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Species of Concern Proactive Conservation Program August 2006 Workshop Proceedings



Humphead Wrasse (*Cheilinus undulatus*)
Photograph © by J.E. Maragos/USFWS



Hawaiian reef coral (*Montipora dilatata*)
Photograph © by J.E. Maragos/USFWS



Bumphead parrotfish (*Bolbometopon muricatum*)
Photograph © by John E. Randall/Bishop Museum



Inarticulated brachiopod (*Lingula reevii*)
Photograph © by Cory Pittman

Executive Summary

On August 21 and 22, 2006, the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) Protected Resources Division held its first Species of Concern workshop in Honolulu, Hawaii, for species in the Pacific Islands region. As defined by NMFS, a “Species of Concern” is a species or vertebrate population for which there is concern or great uncertainty about its status. Species of Concern (SOC) are not listed under the Endangered Species Act (ESA) and are not protected by the ESA. The goals of the SOC Program are: to increase public awareness about these species; to identify those species potentially at risk and in need of protective measures before listing under the ESA becomes necessary; to identify data deficiencies and uncertainties associated with the status of the species; to work cooperatively with regional co-managers and interest groups to obtain the information necessary to evaluate species status and threats; and to identify conservation opportunities. Currently, there are 42 species deemed by NMFS to be SOCs. Four of these 42 species occur in the Pacific Islands region: the Hawaiian reef coral (*Montipora dilatata*), the inarticulated brachiopod (*Lingula reevii*), the humphead wrasse (*Cheilinus undulatus*), and the bumphead parrotfish (*Bolbometopon muricatum*).

The purpose of the workshop was to have researchers and resource managers share their knowledge and research in order to compile updated information on the species, their habitat, threats, research, and conservation ideas. After the open discussion on the species, threats were prioritized, recovery actions/conservation efforts addressing each threat were identified, and data and research needs for each species were listed. These efforts contributed to the development of a draft conservation action plan for each species. This conservation action plan will be a living document that will aid NMFS PIRO to identify, prioritize, and fund conservation and research projects in the U.S. for Pacific Islands Region Species of Concern over the coming years.

The Hawaiian reef coral (*Montipora dilatata*) is a rare coral that has been reported only in Kaneohe Bay, Oahu, from the main Hawaiian Islands, and in the Northwestern Hawaiian Islands (NWHI) at Midway Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, Maro Reef, and French Frigate Shoals. In addition to being a rare species, threats include vulnerability to coral bleaching due to high temperature (as observed in 2002 at Midway, Kure, and Pearl and Hermes); fresh water kills and exposure at extreme low tide; habitat degradation and modification as a result of sedimentation, pollution, alien algae species (*Gracilaria salicornia*, *Kappaphycus/Eucheuma* spp.) and invasive green alga (*Dictyosphaeria cavernosa*) (Kaneohe Bay); a limited distribution; and damage by anchors, fish pots, swimmers, and divers. Potential actions include extensive surveys to determine the presence/absence at these locations, as well as genetic sampling to determine if the species is in fact an individual species and not a hybrid. Further actions may include: developing underwater species identification cards to help researchers identify this species in the field; working towards developing a local action strategy to address invasive species and water quality issues; and partnering with facilities that are capable of genetic research and possible species propagation. In addition, upon further understanding of the threats to and vulnerability of this species, as

well as learning whether the existing environmental conditions are conducive to the survival of this species, in the future it may be possible to reintroduce propagated fragments of *M. dilatata* into Kaneohe Bay.

The inarticulated brachiopod (*Lingula reevii*) is endemic to Kaneohe Bay, Oahu, Hawaii. Threats to the species include habitat degradation and alteration; overexploitation; pollution and sedimentation; a vulnerable life history; and a limited distribution. In addition to extensive surveys in Kaneohe Bay to determine the presence/absence of this species, survey work can help determine habitat preferences and quality. Further actions may include: developing underwater species identification cards to help researchers identify this species in the field; developing a local action strategy to address invasive species and water quality issues; and partnering with facilities that are capable of captive husbandry with an ultimate goal of reproduction. In addition, upon further understanding of the threats to and vulnerability of this species, as well as learning whether the existing environmental conditions are conducive to the survival of this species, in the future it may be possible to reintroduce captive reproduced individuals into Kaneohe Bay.

The humphead wrasse (*Cheilinus undulatus*) is found in the U.S. territories of Guam, American Samoa, Commonwealth of the Northern Mariana Islands, Howland Island, Baker Island, Jarvis Island, Wake Island, and Palmyra Atoll. It has high juvenile mortality, late maturation, and low population doubling time. Threats to this species in U.S. waters include nighttime spear fishing and spear fishing tourism, habitat loss and degradation, and local consumption. Potential actions include: supporting genetic research to gather DNA samples to study individual populations; surveying areas in U.S. territories where the species is thought or known to occur and determining the extent of the species' home range; supporting acoustic research to verify whether the species has an acoustic signature profile and if that profile can provide presence/absence/trends/data; working with local resource agencies and managers to enforce species closure and restrictions; protecting sleeping areas; working with local dive and ecotourism companies to promote conservation of the species; and developing underwater species identification cards to help researchers and divers identify this species in the field.

The bumphead parrotfish (*Bolbometopon muricatum*) is found in the U.S. territories of Guam, American Samoa, Commonwealth of the Northern Mariana Islands, and Wake Island. The species is slow growing and long-lived, with delayed reproduction and low replenishment rates. Threats to this species include nighttime spear fishing and spear fishing tourism, habitat loss and degradation, and local consumption. Potential actions include: surveying areas in U.S. territories where the species is thought or known to occur and determining the extent of the species' home range; supporting acoustic research to verify whether the species has an acoustic signature profile and if that profile can provide presence/absence/trends/data; working with local resource agencies and managers to enforce species closure and restrictions; protecting sleeping areas; working with local dive and ecotourism companies to promote conservation of the species; developing underwater species identification cards to help researchers and divers identify this species in the field; and conducting a literature review of the scientific information currently available on the species.

In conclusion, the great efforts of researchers and resource managers present at the workshop and through communication with international individuals after the workshop, NMFS PIRO has developed a draft conservation action plan for each species. This document will be a living document for NMFS PIRO to identify, prioritize, and fund conservation and research projects in the U.S. for Pacific Islands Region Species of Concern over the coming years, as well as develop and foster regional relationships.

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Meeting Dates and Location:

Monday August 21, 2006 – Discussions on the Hawaiian reef coral (*Montipora dilatata*) and the inarticulate brachiopod (*Lingula reevii*) were held at the Hawaiian Islands Humpback Whale National Marine Sanctuary office in Hawaii Kai, Oahu.

Tuesday August 22, 2006 – Discussions of the humphead wrasse (*Cheilinus undulatus*) and the bumphead parrotfish (*Bolbometopon muricatum*) were held at the Hawaiian Islands Humpback Whale National Marine Sanctuary office in Hawaii Kai, Oahu.

Workshop Participants:

Monday:

Lu Eldredge – Bishop Museum
Kevin Rhodes – UH Hilo/IUCN Groupers & Wrasse Specialist Group
Dwayne Meadows – Hawaii Division of Aquatic Resources/Bishop Museum
Rusty Brainard – NMFS PIFSC Coral Reef Ecosystem Division
Andrew Rossiter – Waikiki Aquarium
Charles Delbeek – Waikiki Aquarium
Fenny Cox – NMFS PIRO Habitat Conservation Division
Jason Philibotte – NMFS PIRO Habitat Conservation Division
Marta Nammack – NMFS HQ
Krista Graham – NMFS PIRO Protected Resources Division
Arlene Pangelinan – NMFS PIRO Protected Resources Division
Chris Yates – NMFS PIRO Protected Resources Division
Michelle Yuen – NMFS PIRO Protected Resources Division
Jayne LeFors – NMFS PIRO Protected Resources Division
Jen Metz – NMFS PIRO Protected Resources Division

Tuesday:

Kevin Rhodes – UH Hilo/IUCN Groupers & Wrasse Specialist Group
Dwayne Meadows – Hawaii Division of Aquatic Resources/Bishop Museum
Rusty Brainard – NMFS PIFSC Coral Reef Ecosystem Division
Jason Philibotte – NMFS PIRO Habitat Conservation Division
Bob Schroeder – NMFS PIFSC Coral Reef Ecosystem Division
Craig Musburger – NMFS PIFSC Coral Reef Ecosystem Division
Ben Richards – NMFS PIFSC Coral Reef Ecosystem Division
Gerry Davis – NMFS PIRO Habitat Conservation Division
John Naughton – NMFS PIRO Habitat Conservation Division
Tom Graham – NMFS PIRO International Fisheries Division
Paul Dalzell – Western Pacific Fishery Management Council
Marc Lammers – Hawaii Institute of Marine Biology

Marta Nammack – NMFS HQ Office of Protected Resources
Krista Graham – NMFS PIRO Protected Resources Division
Arlene Pangelinan – NMFS PIRO Protected Resources Division
Chris Yates – NMFS PIRO Protected Resources Division
Michelle Yuen – NMFS PIRO Protected Resources Division
Jayne LeFors – NMFS PIRO Protected Resources Division
David Schofield – NMFS PIRO Protected Resources Division
Naomi Yamamoto – NMFS PIRO Protected Resources Division

Introductions/welcome:

(Chris Yates, NMFS Pacific Islands Regional Office, Protected Resources Division, Assistant Regional Administrator)

- Protected Resources Division “inherited” the four species of concern species for the Pacific Islands Region in 2004
- First steps beyond gathering information on the species by bringing together knowledgeable individuals is to develop a draft conservation action plan for each of the four species; identify, prioritize and fund conservation and research projects; develop and foster regional partnerships

National Species of Concern Proactive Conservation Program Overview:

(Presentation given by Marta Nammack, NMFS Head Quarters, Office of Protected Resources, National ESA Listing Coordinator)

- First SOC list was developed in 1981
- Program began in April 2004; currently 39 nationally identified Species of Concern
- Purpose of program: identify species currently at risk and prevent them from listing under the ESA; identify deficiencies and uncertainties; promote awareness and further research, etc.
- Species are identified qualitatively based on demographics, threats, concerns and uncertainties
- National SOC Grant Program: annual grant program to fund projects with on-the-ground conservation. Two projects in 2006 were awarded funding:
 1. Mississippi Department of Marine Resources – Salt marsh topminnow project includes GIS mapping, habitat restoration, and conservation action planning and implementation in partnership with The Nature Conservancy
 2. Maine Department of Marine Resources – A multi-state collaborative to develop and implement a conservation program for three anadromous finfish species of concern in the Gulf of Main. Project includes GIS mapping, threats assessment, management planning and implementation, with a revision of laws and policies

- Review of FY 07 President's Budget

Review of Pacific Islands Region Species of Concern Funded Projects for 2006/2007:

(Presentation given by Krista Graham, NMFS Pacific Islands Regional Office, Protected Resources Division, Resource Management Coordinator)

WAIKIKI AQUARIUM

Contract totaling \$9,550.00 was awarded to the Waikiki Aquarium to continue ongoing propagation of *Montipora dilatata* and begin husbandry efforts for *Lingula reevii* in order for these species to be publicly displayed in the future to educate audiences on conservation issues and measures.

Goals and Objectives:

1. Expand the current rare corals holding tank that was originally constructed in 2000 in order to accommodate additional propagation of *Montipora dilatata* and other rare corals.
2. Construct a holding tank for *Lingula reevii* complete with live specimens, and evaluate husbandry conditions to successfully maintain this species in captivity for an extended period of time, with a view to ensuring successful reproduction.
3. Conduct research to measure growth and record husbandry information of both *Montipora dilatata* and *Lingula reevii*, publishing data where applicable.

Anticipated success of these efforts may eventually facilitate the reintroduction of both species into their natural habitats.

NOAA PACIFIC ISLANDS FISHERIES SCIENCE CENTER

Contract totaling \$9,000.00 was awarded to the Pacific Islands Fisheries Science Center for the purchase of various components of Ecological Acoustic Recorder (EAR) units such as electronic sub assemblies, underwater housings, hydrophones, etc. The question remains to whether or not the target species even produces an identifiable and usable acoustic signature, and finding the target species and collecting the appropriate data is another challenge. However, this effort is a small step towards better understanding of the acoustic profiles for both the humphead wrasse and bumphead parrotfish.

Next steps: Begin strides toward a regional buy-in for conservation and research of the humphead wrasse and bumphead parrotfish in American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, and areas including Wake Atoll, Johnston Atoll, Palmyra Atoll, etc. This will include travel to regions and summarizing the results of the PIRO SOC workshop dialogue/discussion and developing partnerships and working with local researchers, resource managers, and local people to implement the conservation action plan which will continue to be a work in progress.

Review of Species (Captured Dialogue by a designated note taker using a laptop):

A. Hawaiian reef coral (*Montipora dilatata*)

- a. First concern: What is the species? Is it a true valid species or apart of another?
Need better methods for describing what the species is.
- b. Where is the species located? NWHI (several locations: Maro, PHR, FFS, Lisianski, original sample from Laysan); Kaneohe Bay
- c. J. Maragos, J. Kenyon – knowledgeable, recommend genetics work for species ID, taxonomy
- d. Need to find out what Waikiki Aquarium (WAq) is growing (right species?) from Kaneohe Bay (KBay), not sure what colony, not recorded
- e. Genetics on HI corals? Porites in HI (Ph.D. work), molecular markers being developed, R. Toonen at HIMB, difficulty with zooxanthellae (lagged behind fish work)
- f. Cloning is in corals, but populations on entire reef ecosystem are sexually reproduced – issue about growing in aq.
- g. Hybridization very high, naturally occurring, closely related species
- h. Material available from WAq. (benefit of propagation)
- i. Q trying to answer: Is this a valid species/what is the species? Is the WAq species the same as SOC? Where are they naturally occurring in wild? Are the genetic makeups the same?
- j. Need to compare the WAq species to other areas.
- k. Possible that this is hybrid? Reproduction studies were conducted at HIMB; experiments with samples; hybrids were fertilized but not able to be reared; only first stages – question not answered.
- l. Able to return to original sites? Extensive surveys currently conducted; possible to get more pictures and confirmed descriptions from NWHI, better map distribution
- m. KBay? No big survey; mass bleaching in 1996 – species disappeared; first susceptible species, no further surveys or research, C. Hunter had some surveys/classes (unknown)
- n. How extensive was previously in KBay? At several places, more than one reef, no formal data, some colonies still there because WAq species from 2000 – important first step is to systematically map presence in KBay.
- o. Volunteers may not be able to id and cause some problems.
- p. Recent invasive algae: patchy dist, previous coral areas do not have the algae, not as big issue as the rarity of species; DAR removing the algae/developing the methods and may be able to id but still ongoing (Tony Montgomery, HIMB)
- q. Contact for HIMB study? Cindy & Dave, need lots of bodies to map and collect genetic samples and then have experts confirm later
- r. Not big area: patch reefs, not on fringing reefs, dense areas around HIMB island
- s. Q: ID in NWHI procedures? Permit process challenging for NWHI esp. corals and esp. this year; next survey = next 2 years, monument FWS and HI State
- t. How distinctive to see in field? Dark chocolate brown color, smoother

- u. WAq permit for collection in KBay
- v. Monument cruises? Next summer
- w. What are the general threats/were they always rare? Always rare, never common in early description; could be abundant in other areas but not specifically looking, could have done better job
- x. How can we help with id? Modify protocols to specifically look for the coral (ex., Invasive algae and other coral species were looked for samples can be collected next time in MHI
- y. Who? R. Toonen (HIMB), Zack (?)
- z. Difficult to have coral taxonomists agree.
- aa. WAq not similar to other Monitpora; possible to compare with other specimens; others collected from Midway (successful)
- bb. Biggest threat = coral bleaching – why susceptible? HIMB group (Ruth Gates) currently investigating; Jokiel and Brown article
- cc. If not new species, is it still SOC? If not species, then no status under ESA; vertebrate species has unknown status and listed as pop until more information; coral hybrids not listed in past; no final decision; better guidance need to be developed
- dd. How determine what we have - morphometric? Genetic markers still being developed; problem is growing in captivity and different conditions from wild; type specimen (original specimen for describing species) never looked at (from British Museum or Germany; Studor 1901; European expedition); ultimate way to describe species; if not similar, then may be new species not necessarily hybrid
- ee. Other labs = Bob Richmond, Mike Hadfield (PBRC Kewalo), use for experiments and comparisons
- ff. Water quality issues/human impacts – still concern? DOH work in Kbay? Local action strategies on other watersheds? May want to coordinate with DOH EPA mandated water quality standards; Coral program (national level) Kauai, Maui, and Molokai (Kathy Chastine?); link to support different aspects
- gg. Invasive species: what extent is the extent? Also orange sponges (Mycale)
- hh. Species: watching the reproductive timing; no breeding beyond larval stage; hybrid; four collected from 2 different colonies for WAq; propagated together; original locations should be documented by D. Gulko; sample from something very different (platey) than picture (long branches/flat tops) from NWHI; may need survey and genetics; still key question for effort and funding

Prioritize Actions for Hawaiian reef coral:

- a. Funding ark was initial priority - Keep going with present propagation (WAq)
- b. Survey & establish distribution (employ students); effective because lots of eyes, time in field, and not expensive; extend to NWHI to confirm old sightings
- c. Genetics and collecting samples – person to id/push to identify molecular markers with species that we have now; meet with coral genetics (R. Toonen, Zack); not guaranteed to give immediate answers; identified individuals could be brought in for spawning – possible same as WAq species but timing different; could compare with the spawning of similar species; look at type specimen – complex; DNA may be true answer; encourage NWHI cruises to collect samples

- d. Concurrent surveys with markers; ask Jim Maragos or assistant to take photos and GIS and look for markers in the meantime, and then compare when finished, all 10 Montipora species
- e. Follow up with Bob Richmond
- f. Build up capability with HIMB for propagation studies; hot spot for invasive issues; need to work there for Kbay species (support, people, ark setting); more options to get coral growing; move mature colonies in bay to more optimal habitat in bay (transplanting)

Next Steps: put literature together to distribute to group

- a. Communicate with group on regular basis to continue discussion
- b. Summarize accomplishments

B. Inarticulated brachiopod (Lingula reevii)

- a. Background information
 - i. 2 shells (dorsal and ventral oriented)
 - ii. Anatomy: lophophore
 - iii. Own Phylum, closely linked with 3 other phylums
 - iv. Very abundant and became extinct, only about 300 species
 - v. 2 categories: inarticulate (no valve, shells held together by muscles); articulate
 - vi. Lingula: 15 species
 - vii. L. reevii: endemic to Kbay, found no other place
 - viii. One other sample found in Indonesia (1 specimen), doubtful
 - ix. Short lifecycle b/c not widely distributed
 - x. No larval stage; hatch out as juveniles; circulation in KBay don't get them out of bay
 - xi. 1969 masters thesis; 1964 thesis – need references
 - xii. 1980s: French researcher (?) on Lingula saying that reevii not endemic
 - xiii. Japanese papers that put Lingula in Japan
- b. Needs: survey of where they are and how many there are? Cindy class surveys; were very easy to see
 - i. Info from 60s include station data and maps- should be redone and repeat areas; no support; could be relatively inexpensive (one person survey in a day or so);
 - ii. Odd that only found in a small part of bay; habitat characteristics; model exists for bay;
 - iii. Need copy of theses for everyone
- c. Type specimen? Challenger Expedition 1880 Davidson; described since 1880 (Honolulu) as ovalis (widely spread); reevii possibly not new or introduced
- d. Life history – makes ballast water not likely source of introduction
- e. Other brachiopods in HI: yes, some but all common
- f. Cindy recently re-surveyed Kbay; 25 sites in bay looking for Lingula; Hank Banner (?) first told of Lingula; collected 300 Lingula and sent to research pharmaceutical

companies for *Lingula* blood; confirmed that not found in other areas in HI; last survey may-june 2004

- g. Carl? 1981 = some surveys
- h. Manuscript written by students – in review by Marine Biol
- i. Max 500 ind/sq m (Worcester); max 100 ind/sq m (1981); max 1.5 ind/sq m (Cindy)
- j. Chuck Birkeland – population could have been a mass settlement back in the 60s
- k. 20 ind collected 3 summers ago; population size really small; don't reattach easily; unknown husbandry; experiment on reproduction; observed spawning in wild at about 4 pm; 15/14 animals left and carefully replanted; showed that they are good at coming up but not at reburrowing; hammerheads seen the next day and only 3 or 4 resighted, valve size less than 2 in;
- l. Plankton tows day and night looking for larvae – found 1
- m. Kahe point also surveyed
- n. Reproduction year round or seasonality? Not sure; imply information from other group (Laurie ? from Australia or Japan); Akasaka Bay/Kyushu Island is very abundant
- o. Correction on isolated sandbar – highest numbers in south bay with a moderate population on Coconut Island; possible nutrient augmentation at Heeia from tour boats and may have contributed to the sandy area population;
- p. 2 Japanese aq contacted – fed live artemia and mash of fish; no evidence; temp exhibit
- q. Information on nutrient loads in waters? Japanese clam gone (big with pollution); always had a freshwater input; original could have been anywhere in Honolulu (from Challenger 1880) which could have been like Kbay and was a sandbar back then
- r. Avg *Lingula* density in bay at 16 sites = 1.84 ind/sq m (170 transects) avg 1.75; *Lingula* rich sites invaded by algae; contributed to decline; observed retraction response and may not be filtering
- s. Why in areas so shallow? Directed by previous paper; from wartime dredge operation; highest density found in 1981; low visibility; could be they're difficult to survey in area
- t. What to do next? WAq folks try at propagation; connection with Japanese Aq; important to keep in same ecosystem
- u. Attach to pebble/bottom of aquariums; depth of attachment dependent on size; Worcester study has information about settlement
- v. Threats: unknown if don't know population pre-pollution; not knowing alien algae; freshwater kills from heavy rain in 1965/1988;
- w. May need to grow in aq to test nutrient levels; assessment difficult
- x. Unknown what is the potential range in bay? Little band of area not easy to get from maps
- y. Habitat disturbance? Recreational boating not in area; sandbar area pretty protected; defining potential habitat difficult; not too close to corals
- z. Propagating benefits? Declining trends in bay, alien algae never eradicated; ARK; ecosystem service not assumed (Worcester) not important member
- aa. Hammerhead pups predation? Possible food source
- bb. NWHI? Cindy looked but none found

- cc. Are there other competitors that could explain decline? Substratum is a loose mixture of sediment & med/coarse rubble; nothing else seen but mystery burrows (shrimp and fish/goby); not attaching in sandbar; susceptible to disturbance – rare storms & recreational activity further away
- dd. May try to get water quality downstream
- ee. Permits not needed to propagate for NMFS/State; no regulations and no status
- ff. Summarize:
 - i. Threats = endemic to kbay; question Indonesia/Japan; alien algae; impact of nutrient loads; potential for freshwater kills; predation (hammerhead research? Pup numbers from 1960s and possible correlation with *Lingula*; Japanese clam next to each other in Worc. But no J clam now; Pearl Harbor – Hammerhead nursery; poor circulation; very different habitat)
 - ii. Research = surveys and potential; habitat preferences; NWHI & Johnston Atoll; survey without disturbance
 - iii. Conservation = Ark (2 of each kind) for captive propagation; for reestablishing pop in bay (giant clam examples) – should be ultimate goal/but some supplementation problems as in fish
 - iv. Outreach = species ID for field work use; burrow ID (material to provide)
 - v. Name still in question – articulated? *Reevii*?
 - vi. Address why in decline in the first place; current numbers may be accurate; introduction may be harmful (previous env = polluted); could be other factors other than nutrient levels; compare with NWHI/Johnston

Prioritize Actions:

- a. Captive propagation possibility w/WAq
- b. Survey work can be/possible done next summer (classes) and easy; possible to add to NWHI cruises for next time; predictive habitat mapping (white paper on morphology, grain size); define habitat preferences

Next Steps: put literature together to distribute to group

- c. Communicate with group on regular basis to continue discussion
- d. Summarize accomplishments

B. Humphead wrasse (*Cheilinus undulates*)

Presentation: Overview of the Humphead Wrasse (Dr. Kevin Rhodes, UH Hilo/IUCN Groupers and Wrasse Specialist Group)

- a. Large species of this Family
- b. 250 cm = max L
- c. Juvenile habitat: sea grass, coral reefs, algal lagoons
- d. Adult habitat: deeper water, outer reefs
- e. Resident fish in particular area
- f. Prey = mollusks, crustaceans, and toxic species (crown of thorns, box fishes, sea hares)

- g. Wide distribution
- h. Diandric protogynous hermaphrodite = can change from female to male via 2 pathways
- i. Seasonal or monthly spawning, depending on the locale
- j. Species aggregates to spawn pelagically
- k. Sexual maturity occurs between 40-60 cm total length
- l. Threats: SE Asia live reef food fish trade typically using destructive fishing practices such as sodium cyanide, etc.; trade operates throughout its range; juveniles are the primary target; one of the most valued species in the industry
- m. Some hatchery success occurring in Bali (Gondol Research Institute for Mariculture); GRIM researchers note that the growth of the species is extremely slow; at around six months of age the juveniles were only 5-6 cm in total length. This feature may limit their attractiveness for aquaculture despite the high price of this species in the live reef food fish trade
- n. Export volumes from various countries – variable; most export is to Hong Kong, Singapore and China
- o. Prices – stable through year; \$120/kg = retail price
- p. Threat: artisanal/subsistence fishing throughout its range; night spearfishing – especially using SCUBA, free-dive or hookah; target size indiscriminate; traditional/cultural values attached to species in a number of countries
- q. Densities typically 10-20 fish/hectare; fishing at moderate-high levels can rapidly remove $\geq 75\%$
- r. Edge of range = largely gone/extirpated; most heavily fished in center of its range
- s. Total global catch estimated at 400 metric tons
- t. Threat: Habitat loss/degradation
- u. Number fished in Philippines greater than in Am. Samoa
- v. Not found in Hawaiian archipelago
- w. Low population doubling time (4.5-14 years); low recruitment; high juvenile mortality; skewed female dominated sex ratios; late maturation (~6 years)
- x. Currently endangered under IUCN (EN2bd+3bd); listed under Appendix II of CITES (Bangkok, October 2004)
- y. Illegal trade and capture for local sale and consumption widespread
- z. Lack of coordinated national or regional management; Australia instituted total protection in 1998; China requires a permit to sell individuals; Indonesia allows fishing only for research, mariculture, and licensed artisanal fishing; Maldives has an export ban; Palau instituted a size limit of ≤ 64 cm TL; Papua New Guinea prohibits export of species ≤ 65 cm TL.
- aa. High economic potential for tourism
- bb. Potential to be effectively protected through: total catch ban (species ban); and MPA development.
- cc. Reproductive life history may make some measures difficult (e.g. size limits, seasonal catch bans)
- dd. Management/enforcement potential may diminish potential for catch limits, etc.
- ee. Q: any impending IUCN wrasse group projects? Following listing, Dr. Yvonne Sadovy will be working with member countries to get trade restrictions enforced, but may be difficult to get measures in place

- ff. Q: are there any publications on the extent of the species' range? Not sure, resident aggregational spawners; if areas extend to spearfishing may be threat

Presentation: Passive Acoustic Monitoring of Humphead Wrasse and Bumphead Parrotfish (Dr. Marc Lammers, Hawaii Institute of Marine Biology)

- a. Potential use to learn more about species; support efforts
- b. Sounds can be indicative of biological processes (courtship, spawning events, feeding, territorial defense)
 - a. Ex. Domino damselfish
 - b. Looking at occurrence of sounds = day/night variability; increased activity during the day
 - c. Predict defense activities
 - d. Relative levels of activity; seasonal pattern (May) = correlated with spawning literature; may relate to coral spawning
- c. Ability to say something about biology
- d. Unknowns: nothing in literature about these species (other parrotfish), or about when sounds are made, or why sounds would be made – determine if acoustic tools useful
- e. If sounds detected, could predict distribution (presence/absence in area); resolve spatial distribution in particular habitat; determine if occur year round or migrate or trends – relate to why use sound (spawning)
- f. Could help validate, raise doubts about or refine traditional survey methods and results – not replaced with acoustics, but possibly supported
- g. Advantages of acoustic monitoring: long-term observational presence (24/7) in an area (sample recording; survey effort increased in remote areas); relatively inexpensive (vs. large scale cruise); simultaneous monitoring at areas of interest (different areas at same time)
- h. Disadvantages of acoustic monitoring: difficult to estimate numbers of animals (still need surveys); site selection must be carefully considered (avoid haphazard sampling in barren areas); potential for false positive identifications (could be another fish with similar sounds)
- i. Q: Would need to ground truth that these species even make sounds, right? A: Yes
- j. Ecological Acoustic Records (EAR): joint effort between HIMB and CRED
 - a. Low power recorder (deployable for long period of time – 1 year battery life)
 - b. Variable bandwidth up to 30 kHz
 - c. Programmable recording duration and duty cycle (record for 30 seconds every 15 minutes); if energy (sound) is above threshold, then will trigger on
 - d. 120 Gb storage disk (depends on amount sampled)
 - e. Currently attached to a cement block and placed on reef
- k. Potential approaches to resolving unknowns:
 - a. in-situ studies of acoustic behavior
 - i. Wake – both species exist in Wake and are in high abundance and easily accessible; determine if species even make sounds
 - 1. Initial contacts made with military persons (Kevin Wong? = interested)

- ii. Palau – follow species around with other recorders to learn more about the species
 - b. Examination of acoustic behavior in captivity
 - i. Currently in Okinawa Aquarium
 - ii. Potential to import to Waikiki Aquarium?
 - 1. Never sure if behavior mirrors what happens in wild
 - 2. Advantages to noise capabilities for species
 - 3. Could borrow from Okinawa and do the captive research here
- 1. Q: how many different fish can be IDed? A: Very few; lots of fish make sounds, and relatively little is known in the Pacific; some collaboration with Cornell; involved process to ID which species make sounds
 - a. Recent Am. Samoa results: initial scanning could have 10 different sounds; some recognizable; some new sounds
 - b. Great opportunity to try to identify the sounds of these two species
 - c. Possible approach is to follow fish in water (but slow process with focused efforts)
 - d. Not much time invested yet: main goal to monitor relative stability of a particular location; not able to determine which sound for which species, but rather (main objective) how stable are ecosystems (decline, jeopardy)?; ex. snapping shrimp sound field
 - e. SOC = Great way to try to identify species
- m. Q: Is an individual person required for analysis? A: Sub-sample of data set looked at to ID sounds and develop signal processing to develop template sounds to search entire data set
 - a. automated software with archived recordings
 - b. search and queried all data set
 - c. over time series could show potential increase/decrease in area
 - d. long term perspective for stability or changes
- n. Q: Do these species make feeding sounds? A: Parrotfish make scraping sounds (algae from coral); have been recorded; not knowing enough to ID species from the sounds they make; possible for captivity studies; more than one sound possible
- o. Q: Are Atlantic signatures distinguishable from Pacific? A: No, but more effort is being put into cataloguing sounds; more effort done on fresh water species than marine species; recent research = only a handful on coral reef acoustic researchers mostly studying spawning aggregations
- p. Q: groupers – large fish? Mostly studied for spawning aggregations
- q. Prospects to lead field in reef fish acoustics for management tool – pioneering potential

Presentation: Fish Survey Methods (Dr. Bob Schroder, NOAA PIFSC Coral Reef Ecosystem Division)

- a. Methods: Belt transects; stationary point counts; roving diver surveys; towed-diver counts
- b. Recording fish larger than 50 cm

- c. Pacific Islands Region; about 50 islands since 2000; variable analysis
- d. Humphead wrasse:
 - i. Am. Samoa: large abundance at Swains; not many individuals from quantitative accounts; some fish seen at all islands (Tutuila, Tau, Swains, Rose, Ofu-Olo); transects = low numbers
 - ii. CNMI: few ind at some sites (3 sites)
 - iii. Wake = more fish (7 recorded in belt-transect area)
 - iv. Palmyra = some fish (2 recorded in belt-transect area)
- e. Bumphead parrotfish:
 - i. Am Samoa: seen only at 2 sites (Tau [2004] and Tutuila [2006]) during towed-diver surveys; none were seen during roving diver/belt-transect/stationary point count surveys in 2002, 2004, and 2006
 - ii. CNMI: one seen (Pagan – 2003) in towed diver survey; considerable effort was made; few seen at Rota (2003);
 - iii. Wake: transects showed more at Wake (3 recorded in belt-transect area); many more were seen here than anywhere else; species don't come that close – rare; saw several large schools (20-50 individuals outside reef; 300-400 inside lagoon/heavy impact area in 2-3 ft of water); very common to see in Wake according to locals
- f. Q: What was the width of the towed diver survey? A: 10 m. Recommendation: for SOC species record sightings outside transect
- g. Statement: interesting distribution of this species; in central CNMI they are rare but are abundant in other areas
- h. Q: fishing pressure not shown in A.S.? For this species, yes, but not all species in area; also interesting distribution; size distribution – few large but with more smaller sized fish

Humphead Wrasse Discussion Dialogue:

- a. Principle threat: food/reef trade; local consumption; trades limited in the East, Fiji furthest; real export potential in poaching, but not easy to document; arrested vessels in AS in 1980s
- b. Both species predominantly harvested; HW readily bite on hook/line & traps (New Guinea)
- c. Q: Can species move into rivers/turbid waters? A: Yes – but very difficult to survey for them there; lots of mollusks (food); refuge from sharks and fishermen; historical trap areas in rivers but they aren't legal anymore
- d. Night SCUBA banned in AS; limited enforcement; decline in fishing effort; difficult to sort out threat (fishery vs. habitat issue)
- e. In AS there is a terminal decline of reef fish; mainly now a pelagic fish
- f. SCUBA spearfishing banned in Guam – hard to enforce
- g. Q: Are there estimates of baseline population? A: Unknown; access to some data from Bob Schroeder; Guam has early data (Gerry Davis); big economic boom in SCUBA 1980s and wiped out fish; spotty info for the CNMI

- h. Palau imposed partial conservation measures in 1996; multi-agency team; huge conservation effort/areas; large increase in numbers of juveniles of both species; not sure if selectively fished; observation of conservation area = impressive; noticeable comeback of juveniles in areas; again enforcement is a problem
- i. Q: Are there other examples of supporting effective MPAs in Pacific? A: Yes - Wake Island = de facto protected area because it is a military area with large fish population numbers
- j. Q: Are there other countries with same trend? Yes: Apo Island in Philippines has had some success
- k. Q: Is the species important to the tourism industry? A: Can be/yes; Palau is a great example of fish interaction with divers; can make more money protecting species for ecotourism; areas in Palau are largely inaccessible to local/artisanal fishers compared to dive boats
- l. Ecotourism is not a major tourist industry in Pacific yet
- m. Q: Community based conservation – potential for partnership? A: There are some problems: there are no permanent closures; tenure system in AS – close areas for a few years and then open them again so that isn't working – village actually has ownership issue/no alternative areas to fish when all fishing areas are no take areas; years away from system; disagreement within govt – huge educational issue – must deal with educational component first; temporary closure may initially increase biomass but not permanently; ultimately no long term effects/net loss
- n. Q: Upcoming initiatives/potential for collaboration? A: AS: DMWR has an upcoming fish survey to survey for size (Malloy) and not quantity; CNMI: status unknown/need surveys for these target species – there are many remote areas so species is present but unknown quantity/population estimate; Guam: have enough info (30% island set for reserves) but not much can be done (politically?); only potential in NE corner which is already a preserve; no size established for CNMI
- o. Data standpoint: vendor receipts can be a source of information of quantity/length/weight; note that fishery in Guam collapsed in 5 years
- p. Q: Is bycatch an issue with commercial fishing? A: Not usually; very infrequent to encounter; opportunistic fishery; only targeted fishery was night spearing; now spearing at night can get anything; problem is that these fish are easy targets with predictable areas and bright colors and the fact that they sleep in groups in caves and crevices
- q. Genetics potential: DNA samples from fishery; collaborate with UC Davis (Kevin Rhodes)
- r. Low reproductive outputs is an issue
- s. Connectivity issue for small populations; widespread MPAs may be difficult; species closure may be better than MPAs; preventing take of animals may be more effective
- t. Q: Is there a regulation of size minimum in areas? A: size limits are not effective with hermaphrodites; every population is different
- u. Largest population is located in Wake Island due to military, but species is not guaranteed protection; dive instructors are teaching about the species and larger fish; PIRO can push for long lasting protection in Wake
- v. Supporting effective enforcement actions, funding for increased enforcement; no regulations for these species and no jurisdictions; nothing to enforce; other areas have

- closed areas or gear restrictions; AS banned SCUBA restrictions (enforcement questionable – grant program may help AS govt); enforcement can work in areas where bans are already in place – just enforce the bans
- w. Grant may help efforts at Wake; council could promulgate regulations; potentially not much of a problem; education/outreach may help; timely for Wake before human population increases
 - x. Keep focus on US waters for now; international/CITES later; freely associated states – unknown/intermediate tier/next steps/depends on particular opportunities to help species as whole
 - y. Vehicle at Coral Reef Task Force Level; other interest and support
 - z. SPC? May have database (Reef Fish Observatory) information on broad range of region; unknown; Paul Dalzell of WPFMC.;
 - aa. Local Action Strategy for overfishing in US territories? Has to be locally driven – not for this group
 - bb. Different potential connections for future (Krista); plan to take this information to the local regions and talk about species; will need help on how to engage discussion with islands (who to talk to, etc.)
 - cc. Need summary of status of these species in Pacific Islands – couple pages (update current fact sheets and continually update as more data is collected); main message to use for other projects (i.e., outreach, tourism, Wake preserve, etc.)
 - dd. Encourage documentation on how to ID the fish; develop an underwater guide with pictures of both species, sexes, and different age levels for opportunistic diving/surveys; include local names
 - ee. Need to know more about habitat degradation and the impact on juveniles; publications; fringing reefs
 - ff. Is there enough data for protection measures? Preserves set up, an additional layer would have to give up something in preserves; is there enough area to protect the fish – larval questions; politically may not have a chance in Guam

*D. Bumphead parrotfish (*Bolbometopon muricatum*)*

Presentation: Overview of the Bumphead Parrotfish (Dr. Kevin Rhodes, UH Hilo/IUCN Groupers and Wrasse Specialist Group)

- a. Largest species of Family
- b. 120 cm TL max
- c. Similar distribution as humphead
- d. Juveniles are found in lagoons; adults located on outer reefs
- e. Corallivore; highly important bioeroder (5-6 m tons consumed/yr); also consume benthic algae
- f. Spatial distribution similar to humphead; wide range
- g. Pelagic aggregational spawner; lunar cycle; protogynous hermaphrodite
- h. Nocturnal spearfishing – vulnerable
- i. Life history: slow grower; later maturation; low pop doubling time (same as HW); low recruitment

- j. Overfished; decline with commercial fishing and unregulated spearfishing
- k. Q: Is this species part of the live reef fish food trade? A: Not a live reef target species, some trade, but not common for trade, more common for artisanal fishing
- l. Declines recorded throughout Pacific (Micronesia, AS); no info from Indian Ocean/Red Sea
- m. Mitigation: MPAs; ban spearfishing, SCUBA; coral reef protection; community-based measures; critical habitat; awareness and training
- n. Q: What is the range of animals – movement patterns? A: Unknown; Rick Hamilton = expert; difficult to tag because tags cause predation by sharks; quick mortality; unknown space for MPA potential; home range probably close, but spawning not known; more of a group species compared to HW which is a solitary species; well known that sleeping locations have resident individuals = may have greatest potential for protection
- o. BP don't prepare sleeping cocoons like other parrotfishes
- p. Free diving – big sport in remote areas and targeting both species; some fish are given away as food but most individuals are simply discarded; unknown how to deal with this
- q. In mid-late 1990s always saw large populations of BPs
- r. Formerly a large population in Guam, but drastically declined from spearfishing
- s. Q: Have genetic studies been done? A: No
- t. Assume spawning on same reef where they reside

Bumphead Parrotfish Discussion Dialogue:

- a. Q: Do BPs move along reef slopes as a response to heavy fishing? A: There is evidence of species moving down the reef slope – reports of ~400 ft. down due to avoiding divers, etc.
- b. Q: Has a review paper been done like the one for HW by Sadovy et al? A: No. Perhaps Sadovy et al could be funded to produce another similar publication?
- c. Numbers are critically low; less protection for BP than HW; half of fish tagged but numbers are getting smaller (poaching); second reef helps keep population refuge (no reserve); CNMI have different areas/problems with protection

Draft Conservation Action Plan:

A. Hawaiian reef coral (*Montipora dilatata*)

Threats:

- a) Rare species
- b) Vulnerability to coral bleaching due to high temperatures
- c) Water quality issues/sedimentation
- d) Invasive algae/sponges

Data Needs and Research:

- a) Genetic/taxonomy work on samples from Kaneohe Bay, the NWHI, and the WAQ to confirm whether it is a species or a hybrid – if the WAQ has a hybrid species, should it still be a species of concern?
- b) Extensive surveys to systematically map the species, quantify the current population size, quantify the occurrence of alien/invasive algae, and characterize and photodocument the habitat types (e.g. substratum and depth) to improve understanding of the habitat requirements:
 - a. Kaneohe Bay
 - b. NWHI
 - c. Main Hawaiian Islands?
- c) Determine why such “susceptibility” to bleaching similar to what occurred in 1996

Conservation Actions:

- a) Waikiki Aquarium “ark” - continue captive propagation efforts
- b) Work with WAQ/HIMB/UH/DLNR for possible species reintroduction/transplanting into Kaneohe Bay
- c) Long-term monitoring of species in Kaneohe Bay
- d) If species is found naturally in the NWHI but is not prolific, consider transplanting propagated species into natural habitats
- e) Distribute propagated corals to other national aquaria
- f) Develop a local action strategy to address water quality issues in Kaneohe Bay

Outreach and Education:

- a) Develop underwater species identification cards to help researchers identify species in the field
- b) Continue partnership with the Waikiki Aquarium – create a gallery display of propagated coral and discuss conservation efforts for the species and the partnership between NMFS and the WAQ

First Steps:

1. Continue captive propagation efforts at the Waikiki Aquarium “ark”
2. Fund extensive survey work in Kaneohe Bay
3. Fund extensive survey work in the NWHI
4. Work on genetic analysis of species

B. Inarticulated brachiopod (Lingula reevii)

Threats:

- a) Endemic to Kaneohe Bay
- b) Invasive alien algae
- c) Nutrient loads?
- d) Freshwater kill?
- e) Predation?

Data Needs and Research:

- a) Extensive surveys of Kaneohe Bay to systematically map the species, quantify the current population size, and characterize and photodocument the habitat types (e.g. substratum, depth, rugosity, sand depth, and sand grain size) to improve understanding of the habitat requirements
- b) Survey the NWHI for species?
- c) Confirm by genetic analysis of reported species sightings in Ambon, Indonesia and Japan

Conservation Actions:

- a) Waikiki Aquarium “ark” – continue initial captive propagation efforts
- b) With success of captive propagation, work with WAQ/HIMB/UH/DLNR for possible species reintroduction/transplanting into Kaneohe Bay
- c) Long-term monitoring of species in Kaneohe Bay
- d) With success of captive propagation, distribute species to other national aquaria
- e) Develop a local action strategy to address water quality issues in Kaneohe Bay

Outreach and Education:

- a) Develop underwater species identification cards to help researchers identify species in the field
- b) Continue partnership with the Waikiki Aquarium – create a gallery display of propagated *L. reevii* and discuss conservation efforts for the species and the partnership between NMFS and the WAQ

First Steps:

1. Continue initial captive propagation efforts at the Waikiki Aquarium “ark”
2. Fund extensive survey work in Kaneohe Bay
3. Fund extensive survey work in the NWHI

C. *Humphead wrasse (Cheilinus undulatus)*

Threats:

- a) Live reef food fish trade – intense and species specific
- b) Artisanal and commercial overfishing
 - a. Spearfishing – done at night using SCUBA gear and free diving
 - b. Hook & line – humphead wrasse readily bite on hook and line and traps
- c) Destructive fishing techniques – sodium cyanide and dynamite stun animals and incidentally kill living coral
- d) Degradation and loss of coral reef habitats
- e) Juveniles – taken from the wild and raised or “cultured” in floating net cages until saleable size
- f) A developing export market for juvenile humphead wrasse for the marine aquarium trade
- g) Lack of coordinated, consistent national and regional management
- h) Illegal, unregulated, or unreported fisheries

Data Needs and Research:

- a) Continue to survey in all U.S. areas of occurrence
- b) Determine extent of home range (how far individuals normally travel)
- c) Identify individual populations using DNA sampling
- d) Characterize and determine locations of spawning aggregations and their usage patterns
- e) Collect creel, artisanal, and commercial fisheries data throughout its U.S. range
- f) Determine if this species makes sound
- g) If the species makes sound, understand when and why the sound is made and use acoustic monitoring to assess population parameters such as presence/absence, spatial distribution, and temporal patterns of occurrence

Conservation Actions:

- a) The species is listed as a Management Unit Species (MUS) in the Coral Reef Ecosystems Fishery Management Plan for the Western Pacific. In fisheries management, MUS typically include those species that are caught in quantities sufficient to warrant management or specific monitoring by NMFS and the Western Pacific Regional Fishery Management Council (WPRFMC) in U.S. Pacific areas – work with WPRFMC to promulgate additional regulations for the species in U.S. areas
- b) Support protection/conservation of the species in Wake Island where numbers appear to be the highest of all U.S. areas
- c) Collaborate with territory governments to support community-based protection/conservation of the species in other U.S. areas
- d) Support data research – CITES
- e) Support species closure/restrictions in U.S. areas
- f) Address and improve enforcement issues in U.S. areas
- g) Collaborate with the Coral Reef Task Force
- h) Collaborate with territory governments for possible hatchery production (aquaculture)

Outreach and Education:

- a) Partner with U.S. dive and ecotourism industries to promote observing the species in the wild versus fishing for them
- b) Partner with territory governments to promote community-based species conservation
- c) Develop underwater species identification cards to help researchers and opportunistic diving/surveys identify species in the field – include pictures of both sexes and different age levels; include local names

D. *Bumphead parrotfish (Bolbometopon muricatum)*

Threats:

- a) Overexploitation – especially the taking of sleeping adults at night with spears or nets
- b) Destructive fishing techniques including sodium cyanide and dynamite
- c) Degradation and loss of coral reef habitats

Data Needs and Research:

- a) Continue to survey in all U.S. areas of occurrence
- b) Determine extent of the species' home range (how far individuals normally travel)
- c) Identify individual populations using DNA sampling
- d) Characterize and determine locations of spawning aggregations and their usage patterns
- e) Understand the importance of the bioerosion of this species to reef ecology since the loss of a keystone species may have adverse effects on overall reef health
- f) Collect creel, artisanal, and commercial fisheries data throughout its U.S. range
- g) Determine if this species makes sound
- h) If the species makes sound, understand when and why the sound is made and use acoustic monitoring to assess population parameters such as presence/absence, spatial distribution, and temporal patterns of occurrence

Conservation Actions:

- a) The species is listed as an MUS in the Coral Reef Ecosystems Fishery Management Plan for the Western Pacific. In fisheries management, MUS typically include those species that are caught in quantities sufficient to warrant management or specific monitoring by NMFS and the WPRFMC in U.S. Pacific areas – work with WPRFMC to promulgate additional regulations for the species in U.S. areas
- b) Support protection/conservation of the species in Wake Island where numbers appear to be the highest of all U.S. areas – work with WPRFMC to promulgate additional regulations
- c) Collaborate with territory governments to support community-based protection/conservation of the species in other U.S. areas – especially sleeping areas
- d) Support data research
- e) Support species closure/restrictions in U.S. areas
- f) Address and improve enforcement issues in U.S. areas
- g) Collaborate with the Coral Reef Task Force
- h) Fund researcher to do a literature review of the species

Outreach and Education:

- a) Partner with U.S. dive and ecotourism industries to promote observing the species in the wild versus fishing for them
- b) Partner with territory governments to promote community-based species conservation
- c) Develop underwater species identification cards to help researchers and opportunistic diving/surveys identify species in the field – include pictures of both sexes and different age levels; include local names