertheless, gleaning of juvenile topshells continued and SMB has apprehended five violators.

### **Impact assessment**

Topshell density of 190 ind/ha in the protected area in Honda Bay is comparable to other areas in the Pacific Region – the maximum population of topshell in a barrier reef in Chuuk State, Micronesia was only 37 ind/ha (Gawel 1997). Mean density of mature topshells was 80 ind/ha in Okinawa, Japan (Isa et al 1997); and 45 ind/ha in Papua New Guinea (DFMR 1997). Mean density of topshell was 556 ind/ha in the inter-island channels and 962 ind/ha on reef flats in the Marshall Islands (Kilma and Kobaia 1997).

The absence of mature topshells in the deeper waters of the unprotected area, even in the survey area just outside of the sanctuary, reflects the extent of harvesting of the resource. Despite awareness among 94% of the fishermen/respondents about regulations prohibiting topshell gathering, results indicate that harvesting continues unabated. The present study also confirms previous findings of Becira et al (in press) in the same site that topshells were conspicuously absent outside the protected area.

Although the community-based stock enhancement approach has contributed to

restoring topshell populations inside the protected area, it has to be evaluated in terms of economic returns. Economic evaluation was not included in the present study because of insufficient data. Additionally, Fisheries Administrative Order 208 (prohibiting topshell collection) allows free trading of topshell, making economic analysis difficult. Since the project is in its introductory phase, future refinements will improve restoration of resources and economic benefits. Data collection should continue as the project progresses and processes shall be fine-tuned.

### **Conclusions**

The Fish Sanctuary and the CBSE Project have addressed the following issues and concerns at different degrees as expressed by the Binduyan community during the 1999 Planning Workshop: 1) lack of alternative livelihood, 2) illegal fishing and weak law enforcement, 3) destruction of coastal habitats, and 4) intrusion of commercial fishing boats in municipal waters. The project has improved topshell resources and livelihoods by increasing topshell numbers and sizes, and also community awareness and attitudes towards restocking and protection. These results imply that the community-based stock enhancement approach is a potential tool for coastal resource management. However, continued harvesting of topshell despite the apparent benefits and prohibitions suggests that partners and environmentally-conscious community members should continue information and education activities, while maintaining law enforcement.

This paper is the first to document the processes used in a community-managed stock enhancement project. Nevertheless, some constraints have to be resolved for the improvement of CBSE technology. It may be advantageous to learn from the lessons of more advanced community-based coastal resource management projects implemented

in other parts of the Philippines (Northern Luzon, Visayas) and around the world.

### **Recommendations to improve future community-based stock enhancement projects**

These recommendations are based on the stock enhancement experiences in Palawan and other BFAR Regional Offices apart from Region 4B, and from the results of three national FRMP workshops on marine stock enhancement in the Philippines (2003-2005).

1. Species selection
  - a. Define selection criteria, including native species
  - b. Consult stakeholders and experts
  - c. Consider socioeconomic and biological aspects of species
  - d. Consider available technology for captive spawning and rearing
  - e. Consider available technology for transport, release, and monitoring
  - f. Know the conservation status of the species
2. Selecting release sites
  - a. Adequate food and shelter; free from heavy siltation, pollution, destructive methods of fishing, etc.
  - b. Area large enough to accommodate released seeds
  - c. Available habitat protection (preferably MPAs with multiple zones), fish sanctuaries, core zone or No Touch zone of MPA with effective law enforcement
3. Release of organisms
  - a. Participation of stakeholders
  - b. Release of hatchery-bred individuals or individuals from the wild in No Take zone of MPAs
  - c. Plan the release activity, e. g., size and density of release individuals, timing and site of release
  - d. Surface and bottom markers at release sites
4. Management
  - a. Use adaptive management that deals with current problems and issues through re-planning process, done regularly
  - b. Use integrated management approach that facilitates sharing of responsibilities and accountabilities among various agencies: government, community, private sector, etc.
  - c. Set up a management body
  - d. Financial, scientific, and technical support from management and partners, especially in the early stages of the project
  - e. Management plan for the project and species
5. Monitoring and evaluation
  - a. Mark or tag individuals for release
  - b. Conduct stock assessment prior to release (baseline information)
  - c. Monitor changes in density and size relative to baseline information
  - d. Evaluate increase in total catch of the species through time
6. Legal and policy framework
  - a. Consider local, national, international laws and policies regarding introduction of species to local waters.

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