

# Nuclear Power Plant, Environmental Impact Assessment and Conservation: Towards a Wise Use of the Suo-nada Sea around Nagashima Island, Seto Inland Sea in Japan

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## Abstract

The Chugoku Electric Power Company (CEPC) has plans for constructing a nuclear power plant (two reactors, 137.3 megawatts each) on Nagashima Island of Kaminoseki Town situated in the Suo-nada Sea, the Western-most portion of the Seto Inland Sea National Park, Japan. The Seto Inland Sea, the biggest half-closed water system in Japan, has suffered from deterioration of its natural environment since the 1970s caused by landfilling, dredging, and industrial sewage from the development of industrial complexes. In the 1980s, the pollution here became one of the most serious social and environmental problems of Japan. It has been revealed recently that the biodiversity of the Suo-nada Sea is exceptionally well conserved in spite of such pollution. Nagashima Island is on the east end of this Suo-nada Sea, and thanks to the warm Kuroshio current washing its untouched coastlines, which are immune from artificial banks, it has by far the best conserved shallow water maritime biodiversity in today's Japan. The Japanese government launched the Environmental Impact Assessment Law in June 1999, and the proposed Kaminoseki Power Plant became the first case of a nuclear power plant in Japan to which this new law was to be applied. The Committee for Technological Evaluation of Environmental Impact Assessment of Yamaguchi Prefecture judged the Preparatory Report made by CEPC (April 1999) as unsatisfactory, and the Ecological Society of Japan (ESJ) expressed their academic concern about the conservation of biodiversity around Nagashima (March 2000), and it demanded a re-assessment (March 2001). Although the project was accepted as a national one by the Japanese government in July 2001, it is still at a stand-still owing to many obstacles and opinions against the project: not all the landowners agreed to sell their land, a fishing cooperative at nearby Iwaishima Island has refused to accept any compensation for the possible loss of their fishing rights, and so on. The authors illustrate some of the recent discoveries from their research, and propose an alternative project of an eco-museum for a more sustainable use of the island ecosystem and the surrounding sea. Nagashima Island will become a focus of ecotour and environmental education that will ensure a wise and more sustainable use of the Seto Inland Sea than constructing nuclear power plants in the midst of this sanctuary worthy of its nomination as a World Heritage Site.

**Key words:** biodiversity, community-based conservation, development, ecotourism, environmental impact assessment, nuclear power plant

## 1. Escorted Visits to Nagashima Island

Walking along the beautiful beach of Tanoura, Nagashima Island in the Suo-nada Sea, the western-most part of the Seto Inland Sea (Fig. 1), you can see a variety of species that have become rare or almost extinct in today's Japan. You may witness the quickly disappearing smooth brown backs of finless

porpoises, the smallest whale of the world. A pair of falcons will fly from the small rocky islet Hanagurijima to soar high in the sky. On the steep cliffs over the beach cling wild *Juniperus* trees, and the slopes of the hillsides are covered with rich laurel-leaved forests. Behind an old artificial bank there spread swamps that used to be fields for rice cultivation two decades ago. Along a footpath



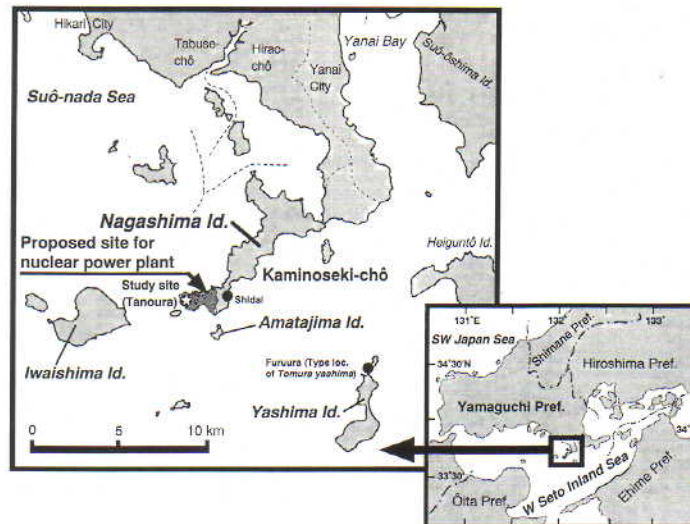


Fig. 1 Map of the vicinity of Nagashima Island.



Fig. 2 Dainohana (left) and Hanagurijima Islets in Tanoura Bay, Nagashima Island.

climbing through the *Satoyama* forest (Washitani, 2001), orchids and other endangered plants grow, and there are remaining rock works elaborately built to make up narrow shelves of paddy fields and a pond for irrigation. Tanoura Beach itself is an archeological site having remains of pottery, ceramic spoons, and stone arrowheads. It probably dates back to the late *Jomom* Era (Kaminoseki Choshi Hensan linkai, 1988). This means that people began dwelling on this beach at least 25 centuries ago.

The rocky shores of Tanoura have been recently proven to have an exceptionally rich fauna of molluscs and other marine organisms as will be described later (Fig. 2).

Just in front of Tanoura Beach you can clearly see the houses of Iwaishima Island located four kilometers away. This island prevents most of the floating rubbish from arriving at Tanoura and helps to maintain its cleanliness. Iwaishima Island has been regarded as a sacred landmark by travelers in the Seto Inland Sea, and appears in the *Man'yōshū*, the oldest anthology of Japanese poems compiled during the

Nara Era, in the 8<sup>th</sup> century (Kato, 2001:3).

Nowadays, every time you visit Tanoura for an excursion or for a survey of biodiversity (Fig. 3), you will find constantly increasing two meter high fences built to prevent you from moving freely (Fig. 4). Furthermore, guards hired by Chugoku Electric Power Company (CEPC) will closely escort you wherever you go. They will note the license plate number of your car, and will warn you not to stray from the footpaths they show you. They may occasionally stop you by blowing a whistle, saying that you should obtain special permission from CEPC or from the chief of the community of Shidai Village for entering the territories in question. If you are on the beach itself, a public space, they will simply follow you, and tell their supervisor by mobile phone whatever you do, and especially the names of species you may discover during your stay. There are numerous remote TV cameras and infrared sensors both on the beach and in the forest at the spots where they installed equipment for studying the environment. Whenever we make an underwater survey using scuba equipment, fishing





Fig. 3 Volunteers having a rest on Tanoura Beach. (Photo by Y. Nakano)



Fig. 4 A fence on Tanoura built by CEPC. (Photo by M. Shimata)

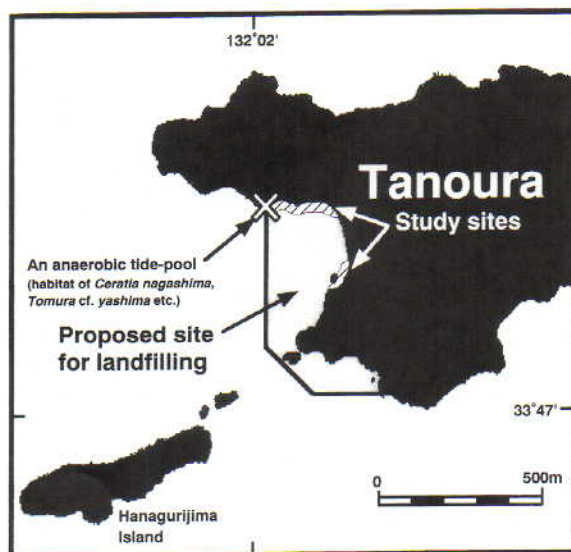


Fig. 5 Tanoura and its vicinity.

boats from a nearby village (in most cases hired by CEPC) approach the site, and we occasionally feel harassed by the closeness of their fishnets and propellers.

For more than 20 years, Tanoura has been the site where CEPC has planned to build the Kaminoseki

Nuclear Power Plant (Asahi News Paper, Yamaguchi Branch, 2001). According to the Reports of Environmental Impact Assessment by CEPC, nearly the entire coast of Tanoura will be landfilled to reclaim a site for construction of the nuclear reactors. The whole area that the power plant is planned to occupy is about 300,000 m<sup>2</sup>. Half of the area (150,000 m<sup>2</sup>) will be produced by reclamation of public sea, with 170,000 m<sup>3</sup> of soil to be brought from the surrounding areas or the sea by dredging (Fig. 5). After the reclamation, the boundaries between the area of the power plant and the sea will be sealed by concrete embankment. Two reactors, 137.3 megawatts each, will draw 190 tons of seawater per second (16.4 million tons per day) to cool them down. Apart from radioactive emissions into the sea, the pumped out seawater of the same amount will be seven degrees warmer than before. Chemicals such as chlorides will be added to prevent marine organisms from growing in the pipelines, and according to a governmental paper, at least 70% of the plankton and larvae will be killed during this process.

Mr. H. Katayama, mayor of Kaminoseki, has worked hard to persuade the local inhabitants to welcome the nuclear power plant project. CEPC established an office in Kaminoseki to facilitate the project, and it has already consumed more than 16 billion yens with some 50 permanent employees whose mission is to persuade the inhabitants to agree with the Kaminoseki Nuclear Power Plant project.

Iwaishima Islanders have always been the core members among local inhabitants of Kaminoseki Town, who have been actively, but peacefully, fighting against the project. Since the proposed site is just in front of their village and port, and their main income has been commercial and tourist fishing by angling, they heavily depend on the sea around them. Unlike the seven other nearby fishing cooperatives, Iwaishima's fishing cooperative has refused to receive any compensation from CEPC in exchange for the inevitable loss of or damage to their fishing rights.

The nearest village, Shidai, is located on the east end, the opposite side, of Nagashima Island. Five families out of a total of 120 families are against the sale of their lands in the proposed site to CEPC. Further, there is property of a *Shinto* shrine located in Shidai Village (*Shidai Hachimangu*), which is 10-hectares in area, and is located just beneath the site for reactor No. 1. Mr. H. Hayashi, the chief priest of the shrine openly declares that it is against the will of the deities of *Shinto* to sell the land for the project of a nuclear power plant (consult Asahi News Paper, Yamaguchi Branch, 2001, for more details).

In short, the project has two main obstacles on both the sea side and the land side. By the year 2000, the discovery of the biodiversity of Tanoura and Nagashima Island became another headache for CEPC. That is why visitors are always put under close surveillance by the guards whenever they visit to be



acquainted with the biodiversity of the sea and forest of Tanoura.

In this paper, we would like (1) to illustrate the extraordinarily rich biodiversity of Nagashima Island, (2) to examine the process of environmental impact assessment by CEPC, and (3) to propose a wise and more sustainable use of the Seto Inland Sea than establishing nuclear power plants in it. Descriptions of the molluscs and brachiopods are quoted from Fukuda *et al.* (2000), and other descriptions are taken from a booklet entitled *Biodiversity of Nagashima Island* published by the Chugoku-Shikoku Branch of the Japan Society of Ecology (edited by Ankei, 2001).

## 2. The Unique Biodiversity of Nagashima Island

Nagashima Island is located in the Seto Inland Sea National Park. The Seto Inland Sea, having a surface of 9,500 km<sup>2</sup>, is the biggest half-closed water system in Japan. It has two narrow waterways on its east and west ends. Since the 1970s it has suffered from rapid deterioration of its natural environment caused by landfilling, dredging, and industrial sewage from the development of industrial complexes. In the 1980s its pollution became one of the most serious social and environmental problems of Japan. The inhabitants of Teshima, a small island of Kagawa Prefecture for example, have suffered from half a million tons of industrial garbage illegally brought from outside.

Unlike other areas of the Seto Inland Sea, the Suo-nada Sea around Nagashima Island has not been heavily damaged by industrialization or heavy use of chemicals (insecticides, herbicides etc.) used in cultivated fields. It enjoys a rapid exchange of seawater thanks to swift water flows including the warm current Kuroshio arriving directly from the Pacific. Furthermore, as much as 75% of Nagashima Island's coastline has been left untouched. This rate drops to as low as 21% for the whole Seto Inland Sea, which has experienced artificial changes on its coastlines.

With the aid of many scientists who agreed to join the Suo-nada Ecosystem Research Group, we have hitherto revealed the current status for the following species in and around Nagashima Island (Ankei ed., 2001).

### A. Flora

Nagashima's flora first came to be known to the world through the work of Franz von Siebold, who visited the island and collected plants on 27 June 1826 (Kaminoseki Choshi Hensan Iinkai, 1988). Today, a well-conserved laurel-leaved forest surrounds Tanoura Beach (the proposed site) of Nagashima Island. According to our surveys of plant ecology (Fig. 6), some parts of the forest should be regarded as a climax forest. Rare and endangered species also occur in and around the proposed site: *Juniperus chinensis* L.



Fig. 6 Measuring a big *Machilus thunbergii* Sieb. et Zucc. in the forest of proposed site.

on steep cliffs (see Fig. 1), *Orostachys iwawake* (Makino) Hara, *Aleuritopteris argentea* (Gamel. Fee) along the footpaths in the forest, *Azolla imbricata* (Roxb.) Nakai, in abandoned paddy fields, and so on (Ankei, T. & Noma, 2001; Noma & Ankei, T., 2001; Suzuki, 2001). These species are listed in the Red Data Book of the Ministry of Environment (1997). The well-conserved forest of Tanoura Beach has evidently contributed to the conservation of the coastal and marine habitats, and to the survival of the exceptionally rich marine organisms of Nagashima as described below.

### B. Finless porpoises (*Neophocaena phocaenoides*)

The finless porpoise, the smallest whale in the world, is listed in the Washington Convention, and is also protected by the Ministry of Environment of Japan. They live along the coast in waters shallower than 50 m from the Persian Gulf to Korea and Japan. Japanese populations are isolated from those of Korea or China, and they themselves are divided into five genetically independent geographical subgroups: those of Ohmura Bay, the Ariake Sea, the Seto Inland Sea, from Ise to Mikawa Bay, and from Sotobo to Sendai Bay.

The population of finless porpoises in the Seto Inland Sea was estimated to be around 4,900 individuals in the years 1976-1978. It is estimated to have decreased to about 750 (down to 15% in two decades) by March-June 1999. Almost everywhere in the Seto Inland Sea they are practically disappearing, and the population around Takehara City, Hiroshima Prefecture, has totally disappeared although they have been protected as one of the natural monuments of Japan. The causes for the decrease in their numbers are: increased mortality through an accumulation of pollutants, and the destruction of their habitats by landfilling and dredging. They have also died from being caught in fishnets or in collisions with ships (Fig. 7).

A unique exception to this heavy decrease of finless porpoises is in the Suo-nada Sea, where the numbers decreased only to 40%-90% of previous values





Fig. 7 A baby finless porpoise found near Nagashima Island.

since two decades ago. A comparison was made along eight routes of ferryboats, and one route that passes by the proposed site for the nuclear power plants (the route connecting Yanai City, Iwashima Island, and Heigun Island) showed a slight (7%) increase in individuals observed. Thus, the waters around the proposed site may be the last sanctuary for the finless porpoises in the Seto Inland Sea (Kasuya, 2001).

#### C. Falcons (*Falco peregrinus*)

Falcons are distributed in cool temperate zones of the northern hemisphere. They also live in Australia. In Japan, they used to be widely observed from Hokkaido to small islands of the sea northwest of Kyushu. A survey in 1999 estimated the population to be as small as 200 to 230 pairs in all of Japan. A pair of falcons are observed to have their nest on Hanagurijima Islet, only 500 m from the proposed site. They are observed to feed on small birds like brown-eared bulbuls (*Hyspipetis amaurotis*) that may abound on the hillsides above Tanoura Beach. Mating has been observed every year, but they failed to have their eggs hatch these two successive years (ESJ, Chugoku-Shikoku Branch, 2001).

#### D. Chordates (*Branchiostoma belcheri*)

*Branchiostoma belcheri* abounds in the sandy bottom of the Sea of Nagashima Island. During every survey dozens of specimens including sexually mature ones are collected (Fig. 8). It has been practically extinct in Seto Inland Sea. The sea offshore of the Takehara City, Hiroshima Prefecture, was actually nominated as a national monument by the Japanese government as a spot having *Branchiostoma belcheri*, but it is now impossible to find it there. Since this genus is almost extinct because of the loss of its habitat in Japan, the proposed site is all the more important to conserve (Sato & Fukuda, 2001).



Fig 8 *Branchiostoma belcheri* from Tanoura.

#### E. Brachiopods (*Discinisca sparselineata*)

A species of brachiopods, remnants of the Cambrian Era, is reported to survive in the Suo-Nada Sea. This species was abundantly observed on the surface of rocks in tide-pools in the intertidal zone, and also on the shells of species that attach themselves to rocks and other surfaces, such as *Pinctada fucata*, etc. In 1995, this species was rediscovered after a hiatus of 55 years on Hashirajima Island near Iwakuni City, Yamaguchi Prefecture (Kato, 1996). This is a surviving example of what must have been the original (pre-human occupation) environment of the Seto Inland Sea. According to Dr. M. Kato (1996, 1999), this species is a "phantom" species (Fig. 9), and he points out that "two related species were recorded during the Meiji Era [1868–1912] in Tokyo Bay and the Seto Inland Sea, but both of these have now become very rarely encountered species." At present, New Zealand is the only other location where species allied to *Discinisca sparselineata* can be observed at intertidal rocky sites.



Fig. 9 *Discinisca sparselineata* abounds in Tanoura.

#### F. Molluscs

One of the authors, H. Fukuda, visited the proposed site three times during August–October 1999, with seven other scholars, and the result showed striking malacozoological diversity of Tanoura (Fukuda *et al.*, 2000). They found and identified 183 species, 144 genera (and six subgenera) and 81 families from Tanoura. Their list contained many new, rare, or endangered species, of which the following were particularly important: (1) *Tomura* cf. *yashima*, a corni-



rostrid gastropod, living in anaerobic tide-pools. The discovery of the family Cornirostridae by Dr. W. Ponder became one of the most exciting topics in today's evolutionary zoology, since it was regarded as a missing link for the evolution of molluscan taxa (Fig. 10). Although malacologists around the world began hunting for this family, it has been quite difficult to find species of this family. This species is distinguishable from *T. yashima* and *T. himeshima* in having distinct spiral cords on the shell surface, but further study is needed for definitive identification. The species at the proposed site of the nuclear power plant may be endemic to that area. (2) *Ceratia nagashima* H. Fukuda, 2000 (family Irvadiidae) was collected beneath stones partly buried in sand in an anaerobic tide-pool (Fig. 11). The present site is the only known locality of this species in the world at present (Fukuda, 2000). (3) Four species of Pyramidellidae were collected alive. Living specimens of *Linopyrga* sp., *Kleinella sulcata* A. Adams, 1862 (Fig. 12) and *Pyrgulina pupula* (A. Adams, 1861) were collected for the first time. (4) Eleven undescribed species of a number of gastropod families (e.g. Cingulopsidae, Eatoniellidae, Rissoellidae, Omalogyridae) were contained in samples of micromolluscs collected with brown and/or calcareous algae. (5) The following eight species, cited as "vulnerable" or "rare" in WWF Japan's red data book for organisms of tidal flats in Japan (Wada *et al.*, 1996), were found to live in this locality. They are *Rissoina* (*Rissolina*) *costulata*, *Chevallieria* sp., *Circulus duplicatus*, *Pseudoliotia pulchella* (Fig. 13), *Columbellopsis yabei*, *Laemodonta exaratooides*, *Laemodonta* sp., and *Porterius dalli*. It is striking that the above eight species were found in the Seto Inland Sea. One of them *Laemodonta* sp. is abundant in the Ryukyu Islands. In the mainland of Japan, however, it is rarely found, and then only in the areas affected by the warm current. *Chevallieria* sp. is usually found only in areas facing the open ocean. These two species were recorded from Tanoura, for the first time in the Seto Inland Sea. The discovery of these species has not been predictable according to the past biogeography of molluscs in the Seto Inland Sea. Further, these species have been registered as threatened outside the Seto Inland Sea. These results demonstrate the two-fold significance of Tanoura's fauna in uniqueness and remaining diversity.

In conclusion, the molluscan fauna of Tanoura shows great diversity. The natural environment there is in exceptionally good condition. Therefore, the present locality is thought to represent the original form of the Seto Inland Sea, which has mostly been lost elsewhere.

Readers may doubt if the intensity of our research may have influenced the frequency of discoveries of rare species. In order to answer this question, we can use the cumulative list of marine molluscs of the Seto Inland Sea compiled by Inaba (1982). His list has been used as a good reference with which we can

characterize the fauna of a certain location. For the purpose of comparison, Fukuda *et al.* (2000) chose six locations near Nagashima Island. They carried out faunal comparisons between Tanoura and five other nearby areas. As a result, they recorded a total of 623 species, 399 genera (and 43 subgenera), 143 families of marine molluscs from the six areas including Tanoura. In Tanoura, the proportion of species which are not listed by Inaba (1982) was far higher than in other areas. The proportion of species only found in Tanoura was the highest (34.6%). This indicates that the specific composition of molluscan fauna in Tanoura is the most divergent among all the six areas compared. It must further be noted that the area surveyed in Tanoura is far smaller than the range of the other five areas compared, and that our survey of Tanoura was done for only about eight hours in four days of a single year, 1999. Therefore, we can conclude that the malacofauna of Tanoura is definitely more diverse and unique than that of the other areas of the Seto Inland Sea. Thus, we are now convinced of



Fig. 10 *Tomura* cf. *yashima*, a cornirostrid from Tanoura.



Fig. 11 *Ceratia nagashima* H. Fukuda, 2000 (Irvadiidae).





Fig. 12 *Kleinella sulcata* rediscovered after more than a century.



Fig. 13 *Pseudoliotia pulchella*, an endangered species.

the importance of Tanoura as the location of an exceptionally well-conserved sanctuary for rare and unique marine organisms (Fukuda, 2001).

Encouraged by such findings, we started multi-disciplinary surveys of the location at regular intervals in 1999. The surveys were made possible with the collaboration of scholars, amateur citizens who love Nagashima Island and the Suo-nada Sea, and various groups of scholars that provide moral and financial help. Every survey has resulted in discoveries of new maritime species either for Japan, the Seto Inland Sea, or Yamaguchi Prefecture (Ankei ed., 2001).

### 3. Environmental Impact Assessment of the Kaminoseki Nuclear Power Plant and its Criticisms

As of October 2002, Japan had 53 nuclear power plants for commercial use (Genshiryoku Bunka Henshubu, 2002). CEPC has the Shimane Nuclear Power Plant comprising two reactors. When the

general public learned of the existence of the project of the Kaminoseki Nuclear Power Plant in 1982, the mayor Mr. H. Katayama and the majority of the local parliament members readily accepted the project as the best way for the development of their local community. Because of the controversy concerning the project, however, the Ministry of International Trade and Industry (today's Ministry of Economy and Industry) did not approve the project until 2000 (Asahi News Paper, Yamaguchi Branch, 2001).

In July 1999, the Environmental Impact Assessment Law came into effect, the first Japanese law to necessitate environmental impact assessment for sustainable development. It introduced the processes of (1) scoping, or determination of assessment methods best suited for the specific site, (2) early and plural chances for listening to opinions of inhabitants and specialists from all over Japan, and (3) follow-up monitoring of the environment during and after the work. Before this law, environmental impact assessment processes were only supposed to observe the minimum criteria common to any kind of works determined by the Cabinet in 1972 (Environmental Impact Assessment Forum, 1999). In April 1999, just two months before the validation of the Environmental Impact Assessment Law, CEPC presented the Preparatory Report of Environmental Impact Assessment for the Kaminoseki Nuclear Power Plant (CEPC, 1999). Since environmental research by CEPC was over by 1997, it apparently tried to escape application of the new law. Accordingly it omitted the process of scoping, and was almost a carbon copy of the Report of the Environmental Impact Assessment of CEPC's Shimane Nuclear Power Plant Reactor no. 3 now under preparation for construction. The Committee for Technological Evaluation of Environmental Impact Assessment, which had been organized by the Governor of Yamaguchi Prefecture, decided that the documents presented by CEPC should be treated in accordance with the new law. Thus, the Kaminoseki Project became the first case in Japan for which this new law will be applied to a nuclear power plant.

CEPC's Preparatory Report failed to note many important aspects of the unique biodiversity of the proposed site: (1) Iwaishima, the nearest island to the site, was omitted from most of the maps, (2) the existence of finless porpoises was totally neglected, (3) falcons, mating on nearby Hanagurijima Islet were simply "seen soaring over the site", (4) most rare or endangered marine molluscs and other non-vertebrates were lacking, and (5) *Juniperus chinensis* L. and other endangered species were not recorded (ESJ, 2001).

Apart from such ecological shortfalls, the report did not assess the influence of radioactive substances emitted from the reactors. This was due to Japan's governmental policies to put all phenomena concerning nuclear power and radioactivity under the control of the Ministry of International Trade and Industry



(today's Ministry of Economy and Industry). The Environmental Impact Assessment Law is not supposed to deal with the impact of radioactivity. This is apparently due to the government's policy of promoting nuclear power. Thus, it became clear that possible radioactive damage on finless porpoises, falcons, or small-sized invertebrates would not be the concern of any of Japan's ministries for the reason that they are seemingly not concerned with human health. This example compels us to insist that an independent organization, rather than a ministry that promotes the use of nuclear power plants, supervise radioactivity risk management.

After about six months of examination, the Committee for Technological Evaluation of Environmental Impact Assessment of Yamaguchi Prefecture came to sign a report on the Preparatory Report of the Environmental Impact Assessment by CEPC, which was then approved as the Governor's official opinion of Yamaguchi Prefecture. His opinion was sent to the Ministry of International Trade and Industry. It contained, among other things, two very important points: it was admitted that the proposed site had rich biodiversity, and that supplementary environmental research should be carried out in a more scientific way. Seeing that any environmental impact assessment should be scientific, the Governor's opinion showed an exceptionally low level of description and analysis of the document. Furthermore, the Governor's opinion included a subsidiary letter urging secure control over radioactive emissions.

The Minister of International Trade and Industry ordered that CEPC should carry out a one-year additional study on the important species that were lacking in the Preparatory Report. It also gave instructions to CEPC to present an interim report.

In November 2000, the Interim Report of CEPC (2000) was presented to the Ministry of International Trade and Industry, and copies of it were presented to the members of the Committee for Technological Evaluation of Environmental Impact Assessment. One of the members, Dr. T. Ankei pointed out that the Interim Report was far from being a scientific environmental impact assessment because for all the species in question, it put some mitigation before assessing the possible damage to the environment. But the members were told that their work had ended when they submitted their opinions to the Governor.

In spite of the criticisms from ESJ, Chugoku-Shikoku Branch (2000), the Ministry of International Trade and Industry hastily accepted the Interim Report as a sufficient condition for the environmental impact assessment to be granted. It had reasons to try to bring the project to a conclusion before its reorganization into the new Ministry of Economy and Industry that would take place on the New Year's Day of 2001.

The Report on the Environmental Impact Assessment for the Kaminoseki Nuclear Power Plant, the final one, was released in June 2001 (CEPC, 2001),

and was approved by the Ministry of International Trade and Industry. It proposed that the islet where *Juniperus chinensis* L. grew would be left as it is, with its surroundings covered with cement. The small tide-pool where *Tomura* cf. *yashima*, a cornirostrid, was found would not be landfilled but would be surrounded by a rocky fence through which tidal waves could penetrate. It is doubtful if these remedies can really save the plants and molluscs growing in small habitats separated from the drastically changing environment of the power plant. In the final report of the environmental impact assessment of the CEPC, only one species was regarded as being difficult to determine whether the conservation remedies to be undertaken would be efficient or not. In accordance with the Law of Environmental Impact Assessment it decided to carry out continuous research on the specific molluscs. In spite of all these programs, the habitat was deprived of sand during a typhoon that hit western Japan in September 1999, and hence there will be no possibility for the Cornirostridae and other rare molluscs to survive in the tide-pools in question because they lack an oxygen deficient, anaerobic habitat. Ironically, another samples of *Tomura* cf. *yashima* were discovered in another habitat where the company had decided to landfill. The report failed to provide cumulative listing of the species found, the basis for any scientific environmental impact assessment. These are examples which illustrate the inappropriate and non-scientific characteristics of the report.

In the meantime, with the discovery of the biodiversity of Nagashima Island, academic societies examined the problem, and issued resolutions against the destruction of this precious biodiversity.

A General Assembly of ESJ held on 25 March 2000, agreed to a resolution demanding conservation of the proposed site (ESJ, 2000), and again on 29 March 2001, it agreed to a resolution demanding a re-assessment of the project (ESJ, 2001). These were the first cases in which ESJ, the biggest academic group concerned with the study and conservation of nature, having about 4,000 members, decided to express its opinion on nuclear power plants. Its Chugoku-Shikoku Branch took responsibility for watching to see if the resolutions of the General Assembly of ESJ were effective for revising CEPC's report and the attitudes of local and national governments (ESJ Chugoku-Shikoku Branch, 2001; Hada, 2001).

In 2000 the Japan Society for Benthic Studies and the Malacozoological Society of Yamaguchi, issued resolutions expressing their opinions for re-assessment. A local NGO, the Association for the Conservation of Nagashima Island, together with WWF Japan, and the Greenpeace Japan protested against the possible destruction of the well-conserved biodiverse habitat of Nagashima.

The Chugoku and Shikoku Branch of ESJ pub-



lished a special issue dealing with the results of research carried out in and around Nagashima Island (Ankei ed., 2001).

#### 4. Towards a Wise Use of the Suo-nada Bioregion

The project itself, although accepted as a national project on 16 May 2001 by the Agency for Resources and Energy belonging to the Ministry of Economy and Industry, is as yet at deadlocks regarding acquisition of land of the shrine on the one hand, and of approval of fishing rights of Iwaishima fishers, on the other. Concerning these problems, at least five suits have been brought to court, and lawsuits are in progress between CEPC and local peoples.

According to an opinion poll census in December 2000, 33% of the inhabitants of Kaminoseki Town were for the project, and 47% were against it. As for the inhabitants of two cities and five towns nearby, only 21% were for the project, and 58% against it (Asahi News Paper, Yamaguchi Branch, 2001). Since the amalgamation of Kaminoseki Town with other municipalities is in progress, it will become more difficult to persuade the local community.

Today, numerous game fishing amateurs visit the sea around Nagashima Island to enjoy fishing for red sea bream, and they provide fishers an opportunity for cash income through guiding and driving their boats. Many of them will surely be interested in learning the secrets of this exceptionally productive sea that still has abundant lancelets (*Branchiostoma belcheri*) fed on by sand eels, which are then consumed by sea breams. Endeavors to revive traditional fishing methods may result in such tourist attractions like *Sunameri Ajiro* (angling for sea bream while finless porpoises are hunting for them) and *Toritsuki Ajiro* (also called *Ikari Ryo* or *Abi Ryo*, angling for sea bream feeding on sand eels while water birds of the genus *Gavia* are hunting for them) somewhat like fishing with cormorants, but much less invasive and needing more ecological wisdom and experience (Kato, 2001; Fujii, 2002). The sea between Nagashima and Iwaishima Island may become the center for co-existence of such natural and cultural heritages in the Suo-nada Sea.

In some areas of the Seto Inland Sea where *Sunameri Ajiro* and *Toritsuki Ajiro* were flourishing, there are shrines which were built and worshipped by fishers to thank these animals and birds as deities (Kato, 2001:3). By witnessing the revival of such fishing methods, visitors may realize the importance of Japanese symbiotic practices and animistic beliefs as an alternative clue to the wise use of this exceptionally well-conserved sea.

The laurel-leaved forest surrounding the abandoned paddy fields was formerly used as a *Satoyama*, or hillside near human dwellings in which rich biodiversity was maintained by human activities (Fig. 14).

There also remains a 10-hectare-wide forest belonging to the shrine. Our surveys revealed the biological importance of such forests as relics of well-conserved *Satoyama* and sacred forests of shrines and temples in Japan.

Every time we visit Tanoura of Nagashima Island, we feel as if we can hear the voices of various forms of lives. For native Japanese people, all lives have been rendered sacred and humans are regarded as only humble members of this convivial cosmos. The location will become a holy place in which visitors can learn and practice animistic views of nature or so-called "deep ecology."

The Association for the Conservation of Nagashima Island is planning to get a Resource Center for the Biodiversity of the Suo-nada Sea started. It will serve as a community-based laboratory for research on biodiversity, and a center for environmental education on Nagashima Island and Seto Inland Sea. The Malacozoological Society of Yamaguchi and ESJ, Chugoku-Shikoku Branch are willing to provide the academic support necessary to



Fig. 14 Remaining rockworks for paddy fields.



Fig. 15 *Hitobito no Tsudoi no Ie* (left) and its solar battery panels (right).



the activities of this Biodiversity Center. We believe that it could be later developed into an open-field eco-museum, which will attract tourists and scholars from all over the world. Guided by local fishers and farmers, visitors will enjoy encounters with the biological and cultural diversity of the Suo-nada Sea (Fig. 15).

On Yakushima Island, a World Heritage Site to the south of Kagoshima Prefecture, famous for gigantic cedar trees and biodiversity, we have already begun to organize researchers to become curators for a virtual eco-museum existing on their website. Since 1998, financially supported by the local municipal town, we have made use of Yakushima Island's biological and cultural diversity as a textbook for environmental education to local high school and university students from all over Japan (Ankei Y., 2001).

In October 2002, inhabitants of Iwaishima Island were busily working to carry log timbers to construct a house on a hillside viewing Tanoura Beach, Nagashima Island. The house, named *Hitobito no Tsudoi no Ie* (House for Interchange of Peoples), will be equipped with a solar battery system, and is intended to become a symbol of an alternative way of life. It will predict the arrival of an era when humans will stop using any non-renewable energy resources like nuclear power. It will also become a symbol of mutual understanding and reconciliation among groups of local peoples, who have been made to oppose each other because of the money provided during the nuclear power plant project.

We strongly hope that the people of Kaminoseki Town will join again to find a more sustainable way of life based on wise use of their sea and land rather than relying on a big project offered from outside their region. We must heal both the relationship between humans and their environment and the relationship between humans and their community. Such a trial for the restoration and revival of the bioregion should be called *moyai-naoshi*, or "reestablishing emotional ties" as people of Minamata City have named it a key concept for the restoration of their quality of life from the ravages of Minamata disease. This could also be one of the objectives of development for the local people of Kaminoseki and surrounding cities and towns.

The Seto Inland Sea, the first national park in Japan, is almost dying today (Ponder *et al.*, 2001). There have been many community-based movements for its local conservation, and they have recently formed a coalition called the Pan Setouchi Congress. We have reasons to believe that the original biodiversity of the Seto Inland Sea can be revived through such endeavors only if there are some core areas retaining untouched biodiversity and original gene banks that are still immune. The Suo-nada Sea, having Nagashima Island to the east, and rich muddy shores and rivers to the west, will surely be the most important location for the ecological revival of the

Seto Inland Sea. If we manage to re-introduce traditional fishing methods as described above, we may plan to nominate the Seto Inland Sea as a World Heritage Site, and invite many eco-tourists who will learn about the revival process as a precious example for the revival of sustainable co-existence between humans and the environment in their respective bioregions (Ankei, Y. 2001).

## Notes

We should note some recent political and legislative changes.

The chief priest of the shrine of *Shidai-Hachimangu*, Mr. H. Hayashi was suddenly dismissed (Mar. 2003). CEPC expects that the new priest will agree with the sale of the 10-hectare land of the shrine in the proposed site.

The district court in Iwakuni City ordered CEPC not to cut down trees or move soil of the territory just beneath the proposed reactor, admitting the rights of local people to use it for communal purposes (Mar. 2003).

Ms. M. Kano, successor of Mr. H. Katayama, obtained 57.8% of the votes, and was elected as the new mayor of Kaminoseki Town. Her secretary in charge for the electoral campaign was arrested under suspicion of offering a bribe. She may be dismissed if her secretary will be proven guilty (Apr. 2003).

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灘の海の活用法への提言」(英文)



